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CORRIGENDA.

Page 35—Twenty-second line from top of page, for "Pseudal velous," read "Pseudalveolus."

Page 35—Thirty-fifth line from top of page, for "Pseudal velous," read "Pseudalveolus."

Page 191—Eighteenth line from top of page, for "Greek" read "Creek." On twenty-second line of same page, for "Palaeozoic," read "Pre-Cambrian." On the twenty-fourth line, make the same correction; also on the third line of page 197.

Transactions

of

The Royal Society of South Australia (Incorporated)

VOL. XLIX.

THE GEOGRAPHICAL DISTRIBUTION OF FOSSILIFEROUS ROCKS OF CAMBRIAN AGE IN SOUTH AUSTRALIA WITH GEOLOGICAL NOTES AND REFERENCES.

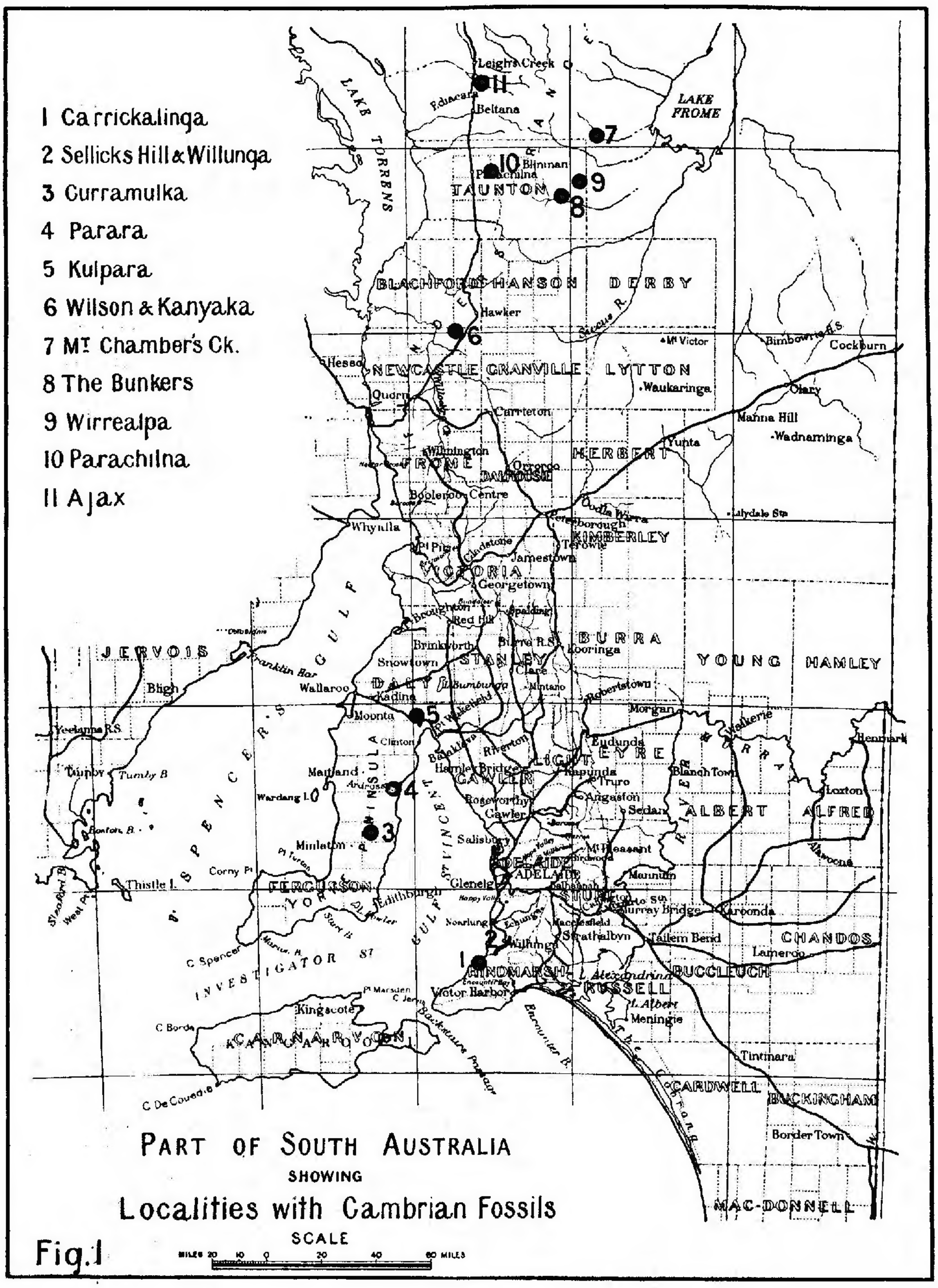
By Professor Walter Howchin, F.G.S.

[Read April 9, 1925.]

Contents.

The present paper deals, primarily, with the geographical distribution of the fossiliferous Cambrian rocks in South Australia, but opportunity is taken for describing the associated geological features from field notes where these have not hitherto been published.

I have to acknowledge my indebtedness to the Government Geologist and the draftsman of the Department for their kind services in the reproduction of the locality map (fig. 1) and the more detailed plans of certain localities by which the usefulness of the paper has been greatly enhanced.



PART OF SOUTH AUSTRALIA
SHOWING
Localities with Cambrian Fossils

Fig. 1

I. CARRICKALINGA, NEAR NORMANVILLE.

The Cambrian limestones in this locality follow the coast from near Normanville, in a north-westerly direction, to Carrickalinga Head. The limestones are greyish to dark-coloured, crypto-crystalline in texture, and, in places, form a black marble capable of receiving a high polish, but, unfortunately, is disfigured by the presence of thin streaks of arenaceous material. The Archaeocyathinae were discovered about 3 miles to the northward of the Normanville Hotel, and within a half-mile of the sea. The position is near the old Wheal Mary Silver-lead Mine.

The Archaeocyathinae occur in narrow zones, in the grey marble, extending over a considerable width of outcrop. They are often somewhat indistinct on account of their partial absorption into the calcareous matrix which has undergone some measure of metamorphism. No species has been described from this locality.

[For further particulars see Howchin, W., 1897.]

II. SELLICK'S HILL AND THE WILLUNGA RANGES.

Sellick's Hill is situated near the western termination of the Willunga Ranges. It is 6 miles distant from Willunga, which lies to the north-east, and 12 miles distant from Normanville, which lies to the south-west. The three localities are practically on the same line of strike. Whether the Archaeocyathinae limestones form a continuous outcrop between Sellick's Hill and the fossiliferous area near Normanville has not been proved. The writer followed the line of outcrop from Sellick's Hill $4\frac{1}{2}$ miles (south-westerly) in the direction of Myponga Jetty, when the fossiliferous limestones were proved to be persistent for the distance mentioned.

At Sellick's Hill there is an excellent section of the Cambrian limestones, which cross the road a little above the Sellick's Hill Hotel, and are exposed in the adjoining paddocks. The fossils are limited to one zone, which is of considerable thickness, and are very abundant, some slabs being speckled with their remains, but are not very conspicuous, as they show little relief by weathering.

Notwithstanding this abundance of individuals it would seem, from Griffith Taylor's experience, there is a very limited range with respect to variety in this locality. He states, "Here [Sellick's Hill] there is a remarkable abundance of the species I have named *Archaeocyathus sellicksi*. Indeed, I have not determined any other species satisfactorily from this locality, though I have examined probably 250 specimens" (Taylor, T. G., 1910, p. 73). The determinations were made, however, on limited material gathered from a restricted area. It does not seem to have been a habit with the Archaeocyathinae for single species to form distinct reefs, so that a more extended examination of the field will probably bring to light other forms. [For a Section of the Sellick's Hill beds see Howchin, W., 1897, pp. 76-80.]

The Willunga Ranges form an upcast faulted block which brings to the surface beds that are lower in the series than are seen on the northern side of the fault. By this earth movement the Archaeocyathinae beds have been exposed at the surface and follow a clearly-marked zone of outcrop near the base of the foot hills. In 1897 the writer followed the fossiliferous horizon from Sellick's Hill, north-easterly, nearly as far as the beds are exposed in that direction. At Springbrook, $2\frac{1}{4}$ miles in a north-easterly direction from Willunga, the limestone has been quarried. No fossils could be detected on examination of the stone by the naked eye, but subsequent treatment of the limestone, by sectioning and examination under the microscope, revealed the presence of Archaeocyathinae in a form that was of very open structure. The limestones continue in the same direction for another three-quarters of a mile, when they seem to terminate

PART OF H^D CURRAMULKA

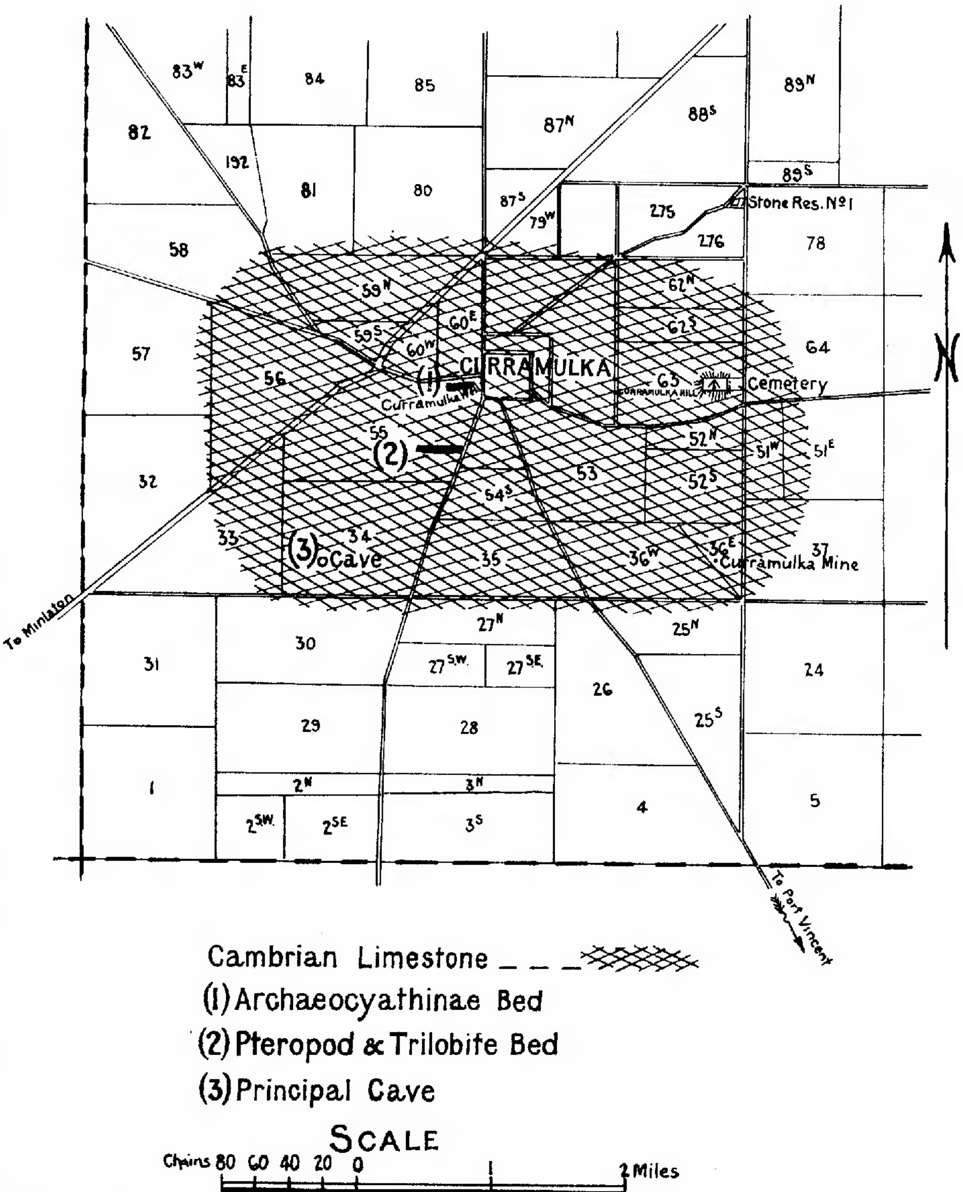


Fig. 2

against the alluvia of the plains, probably cut off at that place by the great fault fracture. The outcrops of the Archaeocyathinae limestones, from near Normanville to their most north-easterly extension in the Willunga Ranges, cover a distance of about 24 miles.

Particulars of field observations made on the journey will be found in the article by the author, as last quoted [pp. 78, 79, and 85, 86] For geological map, showing the position of the Archaeocyathinae beds in the Willunga Ranges, see Howchin, W., 1911.

III. YORKE PENINSULA.

Beds of Cambrian Age occur extensively in Yorke Peninsula, but from the peculiar geological conditions that have prevailed through long ages, they are not favourably situated for observation. In consequence of the successive peneplanations, extending from the Pre-Cambrian to the present, the respective geological systems have been reduced to a common level. The Cambrian sediments were once coextensive with the area represented by the present peninsula, but their continuity is now broken by inliers of granite and associated rocks, and are also obscured, to a large extent, by a mantle of surface travertine which is one of the most persistent surface features of the country.

The Cambrian Series of Yorke Peninsula differs considerably, in a stratigraphical sense, from the series of a like age as developed in the Willunga Ranges and also in the Flinders Ranges. In Yorke Peninsula the beds have a more restricted vertical development. The purple slates, which are of great thickness in both the Willunga and Flinders Ranges, make a very subordinate feature on the Peninsula, especially in the localities to the southward of Kulpara. The basal grits of the series on the Peninsula are a feature peculiar to that region. The dolomitic limestones, which in the Flinders Ranges take the form of numerous and relatively thin beds, are represented on the Peninsula by a thick and massive rock of this type. The Archaeocyathinae limestones are also of less thickness than elsewhere, and have, unfortunately, been removed from large areas by denudation; the prevailing members of the series being the two lower ones, namely, the basal grits and the dolomitic limestone.

The abbreviated form of the Cambrian Series of Yorke Peninsula has been attributed to an overlap and transgression caused by the formation of the great Cambrian geosyncline (Howchin, W., 1918, p. 373).

The only localities from which Cambrian fossils have been obtained on Yorke Peninsula are: Curramulka, Parara (Ardrossan), Dowlingville, and Kulpara.

1. Curramulka (fig. 2).

Curramulka is situated 12 miles inland from Port Vincent, on Yorke Peninsula. Attention was first called to the presence of fossiliferous Cambrian rocks in this locality by the discovery of some Trilobite and Pteropod remains by Mr. A. W. Fletcher, B.Sc., who exhibited the specimens at a meeting of the Royal Society of South Australia (Fletcher, A. W., 1890). A further discovery of similar remains was made by Mr. G. B. Pritchard, who published some notes on the geological features of the locality (Pritchard, G. B., 1892). The fossils, gathered by the two collectors mentioned, were described by Professor R. Tate (Tate, R., 1892). The sponge, *Hyalostelia*, was discovered by the present writer by means of transparent sections, made from the limestones of the same locality (Howchin, W., 1892).

In a recent visit to Curramulka, the present writer discovered some fine examples of Archaeocyathinae which establishes a correlation of fauna, in this respect, with nearly all other localities in South Australia where Cambrian fossils have been found.

The physiographical features of the locality are peculiar. The township of Curramulka is situated near the centre of a self-contained basin, several square miles in extent, margined by what appears to be low ranges of hills, at an average height of about 100 feet, but which is, really, the normal level of the country. The basin consists exclusively of massive Cambrian limestones and residual deposits incidental to the process of solution acting on the limestone. The delimitation of the Cambrian area is a matter of difficulty, as the surrounding country is largely surfaced with travertine to a considerable thickness. This precipitated rock from chemical solution may occur overlying any subsoil of a calcareous nature. This chiefly happens, locally, either above the Cambrian limestones or the fossiliferous Miocene. The latter, although in outcrop on the coast, is not known to occur near Curramulka, and the probability is that the travertine near the latter township has been derived from the older series of rocks. In fig. 2, an attempt is made to draw the line within which the presence of the Cambrian beds may be reasonably assumed to occur below the superficial cover, based on the presence of extensive travertine development, the existence of caves, man-holes, run-away holes, well-sinkings, etc.

The largest accessible cave is on the southern side of the township, in Sec. 34 (Hd. Curramulka), situated about three-quarters of a mile from the road on the eastern boundary of the section and one-quarter of a mile from the road which forms its southern boundary. The spot is marked by a small rise in the ground covered by a clump of trees. The opening to the cave is a crater-like depression, about 40 feet in depth; the upper 15 feet consists of travertine, and the remainder of Cambrian limestone having a nodular structure. The cave contains many passages and chambers, but few stalactites, and is said to have been explored for a distance of three-quarters of a mile without reaching its termination. It probably connects with another cave situated in the centre of the township, which has an opening 100 feet deep, from the floor of which a boring has been made for a further 40 feet which yields an ample supply of water for public use.

There are no evidences suggestive of running water as occurring within the basin, except for short distances on the hard surface of roads, the water, in such cases, finding its way into some adjoining paddocks without making drain marks. In one place, near the bottom of the basin, there is a slight depression in the ground, about a half-acre in extent, where the water stands for a short time after rain, but, generally speaking, the water is absorbed as it falls and passes underground.

The origin of the basin seems quite clear. The local drainage, having found its way by subterranean channels, has not only opened, by solution, extensive passages and chambers in its course, but the limestone at the surface has become lowered in a similar manner. Within the basin proper the Cambrian limestones, as bed-rock, show a gentle slope towards the centre. This does not occur from a cycloclinal dip of the beds as a primary element of rock structure, but from a solution plane, developed by the surface rain water in gravitating towards the lowest point where it entered the cave that still exists, and yields the principal supply of water to the neighbourhood.

It is evident that the large cave, in Sec. 34, was at one time an important receptacle for surface drainage; but it is not so now. It is situated at nearly the highest point of the adjoining areas and is surrounded by cultivated land that shows no evidence of rain wash. A nick in the rocks on one side of the entrance indicates the direction of the inflow, but under existing physiographical features the amount of water that can reach the cave is infinitesimal. We must therefore infer that there has been a great reduction in the height of the surrounding land since the cave originated, this result being probably brought about by the establishment of a new avenue of drainage in the cave at the township, which had the effect of "capturing" the inflow of the higher opening as well as developing the basin as it exists to-day.

The drainage from this basin must have a subterranean course and an outlet somewhere. As no springs occur between Curramulka and the sea, the inference is that the water finds its way to the sea below sea-level. Curramulka Hill forms the highest point on the margin of the depression, but, although it is a trig. station, there are no official records of its height. The nearest point for such records, as to height, is Mount Rat, situated 8 miles to the north-westward of Curramulka, which is stated to be 423 feet above sea-level. Supposing that there is not much difference in height between these respective elevations, Curramulka township would be about 300 feet above sea-level, and the water in the town well, about 160 feet above the sea. In the neighbourhood of Ardrossan, bordering the coast, the Cambrian limestones have a dip to the eastward, and at "Sliding Rocks," 7½ miles to the southward of Ardrossan, the beds pass below sea-level at a considerable angle [Howchin, W., 1918A, pl. xxi.].

The soil on the upper levels of the basin, especially in proximity to the large cave, is of a peculiar character. It is an open, fine-grained, non-gritty, argillaceous soil, entirely destitute of stones, other than fine specks or pellets of white coloured limestone and an occasional nodule of travertine. This fine-grained argillaceous soil forms excellent wheat and pasture land. A large wheat area, consisting of this class of soil, surrounding the large cave, yielded in the present season nearly 40 bushels to the acre. It seems almost certain that this very uniform and stoneless argillaceous "mantle" is the insoluble residue following on the disappearance of a great thickness of limestone by solution, as occur in the limestone soils of Derbyshire and elsewhere.

On the inner slopes of the basin, where the rain operates on a slight grade, the fine argillaceous material is carried to lower levels and a fine sand is deposited. An occasional sandy layer in the limestone is sufficient to account for the presence of this sand in the residual soil.

The geological features of the locality are extremely simple. The Cambrian limestones and their derivative, concretionery travertine, are the only rocks present. The lower portion of the basin consists of very dense crystalline, or subcrystalline, rock; weathered by solution into fantastic curves and pits maintaining a very uniform level and only sparsely covered with soil in the shallow depressions. On account of the unbroken nature of the surface it is difficult to determine the dip of the beds, which appear to be practically horizontal, as shown in the entrance of the big cave in Sec. 34. The slope of the beds in the basin towards its centre arises from a plane of solution, as described above.

Overlying the grey-coloured and crystalline limestone, which forms the principal surface at the lowest levels, is a dark blue and less crystalline form of the limestone, carrying the remains of numerous Pteropods and fragments of Trilobites. This member of the series can be best seen on the southern side of the basin, where it forms a slight terrace. At higher levels, on more level ground, the Cambrian limestones become obscured by thick and compact layers of travertine.

The Archaeocyathinae occur in a dense, grey-coloured, and subcrystalline matrix, at about the lowest level in the basin. So far as could be determined the fossils occur in a narrow zone, starting from the western side of the public well (opposite to the hotel) and extend in a westerly direction for about 200 yards, but much of this ground is covered by a thin layer of soil. The uniform level of the limestone, forming the natural surface, and its massive character, make it difficult to obtain the fossils from the matrix. Moreover, the Archaeocyathinae are calcareous and show little differential weathering from the matrix which render them inconspicuous and liable to be overlooked. The Archaeocyathinae include very fine examples in which some of the cups have a diameter of 2 inches. Many of the examples have a profuse exothecal development. Among the latter *Archaeocyathus sellicksi* can be recognised. The order of superposition in the respective fossiliferous zones at Curramulka agrees closely with that at Ardrossan.

I cannot confirm Mr. Pritchard's supposed discovery of glacial striae on the limestone at Curramulka. The pseudo-striations are such as are common to most limestones under weathering. There is an entire absence of collateral glacial phenomena. A great thickness of the surface limestone has been removed by solution—a process that is still going on—which must have long since obliterated glacial markings had they once existed. The entire absence of stones and other glacial debris from the locality also tells against the idea. In a four days' perambulation of the area, in all directions, the writer did not come across a single stone other than those that had been derived from the local limestones, and very few of these.

2. Ardrossan (Parara and Dowlingville).

Ardrossan is situated on the western shores of Gulf St. Vincent, about 24 miles to the northward of Curramulka. The locality supplies the most connected succession of the Cambrian Series that occurs on Yorke Peninsula. As compared with beds of a like age in other parts of the State the succession is very simple and includes but few stages. The following is the order of succession, based on the Parara section and the No. 1 Maitland Bore [see Howchin, W., 1918a, p. 202], reduced to groups, having a total thickness of about 300 feet:—

Limestones—

Upper: Dark-coloured, impure, Pteropod-Trilobite limestones.
Middle: Light-coloured marble (Archaeocyathinae marble, in part).
Lower: White and yellow granular-crystalline dolomites.

Argillaceous—

Purple slates (20 feet).

Arenaceous—

Basal grits and conglomerates (51 feet).

The fossiliferous beds near Ardrossan are limited, so far as known, to a gully (called by Tepper, Horse Gully), which crosses the main road about one mile to the southward of Parara Head Station and 3 miles from Ardrossan. The gully extends westward to the first north and south district road. The Pteropod and Trilobite beds occur at the lower end of the gully and the Archaeocyathinae, at the upper portion, on cultivated land adjoining the district road just referred to. Fossiliferous pebbles occur on the Ardrossan beach which are supposed to have been derived from this gully. Stationary pebbles, derived from the Pteropod bed, weather with the fossils in relief; while, in the case of those derived from the Archaeocyathinae limestone, interesting sections of the fossils are shown on the smoothed surfaces of the pebbles that have been subjected to wave action on the beach.

The lower members of the Cambrian limestones can be traced for several miles to the southward of Parara. At Rogues' Gully, 6 miles to the southward of Ardrossan, the dolomitic limestones occur in scrub country, having a thickness in the gullies of about 100 feet. To the westward of these limestones, the basal grits and the Pre-Cambrian complex occur, near the main north and south road.

The limestones are also seen on the coast, at "Sliding Rocks," 1½ miles to the southward of Rogues' Point, in Sec. 49 (Hd. of Muloowurtie), with a dip easterly.

Cambrian limestones are present at Maitland, 16 miles to the westward of Ardrossan, proved by borings, as mentioned above; and at Yorke Valley, on the western ridge, 5 miles to 6 miles to the southward of Maitland.

To the northward of Ardrossan the limestones can be traced for some miles. At Dowlingville, 7½ miles from Ardrossan, there are extensive exposures, and a casual examination of the beds showed the presence of Trilobite fragments. The presence of these limestones is indicated at many points by well-sinking, sunken areas, etc., and was traced as far north as Winulta Creek, in the south-eastern portion of the Hundred of Tiparra.

[For detailed descriptions of this district see Howchin, W., 1918A.]

3. Kulpara and Neighbourhood.

(1) Wallaroo-Kadina Belt.

The Cambrian limestones in the northern portions of Yorke Peninsula occur in three parallel lines of outcrop. The more westerly of these outcrops follows the coast in the neighbourhood of Wallaroo and Kadina, and may be distinguished as the Wallaroo-Kadina line of outcrop [Jack, R. L., 1917]. The beds represent the lowest members of the series, are strongly dolomitic, and often associated with the basal grits and conglomerates. A good section of the limestone can be seen in the railway yard at Wallaroo, where the beds form a cliff.

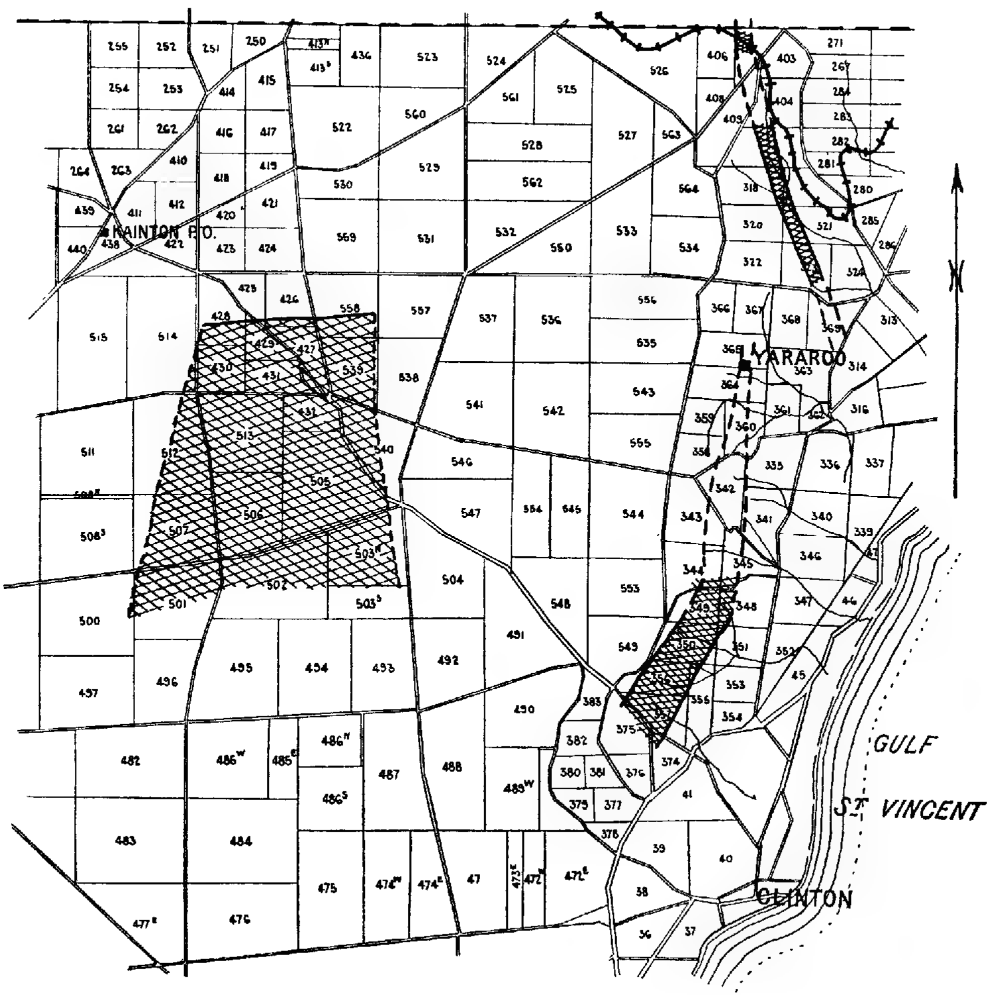
(2) Kainton Belt (fig. 3).

The middle line of outcrop occupies an area about 2 miles in width, having its north-western angle about 1½ miles south-eastward of Kainton Post-Office, in the Hundred of Clinton, and may be called the Kainton area. The limestone, at its northern limits, is cut off along a line, nearly east and west. Beginning on the western limits of Sec. 428, it passes through the upper portion of Sec. 429, near the southern boundary of Sec. 426, and crosses to the eastern boundary of Sec. 558 (Hd. of Clinton), near the farmstead of Mr. Stephenson, where its presence is proved in a "prospecting" hole, in scrub land, near the house. This nearly straight line of outcrop is marked by large blocks of brecciated limestone, mixed with quartz, suggestive of a line of fault. In the adjoining section, on the northern side (No. 559), there is an outcrop of Pre-Cambrian igneous rocks.

The western limits of this limestone area starts from the angle, mentioned above, in Sec. 428, and passes, diagonally, in a south-westward direction through Secs. 514, 512, 507, and 501. The eastern limits run almost directly south, beginning near the eastern fences of Secs. 558 and 539; through the centre of W. Con. Res. 540, through Howe, and Sec. 503N, covering a distance of about 3 miles. Its extension to the southward of this point was not investigated. The beds, as a whole, make low surface features and are often more or less obscured by a surface mantle, but there are strong outcrops in Secs. 502, 503N, and 506, as well as on the western road. In Sec. 558 (near the south-eastern angle), there is a large deposit of limonite that has been quarried for flux. This is, probably, a metasomatic displacement of the limestone in a line of fault. The strike of the beds is in the direction of the Winulta outcrops, that occur near the six-cross-roads, at the junction of the Cunningham, Tiparra, and Clinton Hundreds. These respective limestone areas are, probably, to be correlated as on the same geological horizon.

(3) Clinton-Kulpara Belt (fig. 3).

The most easterly line of Cambrian limestone outcrops in Northern Yorke Peninsula borders on the shores of Gulf St. Vincent, in the Hundreds of Clinton and Kulpara, and may be distinguished from the other two as the Clinton-Kulpara line of outcrops. The beds vary greatly in colour, texture, and composition. All appear to be microcrystalline in texture, and more or less dolomitic in composition. Observation in the field leads to the conclusion that they form a continuous belt (sometimes overlaid) from the northern limits of the Hundred of Clinton,



PART OF Hd CLINTON

— SCALE —

0 40 80 160 240 Chains

Cambrian Limestone

Fig. 3

southward, to within 2 miles of Clinton Jetty (9 miles), and perhaps further. It is disappointing that the deep cuttings on the Kadina and Port Wakefield Railway, at the southern end of the Hummocks, do not penetrate the limestones of the Cambrian Series, but expose a thick series of purple slates and quartzites that overlie the limestones. The strike of the limestones takes them a little to the westward of these cuttings, and where intersected by the railway, the country is flat.

(a) Melton and Clinton.

The Cambrian limestones are exposed near the Melton Railway Station (fig. 4), where they have been bared in a small excavation. A small outcrop of dark-coloured limestone also occurs in a low cutting on the railway, 2 miles to the eastward from Melton, in Sec. 407, Hd. of Clinton (near the boundary line of the Hd. of Kulpara), where the permanent way makes a slight rise. The exposure in the cutting shows a covering of white marl, 4 feet in thickness, containing a great number of travertine concretions, forming the cap of the limestone. The latter is seen in several large isolated and rounded "floaters" which occur in the marly travertine near its base.

From this point the beds follow a S.S.E. direction. In Sec. 318 contorted purple slates are exposed in a small tributary creek, and, at a short distance, the limestone is well developed in the main, or Long Creek, showing dip E. 20° N. at 45°. It is also seen close to the railway (which here makes a great loop to the south), having the same direction of dip with a lessened angle at 20°-30°. A little further down this creek there is a strong exposure of an arenaceous limestone, with a dip south-easterly. The limestones pass Yararoo Head Station, formerly occupied by the late Mr. W. Fowler, situated in Sec. 365 (not "Yarro" Woolshed). The house is situated on the upper beds of the limestone series, the section passing up into thin limestones intercalated with quartzites and purple slates. The outcrop near the station house is about a mile in width, but is generally masked by a travertine crust through which the older limestone is sometimes seen to come to the surface. The stone varies from a siliceous blue-metal limestone to a yellowish crystalline marble-like stone. Dip N.E. This line of strike was followed southwards to a conspicuous outcrop of impure nodular blue limestone situated in a creek near the roadside in Sec. 374, within about 2 miles of Clinton Jetty. The limestones in Secs. 344, 349, 350, 356, and 357 have yielded the well-known Clinton phosphate deposits. [See Jack, R. L., 1919.] The extensive lignite deposits proved in this neighbourhood rest on a platform of the Cambrian limestone series that is thrown down on the eastward side to a depth of several hundreds of feet. This step-faulting on the westward side of Gulf St. Vincent can be correlated with similar earth movements on the eastward side, thereby defining the boundaries of the great Adelaide Rift-Valley in the respective areas.

(b) Kulpara (fig. 4).

The most northerly patch of the Cambrian limestone in the district occurs about 1½ miles to the eastward of the township of Kulpara, and it is of interest as containing the only known fossiliferous beds of this age in northern Yorke Peninsula. A section of the overlying beds can be followed in the creek which takes its rise in Sec. 243 (Hd. of Kulpara) rather more than a mile above where it intersects the limestone beds. The succession, in descending order, is as follows:—

In Sec. 243, at high end of creek—
Quartzite, dip E. 20° S. at 30°, underlain by
Thick hard purple slate, sometimes massive and calcareous.
Thick purple limestone.
Calcareous grits passing into small-grade conglomerate.

Flaggy sandstone, dip E. 20° S. at 30°.
Thick red quartzite, much broken, dip E. 10° S. at 50° (seen in western branches of creek).
Thick purple slates, finely laminated, passing up into grass land forming the good agricultural ground around Kulpara.
Further down the creek (Sec. 238) a bar of pinkish limestone occurs in quartzite, and just south of the old east and west fence, that separates Secs. 236, 235, a thicker limestone crosses the creek with a strike S.W. and marks the beginning of the main limestone series.

The main limestone of the district is not generally conspicuous, except in creeks, in which case it often shows a face up to 20 feet in the banks. It is for the most part a micro-crystalline, bluish to reddish, or buff-coloured, limestone. Its northern limits are in Sec. 235, just above Mr. Maxwell's (late Hubble), where it is cut off by an east and west fault, bordered by quartzite, with a wedge of quartzite faulted, or folded, into its northern side. Great developments of limonite and quartz occur on its north-eastern limits, where the limonite has been quarried to a small extent for flux. The eastern boundary of the limestone follows the western side of the road that passes Maxwell's and passes over the creek, near by, about 50 yards west of the house. It then follows the valley on the western side of the road with prominent outcrops on the banks of the creek, and, curving over the paddock, crosses the road that separates Secs. 231, 232; it then crosses the 3-chain road, a little below the junction of the Balaklava and Port Wakefield roads, and forms the dividing line between the rise of the land on the western side and the plains on the east. It then passes on the western side of Mr. Mayfield's house, in Sec. 199, curves round to the south through Sec. 203, and meets the western boundary in the creek bottom in Sec. 209. On the western side of the creek, in the same section, the limestone is exposed by creek erosion for about 100 yards in length and is seen on both banks, dip E. 20° S. at 35°.

The western boundary of the main limestone area, from its north-western angle, in Sec. 235, follows a small gully, southwards, and crosses the creek, in the same section, just above the bend in the road. The beds can be traced across several small tributaries in Secs. 233 and 230, near the west boundary fence. They cross the 3-chain road and pass to the south near the gate on the road which goes down to Mr. T. F. Mayfield's, following the eastern side of the gully in Sec. 206. They strike south, near the dividing fence between Secs. 208 and 204, and cross the district road in Sec. 209, where they are well developed in the angle of the creek, with a thickness of about 40 feet. Dip E. at 35°. At the south-western angle there is a considerable show of quartz and limonite and metasomatic changes in both limestone and quartzite. The four sides of this patch of limestone seem to be determined by faults, the quartzites being thrown against the limestone. This is most evident in the northern limits and the south-western portions, giving rise to the limonite and quartz developments.

Near the south-western extremity, a small outlier of limestone occurs which is separated from the main limestone by a reddish quartzite.

The fossiliferous beds occur towards the eastern side of the Kulpara area in grey and buff-coloured limestones that have a less crystalline texture than the other limestones of the series. The localities specially noted for their occurrence are in the north-east angle of the area, and in Sec. 405, on a rise near the junction of the two 3-chain roads. The remains, so far as noted, are limited to Trilobites and Pteropods, the former being present only in a very fragmentary condition, but, in places, abundant. No time was spent in looking for more complete specimens, although such will probably be found if carefully looked for. In one place the rock had a brownish, earthy appearance, with the fossils changed to an ochreous substance. The fossiliferous horizon may be considered as the equivalent of the Pteropod-Trilobite beds of Parara, which in that locality form the

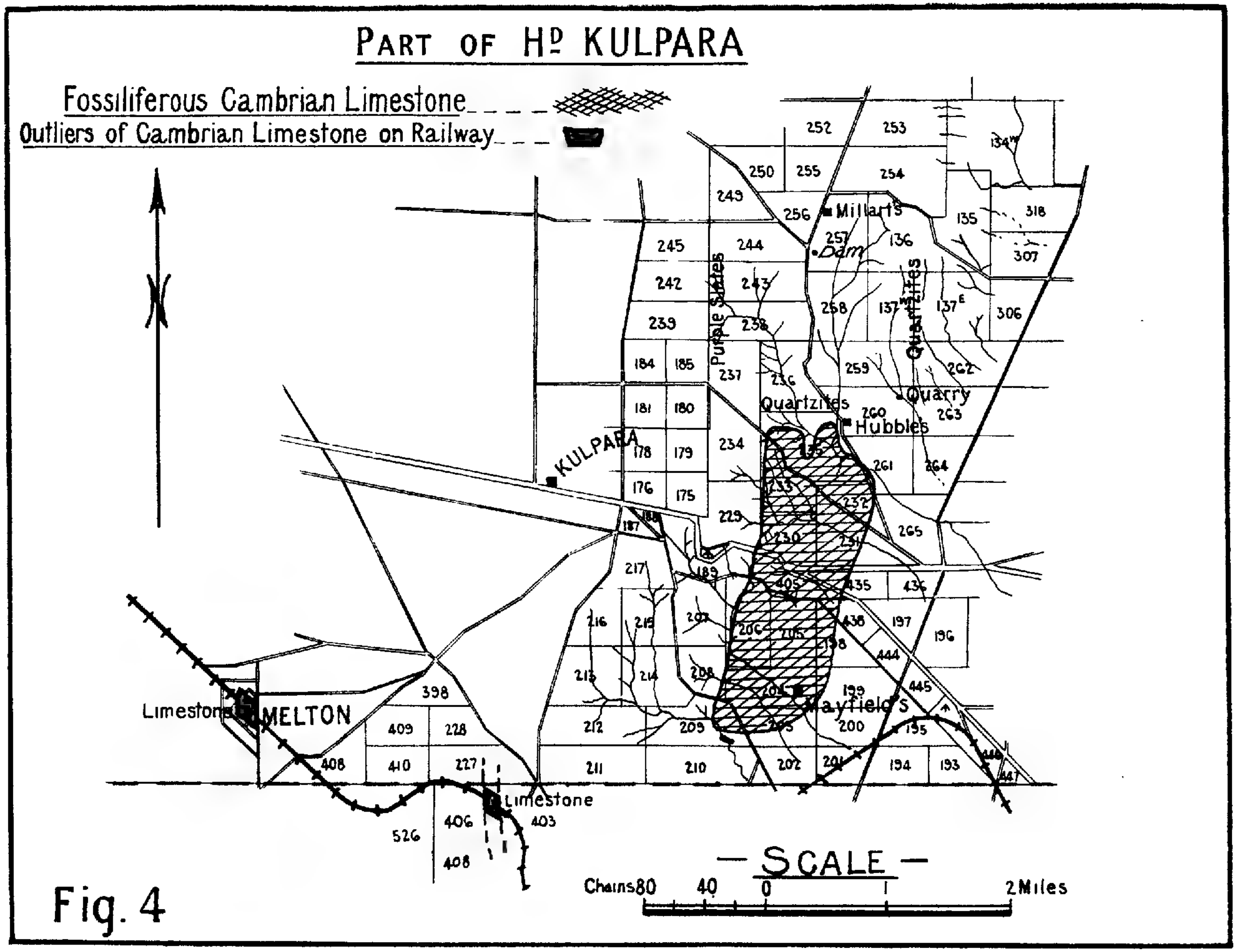

PART OF H^D KULPARA
Fossiliferous Cambrian Limestone
Outliers of Cambrian Limestone on Railway
KULPARA
Millart's
Dam
Quartzites
Purple Slates
Quarry
Hubble's
Mayfield's
Limestone
MELTON
SCALE
Chains 80 40 0 1 2 Miles

Fig. 4

uppermost beds in the limestone series. Another resemblance which the Kulpara fossiliferous beds bear to the upper beds at Parara, is in the absence of Archaeocyathinae remains. The geological horizon of the latter is lower in the series than that of the Trilobite beds, and, therefore, may be expected to occur in the lower members, situated more to the westward. But the beds in that direction have been much altered by crystallization and dolomitization which may have obliterated the evidences, as has certainly been the case in some localities adjacent to limestones carrying Archaeocyathinae remains.

IV. FLINDERS RANGES.

1. Wilson and Kanyaka (figs. 5, 6).

(1) Country to the West of Wilson.

Wilson is situated on the Great Northern Railway, 265 miles from Adelaide and 31 miles north of Quorn.

Quartzites.

The most conspicuous land feature of the locality is a range of hills situated about 4½ miles to the westward of the township and limits the view in that direction. This range, which has an approximately north and south direction, is a great outcrop of quartzite, either massive, or, in part, divided into distinct beds of about a foot, or more, in thickness. The stone is light-coloured, sometimes reddish, very siliceous, and typical of the thicker quartzites of the Upper Cambrian Series. In general outline it is craggy, razor-edged, or broken into pinnacles. Opposite Wilson it has the outline of a cockscomb.

The range was examined near the last-named point, in a direction west-north-west from Wilson. On the rise, half-way up, the strike was S. 15° W., and at the summit of the range, strike S. 22° W., dip easterly at 70°. The jointing is at right angles to the dip which tends to split the beds into quadratic prisms or columns.

On the western slope of the range the dip increases to vertical, or slightly overhanging, making precipitous faces. The quartzite forms a sharp wedge-shaped range, estimated at about 500 feet in height, and the quartzite, forming the range, about 1,000 feet in thickness. The latter ends abruptly on the western side in a junction with the purple slates which, in bare and serrated outcrops and low rises could be easily traced by the eye for a distance of 2½ miles. The dip of these beds could be recognised as being high, nearly vertical; dipping to the westward, on the near side, and then changing to an easterly dip at a greater distance (see fig. 6).

A feature, not uncommon in the Flinders Ranges, is developed a little to the north-westward of Wilson, in a spur which bifurcates with the main range, and, at a distance of about 5 miles, terminates in the broken crags of the Devil's Peak, a conspicuous object in the bend of the railway near Wilson. The Peak forms the eastern end of a great curve in the ranges. The south-western face makes a dip-slope with a reading S. 6° W. at 18°-22°, taken at a point 700 yards further westward than the Peak. Half a mile still further to the westward, along the ridge, the dip was found to be S. 35° W. at 22°.

Horizontal and lateral slickensides are a special feature of the Devil's Peak spur. At a place which suggests the name of "Slickenside Point," the rocks are much crushed and slickensided laterally. The quartzite rock had by differential movements been rubbed and altered to a quartz face. In one position a 9-feet face was exposed which showed a complete slickensided surface. Many parallel faces of a like kind were noticed along the southern face of the spur.

The Devil's Peak spur consists of quartzite identical with that of the main range. At its north-western end it converges with the main range, but in its south-eastern extension it gradually swings round to a position at right angles to the main range. This swinging-round movement has probably caused the lateral and horizontal slickensides that have been so intensely developed in the spur. There is a long talus from the latter which passes down to Palmer's Creek, near the southern boundary of the Hundred of Wonoka. A wide flood plain exists between the Palmer and Kanyaka Creeks, following the road in a north-westerly direction to the five-cross-roads, near Secs. 21W and 21E (Hd. of Wonoka), in which sections consolidated alluvia occur. [See below.]

Limestones.

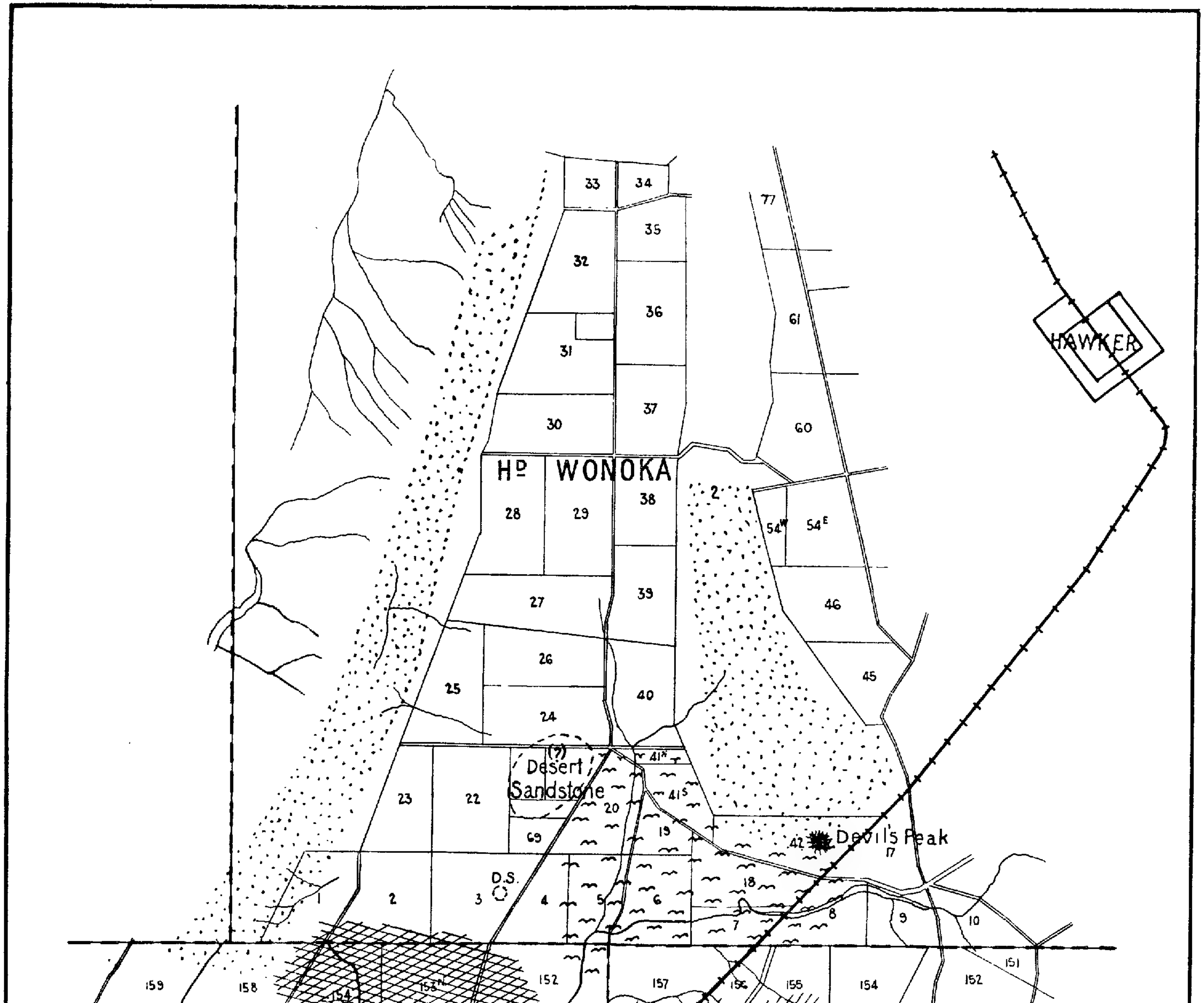
The main range and the Devil's Peak bifurcation border a semi-enclosed basin, in which the softer and more soluble rocks, consisting of shales and limestones, form a peneplain.

On the western side of the township of Wilson, yellow and kaolinised forms of purple slates (or shales) occur sparingly at the surface, and are also proved in well-sinking, until near Kanyaka Creek, nearly a mile from the township, where blue limestones first appear at the surface. The latter continue down to the creek where strong exposures can be seen. The limestone at this horizon is banded and interspersed with earthy or dolomitic material, giving a dip S. 30° E. at 52°. This limestone can be followed over the next low rise, going west, where it occurs in thick tabular masses having a strike S. 20° W., taken on sight readings along lines of darker material. No fossils were detected in these beds which would be classed by quarrymen as "blue metal."

This banded limestone passes into a dark-coloured and more homogeneous bed carrying Archaeocyathinae. It continues in outcrop, with less exposure, through Secs. 153N and 154 (Hd. of Kanyaka). In the creek bed that occurs in the last-named section some fine examples of Archaeocyathinae were obtained. This was followed by a zone of limestone that appeared to be unfossiliferous. On crossing the road, which divides Sec. 154 from Sec. 158, the limestone was obscured by a talus, shed from the ranges, near the boundary of the Hundreds of Kanyaka and Wonoka, at a distance of 4½ miles from Wilson.

Another traverse of the limestone area was made more directly west from Wilson. The limestone outcrops were followed down the Kanyaka Creek to the junction that the latter makes with the main tributary coming in from the north-west. There is a great development of limestone at the fork of the two streams. In the main stream the limestone is of the "blue-metal" type, with a dip S. 35° E. at 35°. In the tributary creek the dip is S. 60° E. at 30°. At a sharp northerly bend of the stream, a quarter-mile above the junction, there is a crush-rock, 12 feet wide, much veined with calcite, probably indicating a line of fault as the dip is reversed [N.W. at 70°]. Above this point (near the public road) the limestone is banded, crosses the creek, and passes under a massive limestone lower down the creek. Two hundred yards higher up the creek, the dip is S. 30° E. at 47°. 50 yards higher, S. at 41°; 300 yards higher, W.S.W. at 25°, passing here into a more solid limestone; 60 yards further, S.W. at 30°; 100 yards further, W. 5° S. at 44°, banded. Near the second road passed in the line of traverse (between Secs. 154, 158) a banded limestone, showing sponge spicules weathered into relief, was met with. Strike N. 16° E., dip, E. at 70°. In creek, above the road, dip N. 30° W. at 28° (banded).

The stratigraphical relationship of the quartzite ranges to the limestone is not quite clear. The dip of the limestones, in the main, is in an easterly direction, which agrees with that of the quartzites, while the reversed dip, in a westerly direction, appears to be almost limited to the ground in the angle at the bifurcation of the range, and may easily have arisen from the powerful lateral movements which, we have seen, accompanied the great whirling curve in the range. The immediate contact between the quartzite and the limestones is obscured by talus from the ranges.


HAWKER
Hd WONOKA
Devil's Peak
(?) Desert Sandstone
D.S.
33
34
35
32
36
31
37
30
60
61
77
28
29
38
2
54W
54E
27
39
46
26
25
40
45
24
41N
41S
23
22
20
69
19
42
17
1
2
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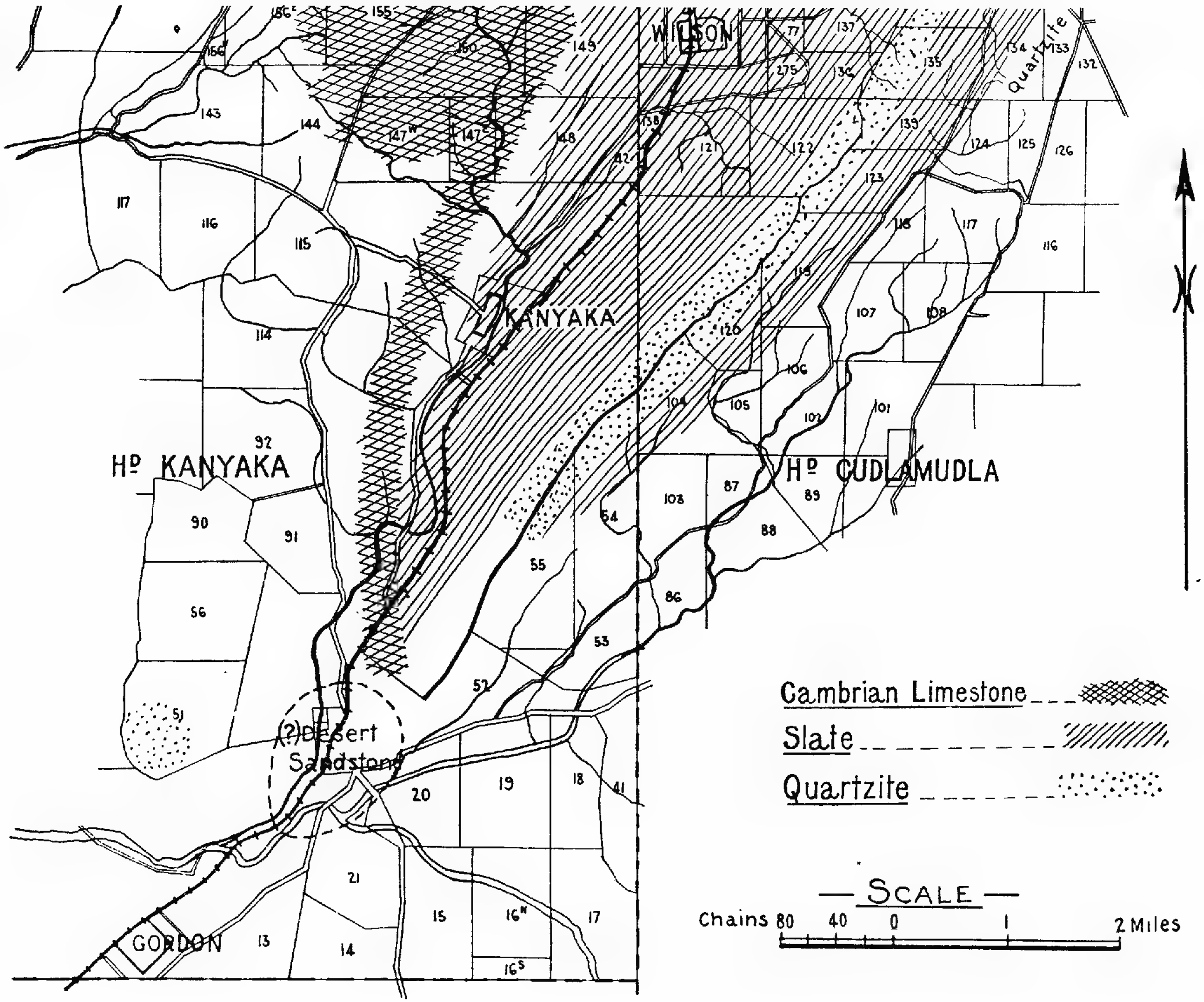
WILSON
KANYAKA
Hd KANYAKA
Hd CUDLAMUDLA
Quartzite
(?)Desert Sandstone
GORDON
Cambrian Limestone
Slate
Quartzite
SCALE
Chains 80 40 0 1 2 Miles

Fig. 5

(2) Township and Eastern Side of Wilson.

Passage beds between the limestone and overlying slates begin on the eastern side of Kanyaka Creek [Secs. 148, 149]. The limestone becomes flaggy and more earthy with bands of buff-coloured slate. Nearer the railway, the beds consist of yellow-coloured slates that include nodular layers of blue limestone. On a small rise, north of Wilson and near the eastern side of the railway, there are slight exposures of limestone with high easterly dips. A well sunk at the Wilson Hotel passed through alluvial beds and grey shale to a depth of about 60 feet, and, then, "blue-metal" limestone to a further depth of 45 feet. In the creek near a culvert on the railway (Sec. 42) are green slates, very fissile and thick-bedded. Dip S. 55° E. at 60°.

A section was taken of the beds on the eastern side of Wilson for a distance of about 3 miles (fig. 6). For the first mile, or a little more, the country is flat with outcrops of shale in low positions. Following which is a range consisting of quartzite of no great height in a line with what is marked "stone wall" on the Hundred map. The foot hills of the range are formed of consolidated alluvium, to be referred to presently. The quartzite of the range is of a white, vitreous nature, not columnar, but split up on parallel planes, and is sometimes false-bedded. At about one-third up the spur the dip is S.E. at 60°; a little higher up the dip has increased to 80°, which is maintained to the summit with a direction due E. On the eastern side of the range the stone is massive, showing vertical scarps, is much jointed, and highly slickensided, the striations showing a dip of 18° to the westward. The bedding has a dip of E.S.E. at high angles up to 90°.

Passing over the range to the eastward, as soon as the talus is passed the purple slates are in evidence, including thin beds of a calcareo-arenaceous kind. At a distance of half a mile from the range characteristic purple slates are exposed in a small creek. The dip here is, practically, vertical, with a wobbling variation passing, alternately, to either west or east. The beds are very fissile. Forty yards lower down the creek the dip is E.S.E. at 85°, then it becomes suddenly reversed in direction at the same angle. At one mile east from the range a small tributary joins the larger creek exposing thick purple slates with a dip W. at 80°, which is again reversed to E. with an irregular strike. These slates pass under quartzites which form the next range to the eastward, parallel with the one just described. This creek was followed in a northerly direction through Sec. 144 (Hd. of Cudlamudla) as far as the Craddock road. Slates outcrop on this road and continue quite through the gap to Wilson, the gap having been caused by this belt of slates which appears to have cut off the quartzite range which exists to the south.

Examination of the ground to the south of Wilson was limited to about 2 miles, in that direction, beyond which, observations made from the train showed that the belt of slates continued southwards along the railway line until near old Kanyaka Head Station, about 6 miles from Wilson, when the limestones came into view and could be seen on both sides of the line, and then passed to the eastern side of the latter. Specimens of the Archaeocyathinae limestones from near Kanyaka Head Station contain numerous small calices closely crowded together. From specimens received from the late Prof. Tate, obtained from near Kanyaka, Mr. Robt. Etheridge described the following new species:—*Ethmophyllum hindei, Protopharetra (?) scoulari,* and *Coscinocyathus tatei.*

(a) A Review of the Field.

In a review of the field, as a whole, several points of interest may be noted:—

1. A similarity exists in the order of succession in the Wilson Series, as compared with the beds at Parachilna and Wirrealpa, in that, in each case, a thick, light-coloured quartzite underlies the Archaeocyathinae limestones.

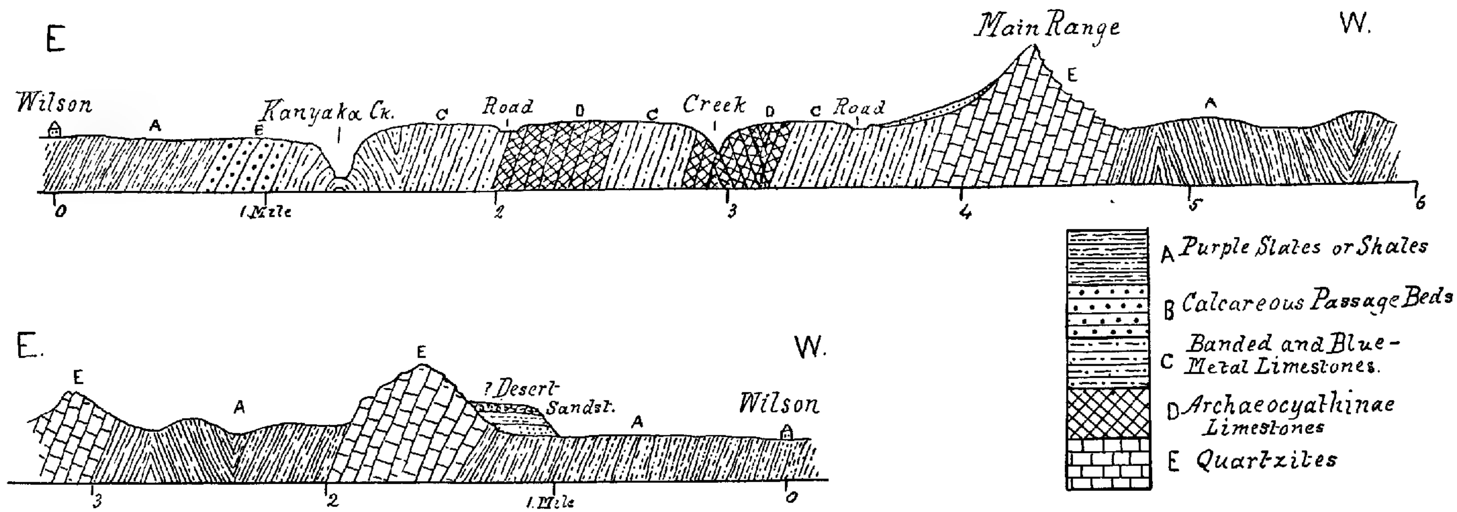

Fig. 6. Sketch Section East and West of Wilson.

2. It seems probable that the Archaeocyathinae limestones that occur on the western side of Wilson are contained in a basin-like fold, the quartzite ranges forming the rim of the basin on two sides and thereby cuts off the limestones from the northern side of the Devil's Peak branch.

3. The limestones have been reduced to a peneplain in which the Kanyaka Creek and its tributaries have cut deep channels in the beds.

4. The dip of the limestones is, for the most part, in directions ranging from east to south, although reversals to a westerly dip do occur. The swing round of the Devil's Peak limb, in opposition to the main range, has resulted in some crush zones as well as changes of dip. As the limestones extend over an area of 3 miles, measured across the strike, at relatively high angles, it is certain that the beds are repeated either by folding or faulting.

5. The limestones occur in four well-marked zones, alternately, as follow (starting from the township):—(1) Banded, impure, unfossiliferous limestone. (2) Compact limestone with fossils. (3) Banded unfossiliferous limestone. (4) Fossiliferous limestone. This repetition of the beds is strongly suggestive of faulting along the strike, as suggested above.

6. The limestones carrying the Archaeocyathinae, in this neighbourhood, are of a black colour, sometimes showing ochreous (yellow) spots. Small segregations of silica show in relief on weathered surfaces. (Griffith Taylor gives the insoluble percentage of two analyses as 3·6 and 3·8). The Archaeocyathinae, unlike those of the Ajax, and some others, are almost entirely calcareous in composition, and seldom make prominent features by weathering. Occasionally some portion of a calice has been altered to silica so that one side of the cup stands in relief while the rest is depressed. The central cavity of the cup is not infrequently filled with white rhombohedral calcite. A considerable variety of forms is present. From specimens collected on this visit Griffith Taylor has described a single species genus, *Metaldetes cylindricus*, which has not been definitely recognised elsewhere.

(b) Ancient Consolidated Alluvia.

([?] Desert Sandstone.)

Outliers of ancient deposits of alluvia occur at intervals in many places within the area examined (see fig. 5). If these remains occurred further to the north they would undoubtedly be classed under the ambiguous name of "desert sandstone." The following examples were noted: A gentle rise in the ground in Secs. 21w and 21E (Hd. of Wonoka) was entirely covered with nodules of "desert sandstone." In Sec. 3 is a hill entirely composed of stones of a like kind. Across the road, a little to the southward, in Sec. 4, is a hill with indurated alluvia in solid beds not less than 3 feet in thickness. Also, due south, across the adjoining slack in the ground (Hd. of Kanyaka, Sec. 152), is another hill, similarly capped, showing a thickness of 10 feet. This group of hillocks is from 15 feet to 20 feet in height, and situated about a quarter of a mile from each other in a north and south direction. Other cappings of a similar kind are found on rises, on the eastern side of Kanyaka Creek, nearly due west from Wilson; and another strongly-marked fragment, measuring 150 yards by 30 yards, in extent, is situated in Sec. 149; and another on high ground, in Sec. 150, near the top of the hill above Kanyaka Creek, to the south of an old ironstone mine. It is evident that these alluvial deposits are isolated fragments of an extensive sheet of sediment that was laid down on a peneplained floor of Cambrian limestone. Subsequent denudation has left these weather-resisting beds above the present normal level.

The lithology of these beds is very similar to that of the "desert sandstone" in Central Australia. They consist of sands and clays that have undergone silicification; jaspery nodules; porcellanite, containing rounded fragments of the

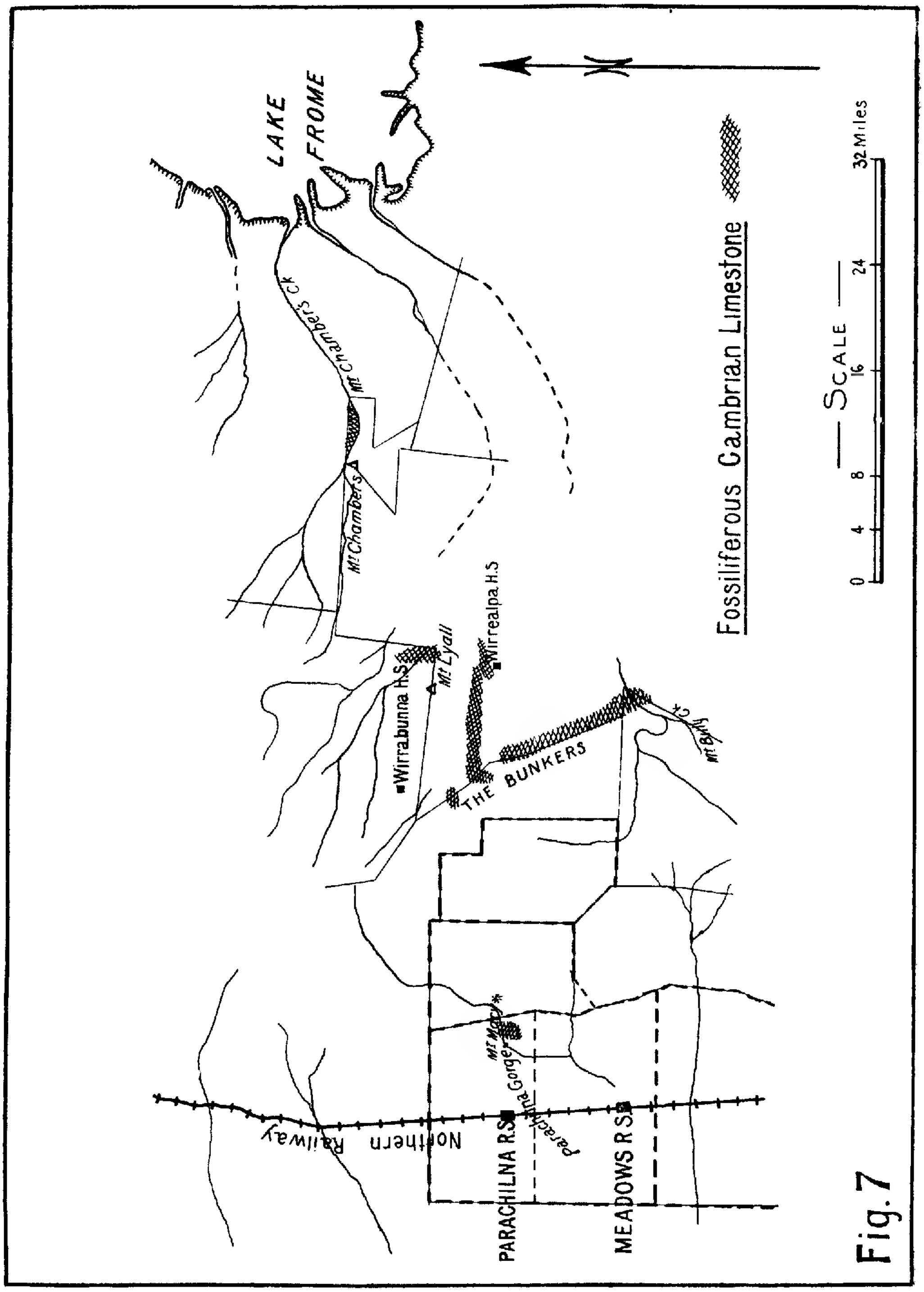
LAKE FROME
N
Mt Chambers Ck
Mt Chambers
Wirrabunna H.S
Mt Lyall
Wirrealpa H.S
THE BUNKERS
Mt Billy Ck
Northern Railway
PARACHILNA R.S
Parachilna Gorge
Mt Mary
MEADOWS R.S
Fossiliferous Cambrian Limestone
SCALE
0
4
8
16
24
32 Miles

Fig. 7

same kind of stone, simulating a conglomerate in appearance but homogeneous in composition, etc.

The most important fragment of this class of rock occurs on the eastern side of Wilson, in the form of a foot hill to the quartzite range in that direction (described above). The exposure is not less than 50 feet in thickness. The lower beds are softish, dark-red, vesicular sandstone, which has been quarried in a small way. To the rise, the stone crops out in hard siliceous sphaeroidal masses, that is very characteristic of beds of this type. One of these beds has a thickness of 12 feet. There is also a bed of white kaolin in the section, which is also a feature, in places, of the "desert sandstone" in Central Australia. As these beds flank the ranges they mark the limits of the deposits in that direction.

What appear to be large sphaeroidal masses of the same class of stone can be seen, from the train, on the banks of the Kanyaka Creek, about 1½ miles south of the old Kanyaka Head Station.

During a part of these explorations I was accompanied by Mr. (Dr.) W. G. Woolnough.

2. Parachilna, Wirrealpa,[1] and Mount Chambers' Creek (fig. 7).

No occurrence of fossiliferous beds of Cambrian Age is known to exist between Wilson and Parachilna, a distance of about 65 miles. Archaeocyathinae limestones form bold features at the entrance to the Parachilna Gorge. The country, from the western outlet of the Gorge, through to the eastern limits of the ranges that face the Lake Frome plains, consists exclusively of Cambrian strata. The structural features are on a grand scale. Blinman, at about half-way across the ranges, forms the apex of a great dome, the Archaeocyathinae limestones, dipping west at the Parachilna end, and east at the other extremity, near Eregunda Creek. From the latter point, beds newer in the series are exposed. The section across the ranges supplies evidence that the Cambrian beds in this region are of very great thickness, by far the most complete and thickest section of beds of this age known in South Australia. [Howchin, W., 1922.]

The fossiliferous beds occur at intervals on an east and west line of about 50 miles. As the thick Archaeocyathinae limestones form the lowest fossiliferous horizon, there are no outcrops showing fossils in the great dome structure except at the two extremities, mentioned above. At the Eregunda end, the main fossiliferous limestones follow several radiating lines. Two of these lines start from the gap in the Bunkers Range, near the Eregunda Springs; one line of exposure follows in a north-easterly direction, passing by the old Wirrealpa Station buildings to Mount Lyall; and, at a greater distance, in the same direction, an outlier of the Archaeocyathinae beds occurs in the Mount Chambers' Creek, covering a distance (including a break in the continuity of the beds) of 28 miles. Another fossiliferous area exists between the old Wirrealpa Station and the present Wirrealpa Head Station, a distance of 9 miles. A third follows the eastern side of The Bunkers, in a south-easterly direction, to near Billy Creek, a distance of about 15 miles.

At a higher horizon than the thick Archaeocyathinae limestones are several smaller limestones, richly fossiliferous, containing Brachiopods (*Obolella*, etc.), Pteropods, Trilobites, *Girvanella*, etc. These occur on the western side of Wirrealpa Head Station house, also on the road near the old Wirrealpa Station, on the road on the eastern side of Mount Lyall, in Balcoracana Creek, and other places.

The Wirrealpa district has yielded the greatest variety of Cambrian fossils hitherto obtained in South Australia. The geological succession in the district also includes fossiliferous beds higher in the series than are known elsewhere in

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[1] This mode of spelling the name is in accordance with the Government Maps. Some local residents state the correct spelling is Wirrialpa.

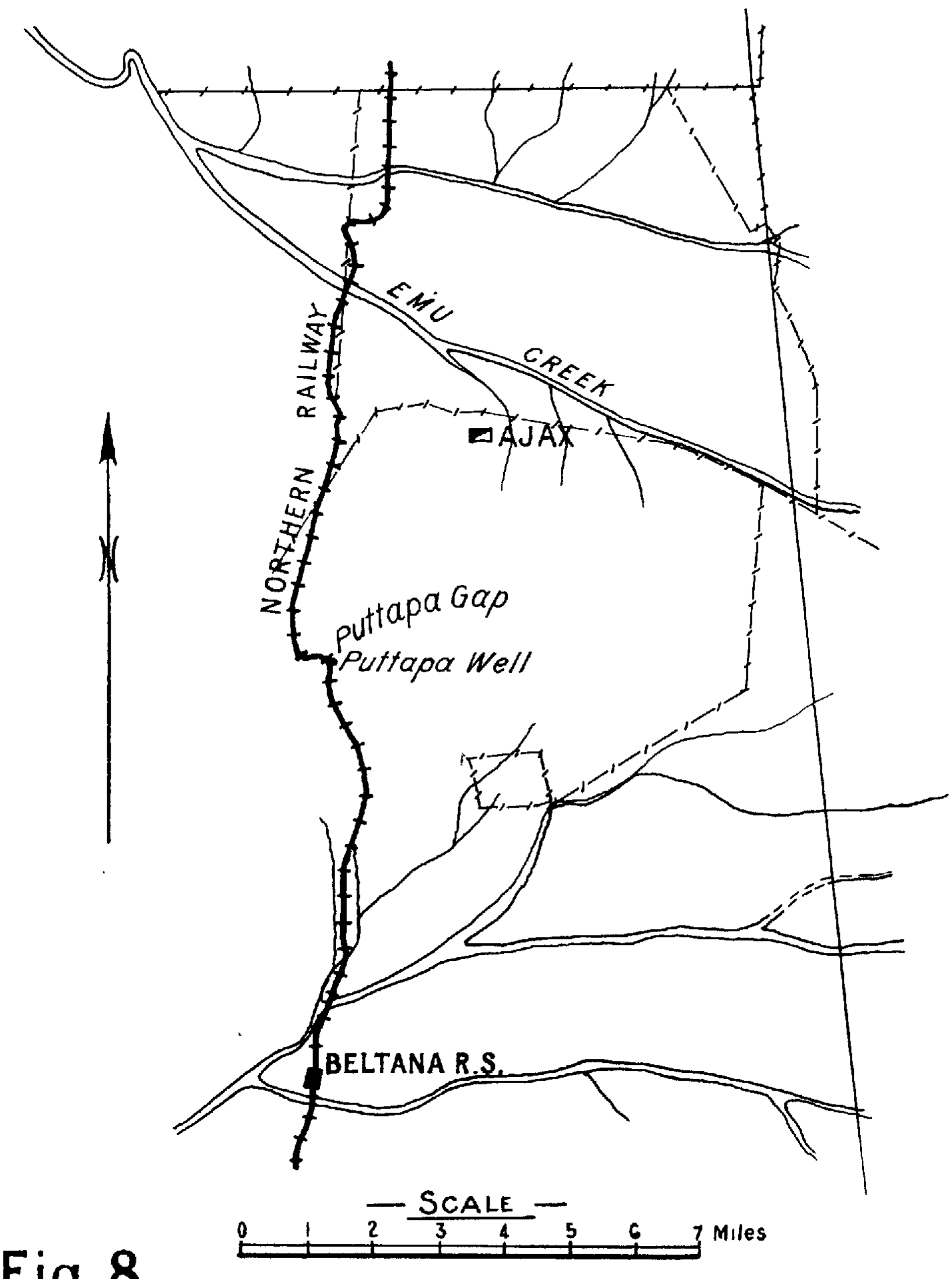
EMU CREEK
NORTHERN RAILWAY
AJAX
Puttapa Gap
Puttapa Well
BELTANA R.S.
SCALE
0 1 2 3 4 5 6 7 Miles

Fig. 8

South Australia. With respect to the Archaeocyathinae, *Somphocyathus coralloides, Archaeocyathus wirrialpensis,* and *A. equivallum,* have not been found elsewhere; while *A. concentricus* is supposed to be identical with the Sardinian species of that name. [See Taylor, T. G., 1910, p. 74.] *Ethmophyllum hindei,* described by Etheridge, came from the same locality.

[For detailed descriptions of this district see Howchin, W., 1922.]

3. The Ajax Outlier (figs. 8, 9).

The most northerly exposure of fossiliferous Cambrian beds, so far as known, is situated in close proximity to the old Ajax Copper Mine and Emu

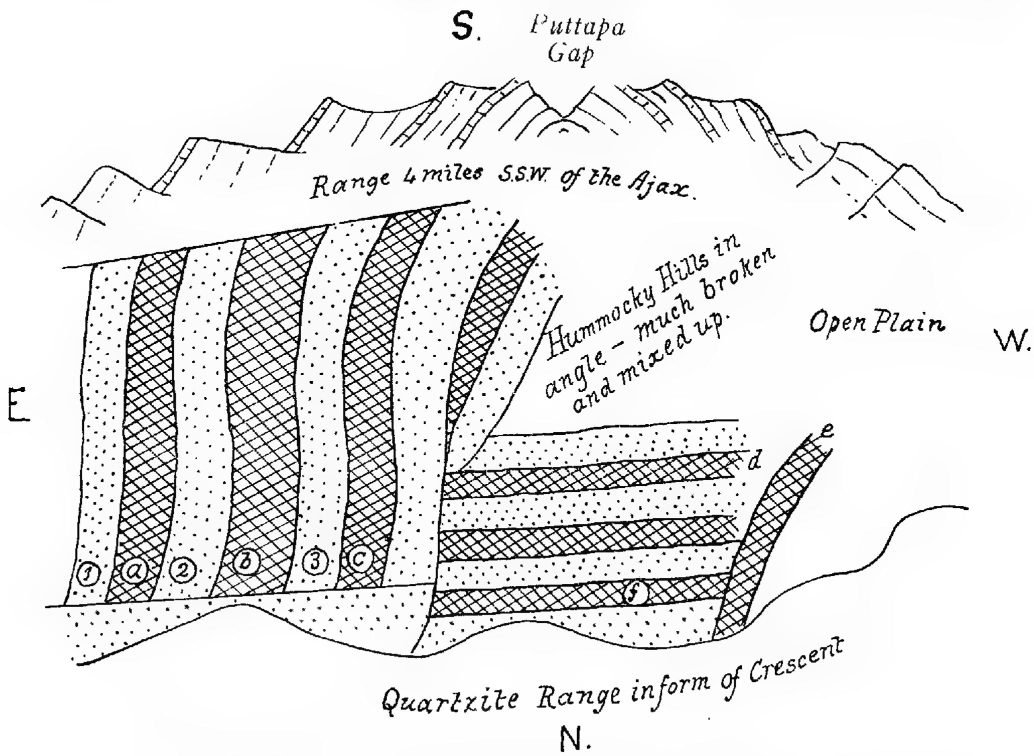

Fig. 9. Rough Sketch-plan of the Archaeocyathinae Field at The Ajax Mine.

Limestones:—

(a) Limestone containing pebbles of quartzite. Strike E. 20° S., dip 85° southerly.

(b) Archaeocyathinae limestone. Dip 65°.

(c) Buff-coloured limestone (dolomitic). This has features similar to limestone *(b)* and is probably on the same horizon as the latter, although no fossils were seen in it.

On the western side of the field extraordinary displacements have taken place, resulting in a change of strike to right angles with much broken ground in the angle.

(d) A limestone conglomerate (? autoclastic) mixed with Fe_2O_3. Possibly a repetition of limestone *(a)*.

(e) A broken segment of limestone turned to an angle by a spur of quartzite.

(f) Limestone nearest quartzite range. Strike N. 110° W., dip 50° northerly—that is, towards the quartzite hills.

Quartzites:—

1. Structure shows lines or laminae. Strike E. 20° S., dip southerly at 78°.
2. Rock much broken and slickensided (? fault breccia). Strike N.W. and S.E.
3. A quartzite of about 3 chains in width.

Creek, about 10 miles to the northward of Beltana Railway Station, and 36 miles from the Parachilna-Wirrealpa fossiliferous district (fig. 8).

Around Beltana and Puttapa (situated between Beltana and The Ajax) the beds have only a slight inclination, but at Puttapa Gap, which has been excavated on the axis of an anticline, a great change occurs in the country lying to the north-eastward. The beds are, commonly, at a high angle and the field is intensely faulted.

In the neighbourhood of The Ajax there are only slight indications of the presence of true slates as the exposures are almost exclusively in the form of quartzites and limestones. The quartzites are often much broken and reduced to fragments, like road metal, and supply endless examples of slickensides, on the fragments. The quartzites frequently cut off the limestones, or, by strike-faulting, repeat them. The dip is generally high. It is a question as to whether the Archaeocyathinae limestones roll, or not.

The Archaeocyathinae limestone has a great spread, probably reaching 500 yards across the strike, with a fossiliferous zone of about 250 yards. There is no doubt that the occurrence of fossils was originally more extended than appears at present, as the limestone has been much altered by dolomitization, metasomatic deposits of ironstone, barites, etc. The outcrop along the strike extends for about a mile, or a little more, and is bounded by quartzites on all sides. On the western side there is a basin, while the crescentic hills of Puttapa Gap Range occur to the southward, and a similar crescentic range of quartzite hills to the northward (see fig. 9). The lateral movement which has taken place has, apparently, crushed the limestones and associated beds into angular segments.

So far as the Archaeocyathinae remains are concerned, it is the richest field for this class of organism known in the State, and probably in the world. Of the 35 species described by T. Griffith Taylor, in his monograph, no less than 25 were obtained from The Ajax area *(op. cit.,* p. 74). In addition to the great number of individuals, the field has a further advantage in that the fossils occur as pseudomorphs in silica, by which not only is the structure well preserved, but the solution of the matrix, in weathering, has left the fossils more or less in relief. In so extensive a field, and with a tendency to prolific differentiation in the organism, there remains, no doubt, a rich harvest for future workers in the elucidation of this interesting and long-lost fauna.

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ON ROLLING DOWNS FOSSILS COLLECTED BY PROF. J. W. GREGORY.

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(Communicated by Edwin Ashby.)

[Read April 9, 1925.]

Plates I. and II.

During the excursion [1] conducted by Prof. J. W. Gregory, in the summer of 1901-2, a number of Cretaceous fossils were collected in the critical area to the north-west of Lake Eyre. In this area Upper Albian [2] beds, typically developed at Dalhousie Springs, Charlotte Waters, and Woodduck Creek, overlap the Upper Aptian beds of the Peake, Primrose Springs, and neighbouring districts. The collection, which is lodged in the Geological Department of the University of Glasgow, was kindly lent to the writer by Prof. Gregory.

Lamellibranchs, Gastropods, Scaphopods, and Cephalopods (Belemnites) were collected. The Belemnites, which are entirely free from matrix, came from Woodduck Creek, the remainder of the collection having been made at the Peake Station. These latter specimens are embedded in a fine-grained bluish-grey limestone similar to that from Wollumbilla and the Walsh River, in Queensland. In some cases, however, the limestone of the matrix and the calcite and aragonite of the tests are largely converted into gypsum.

Genus Pseudavicula, Etheridge, Jr.

Pseudavicula anomala [3] (Moore).

Pl. i., figs. 1-3.

1870. *Lucina anomala*, Moore, Q.J.G.S., vol. xxvi., p. 251, pl. xiv., fig. 4.
1870. *Lucina (?) australis*, Moore, *Id.*, pl. xiv., fig. 5.

From a study of the large suite of specimens in the present collection, and of a collection from various localities lent by the Geological Survey of Queensland, the writer is unable to uphold the specific identity of *Pseudavicula australis* (Moore). The two specimens figured by Moore have, unfortunately, been lost. Speaking of "*Lucina (?) australis*" he [4] remarked "this shell may be distinguished from *L. anomala* by the costae being finer; and, although it is larger, the anterior hinge-line is less extended." Etheridge, [5] in 1892, wrote: "*P. australis* is decidedly larger than that I take to be *P. anomala*, and although the sculpture is of the same type it is never, so far as my experience goes, so sharp and regular. The test of *P. australis* must have been very thin as it is seldom actually preserved." Later still Etheridge [6] remarked that *P. anomala* "is a smaller and more delicate form than *P. australis* and highly gregarious."

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(1) See J. W. Gregory, "The Dead Heart of Australia." London, 1906.

(2) The evidence for this will be given in a later paper (Mems. Q'land Mus.) dealing with the Ammonoidea.

(3) In this paper only the original reference to the species and the references after the year 1902 are given in the synonymy. For references up till 1902 see Appendix II. (Etheridge and Dun) to Mem. Geol. Surv., N.S. Wales, Pal. No. 11, 1902.

(4) C. Moore, Q.J.G.S., vol. xxvi., 1870, p. 252.

(5) R. Etheridge, Jr. (in Jack and Etheridge), "Geology and Pal. of Queensland," etc. Brisbane and London, 1892, p. 451.

(6) R. Etheridge, Jr., Mems. Roy. Soc. S. Austr., ii. (1), 1902, p. 16.

Three points of difference were thus indicated by these authors—size, strength of costae, and length of anterior hinge-line. The last-named criterion may be dismissed, for the umbones in *Pseudavicula* are practically terminal and Moore's original *P. australis* had the anterior portion broken. The examination of a large number of specimens has convinced the writer that, while there is a certain variation in strength of costae, yet, by taking Moore's figures as types, no division into two groups is possible from this feature. There is a complete gradation between forms of different costal sharpness; and this gradation is often well shown in specimens embedded in the same block of matrix. Similar remarks apply to the criterion of size. Caution must be observed in comparing the ornamentation of specimens of this species; for the nacreous shell exfoliates so easily that one is liable, at times, to confuse an exfoliated surface with the original surface of the test. But a comparison of external moulds (for the external ornamentation) and of internal moulds (for internal ornamentation) has led the writer to believe that the gradation is continuous.

One group, however (typified by the form figured by Etheridge, *loc. cit.*, 1892, pl. 24, fig. 8), may eventually require separation from *P. anomala;* but it cannot, of course, receive the name *P. australis.*

The hinge-line of the genus has not been satisfactorily observed hitherto. One specimen, in the present collection, however, shows the hinge of a left valve, while further information is available from the cardinal regions of internal moulds. The hinge is typically aviculid (compare, *e.g.*, the hinge of *Pseudomonotis* figured by Pompeckj[(7)]). It is edentulous with a narrow rectangular ligament pit on the posterior portion. A slight inflection of the hinge-line provides a rudimentary type of articulation (see pl. i., figs. 1, 2). No byssal sinus is present in the right valve.

Genus Maccoyella, Etheridge, Jr.

Maccoyella barklyi (Moore).

1870. *Avicula barklyi*, Moore, Q.J.G.S., p. 245, pl. xi., figs. 1, 2.
1915. *Maccoyella barklyi*, Newton, Proc. Malac. Soc., vol. xi., pt. iv., p. 225, pl. vi., fig. 19.

A large number of specimens of this species, mainly fragmentary, are in the collection. All are at the stage where quaternary ribs are developed. The significance of this stage of ornamentation will be discussed in a forthcoming paper.

Genus Pecten, Müller.

Subgenus Camptonectes, Agassiz.

Pecten (Camptonectes) socialis, Moore.

1870. *Pecten socialis*, Moore, Q.J.G.S., vol. xxvi., p. 248, pl. xi., fig. 9.

The specimens of this species in the collection are all internal moulds similar to the form originally described by Moore. Moore's specimen has been lost; but until more perfect specimens are figured than those already known, it is inadvisable to choose a neotype.

Frequently since the Bathonian, with its *P. (C.) lens*, J. Sow., the group of smaller *Camptonectes* (as distinct from the group of large forms typified by *P. (C.) cinctus*, J. Sow.), has given rise to forms of a rather uniform type, thereby making specific distinctions rather difficult. The Upper Cretaceous forms of Europe, *e.g.*, are seriously in need of revision, and though many specific names are in existence the number of species is probably small. *P. (C.) striatopunctatus*, Römer, especially the smaller forms like those figured by Pictet as

(7) J. F. Pompeckj, Neu. Jahrb. f. Min., etc., B. Bd. xiv., 1901, pl. xv., fig. 15.

P. arzierensis, de Loriol,[8] is very similar to *P. (C.) socialis*, differing in size and in the greater number of ribs. Römer's species is typical of Hauterivian, but has been recorded from the Valanginian and even as high as the Upper Gault. *P. (C.) curvatus*, Geinitz,[9] widespread in the Upper Gault (but ranging much higher also), is similar, but is again larger and has thicker ribs. *P. (C). projectus*, Tate, from the Uitenhage beds of South Africa, is also very similar.

Subgenus Syncyclonema, Meek.

Pecten (Syncyclonema) gradatus (Eth. fil.).

1902. *Protamusium (?) gradatum*, Etheridge, Jr., Mem. Roy. Soc. S. Austr., ii.,[10] p. 10, pl. i., fig. 14.

Only one specimen of this species is present, showing even less detail than the holotype. Etheridge quoted five genera which may have claims to include the species, and, while placing it provisionally in *Protamusium*, he seemed to regard *Amusium* as a very probable genus for it. The rugosity of the exterior and smoothness of the interior, however, together with the absence of the long crura, remove it decidedly from *Amusium*. Woods[11] has pointed out that the name *Protamusium* must be abandoned, since the type species quoted by Verrill, *Pecten demissus*, Phill., is the type of *Entolium*, which has precedence. He remarks further that *Entolium* should probably be united with *Syncyclonema*.

Even if the two genera are to remain distinct the present species must be referred to *Syncyclonema* (Genotype *Pecten rigidus*, M. and H.). It is rather to be deplored that a new name should be given to such a poor specimen as the holotype of the present species. However, the small portion of adherent test on the specimen allows a reconstruction to be made and to show that the surface of the left valve was ornamented by strong concentric costae. It is the opinion of the writer that the long-lived (Hauterivian to Upper Cenomanian) *P. (S.) orbicularis*, J. Sow.,[12] has been the main stock from which most of the other Cretaceous members of the subgenus evolved. But for the strong costation, *P. (S.) gradatus* is very similar to this European species.

Genus Modiola, Lamarck.

Modiola subsolenoides, Hudleston.

1890. *Modiola subsolenoides*, Hudleston, Geol. Mag. Dec., iii., vol. vii., p. 245, p. ix., fig. 8.

1902. *Modiola subsolenoides*, Etheridge, Jr., Mem. Roy. Soc. S. Austr., ii. (1), p. 22.

1902. *Modiola dunlopensis*, Etheridge, Jr., Mem. Geol. Surv. N.S. Wales, Pal. No. 11, p. 23, pl. v., figs. 4, 5; pl. vi., figs. 1, 2; pl. vii., fig. 1.

An examination of Hudleston's type, in the British Museum (Nat. Hist.) Collection, has shown that this species is identical with Etheridge's *M. dunlopensis*.[13] In the present collection it is represented by fragments only. The species is very similar to the Aptian to Upper Albian, *M. subsimplex*, d'Orb.,[14] but attains a larger size. The Upper Neocomian *M. rectior*, Wollemann,[15] may be closely compared with the straighter forms of *M. subsolenoides*.

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(8) Pictet, Foss. Terr. Cret. de St. Croix, 4th part, 1868-71, p. 195, pl. clxxi., fig. 3.

(9) See Geinitz, Die Verstein. von Kieslingswalda, 1843, p. 16, pl. iii., fig. 13.

(10) See Tate, Q.J.G.S., vol. xxiii., 1867, p. 155, pl. ix., fig. 6; also Kitchin, Ann. South African Mus., vol. vii., No. 3, 1909, p. 66, pl. ii., fig. 5.

(11) Woods, Mon. Cret. Lamellibranchiata, vol. i. (Mon. Pal. Soc.), p. 145.

(12) J. Sowerby, "Mineral Conchology," vol. ii., p. 193, pl. 186.

(13) Etheridge, *loc. cit.* (N.S. Wales), 1902, p. 23, pl. v., figs. 4, 5; pl. vi., figs. 1, 2; pl. vii., fig. 1.

(14) See d'Orbigny, Pal. Franc. Cret. Terr., vol. iii., p. 269, pl. cccxxxviii., figs. 1-4 (as *M. simplex*).

(15) Wollemann, Zeit. d. Deutsch. Geol. Gesell., vol. xlviii., 1896, p. 844, pl. xxi., fig. 6.

Certain forms (*e.g.*, the specimen figured by Etheridge, *loc. cit.*, N.S. Wales, 1902, pl. vii., fig. 1) connect the species with *M. angusta* (Hudl.).[16] The latter species exhibits the "ensiform" type of shell originally characteristic of Middle Jurassic beds (*e.g.*, *M. sowerbyana*, d'Orb., *M. icaunensis*, de Loriol, etc.), but reappearing in the Cretaceous in such species as the Neocomian. *M. baini*, Sharpe,[17] and the long-lived Upper Cretaceous, *M. flagellifera*, Forbes.[18] The Neocomian, *M. gillieroni*, P. and C.,[19] is also similar.

Modiola cupula, n. sp.

Pl. i., fig. 4.

Sp. Chars. Shell curved-pyriform in outline, rather narrow, tapering acutely towards the anterior end. Test moderately thick, ventral margin concave, dorsal margin long and very slightly convex; posterior margin regularly rounded. Antero-ventral portion of the shell narrow and sharply bevelled, the dividing edge between the two areas rounded. Ornamentation by regular fine growth striae. Byssal sinus not apparent.

The species is represented by a number of specimens, most of which, including the holotype, are in the form of external moulds. The species is closely related to *M. eyrensis*, Eth. fil.,[20] from which it may be distinguished by its slightly greater curvature and longer hinge-line. It may perhaps form a link between that species and *M. subsolenoides*, Hudl. "*Mytilus*" *rugocostatus*, Moore,[21] is also very similar, but has a shorter hinge-line and develops concentric rugae. The correct relationship of these Rolling Downs *Mytilidae* cannot be determined, however, till the zonal range of the species is known.

Owing to the simplicity of its characteristics *M. cupula* might well be compared with the forms from many horizons. Perhaps the foreign species most similar is *M. subsimplex* (d'Orb.).[22]

Genus Mytilus, Linnaeus.

Mytilus inflatus, Moore.

1870. *Mytilus inflatus*, Moore, Q.J.G.S., vol. xxvi., p. 252, pl. xiii., fig. 4.

This species is represented by numerous specimens. There is a considerable amount of shape variation in the species, grading, apparently continuously, from wide forms, such as that shown on pl. ii., fig. 12, of the South Australian Memoir (Etheridge, *loc. cit.*, 1902), to elongate forms with truncate antero-ventral region.

M. primulafontensis, Eth. fil.,[23] is very closely related, and apparently connects the species with *Modiola eyrensis*, Eth. fil. On the other hand, the unique *M. palmerensis*, Eth. fil.,[24] may also be related; but it is so distinct from the usual mytilid type that it is difficult to make comparisons with foreign forms.

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(16) Hudleston, Geol. Mag., 1884, i. (3), p. 341, pl. ii., fig. 5. The Hudleston collection (in the British Museum) contains a number of specimens of the species in good preservation. Unfortunately a rather distorted form was figured under the name *Gervillia angusta*. The species is identical with, and must replace the name *M. ensiformis*, Eth. fil. (*loc. cit.*, 1902, S. Austr., p. 22, pl. iii., figs. 8-12).

(17) See Sharpe, Trans. Geol. Soc. Lond., ser. 2, vol. vii., 1856, p. 193, pl. xxii., figs. 2, 3.

(18) See Forbes, Trans. Geol. Soc., ser. 2, vol. vii., 1856, p. 152, pl. xvi., fig. 9; also Woods, loc. cit., p. 99, pl. xvii., figs. 1, 2.

(19) Pictet and Campiche, Foss. Terr. Cret. de St. Croix, iii., pt. 1864-7, p. 503, pl. cxxxiii., figs. 9, 10.

(20) Etheridge, *loc. cit.*, 1902 (S. Austr.), p. 22, pl. ii., figs. 5-9.

(21) Moore, *loc. cit.*, p. 252, pl. xiii., fig. 2.

(22) d'Orbigny, *loc. cit.* (v. supra).

(23) Etheridge, *loc. cit.*, 1902 (S. Austr.), p. 18, pl. ii., figs. 22-24.

(24) R. Etheridge, Jr., Bull. Geol. Surv. Q'land, No. 13, 1901, p. 21, pl. ii., fig. 9.

One specimen in the collection has developed faint radial costulae. The appearance of this feature strengthens the view the writer has long held that the names *Brachydontes, Mytilus, Lithophagus,* etc., as commonly used, have a morphic rather than a generic significance. and that, in each case, they cover heterogenous groups repeatedly derived from the persistent *Modiola* stock. No more systematic significance should be attached to them, it is believed, than to the comprehensive "*Gryphaea*" and "*Exogyra*." At numerous horizons one is confronted with the difficulty of deciding whether a species should be allotted, e.g., to *Modiola* or *Mytilus* in their accepted sense;[25] and the conchological distinction on which a division is made rests on such slender foundations that one would be surprised if the groups are homogeneous. So with other "genera." The group designated *Lithophagus,* Mühlf., *e.g.* (=*Lithodomus,* Cuv.), represents, in the writer's opinion, diverse branches of *Modiola* that have adopted a boring habit. The whole group presents other interesting problems (*e.g.*, the repeated appearance of "ensiform" types); but it has attracted so little systematic attention that it is not possible to make the suggestions given above more definite at present. The writer is convinced that a detailed chronological analysis of many Lamellibranch groups would make this class infinitely more valuable for zonal work than it is at present; and that, as Spath[26] has hinted, the Lamellibranchs owe their present limited zonal value to the fact that, systematically, they are little used.

Genus Thracia, Leach.

Thracia primula, Hudleston.

Pl. i., fig. 5.

1890. *Thracia primula,* Hudleston, Geol. Mag. Dec., iii., vol. vii., p. 245. pl. ix., fig. 7.

One specimen is present agreeing with Hudleston's type (B.M. Coll.). The species is closely related to the slightly lower, *T. wilsoni,* Moore.[27] The latter species occurs at Wollumbilla and in the chert beds of Maryborough, in Queensland (3 specimens are in the Sedgwick Museum Collection). *T. primula* is more transversely elongate, has a somewhat wider ante-carinal area, and is, apparently, less tumid than *T. wilsoni.*

T. wilsoni is very similar to the Hauterivian and Lower Barremian *T. phillipsi,* Römer,[28] while, perhaps, *T. primula* is most like the unnamed form[29] from the basal Hauterivian[30] (Uitenhage) beds of South Africa. The Lower Aptian, *T. robinaldina,* d'Orb.,[31] is also very similar. The Canadian *T. semiplanta,* Whiteaves,[32] is closely comparable, but its precise horizon is unknown. The difficulty, mentioned above in the case of *Camptonectes,* of making comparisons with a genus of limited variation, is met with here; and in addition to the Cretaceous species enumerated above, even such Jurassic forms as the Oxfordian *T. depressa,* Sow., might well be cited for comparison.

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(25) *E.g.*, there is apparently, as indicated above, a definite inter-relationship between the various Rolling Downs species at present distributed between *Modiola* and *Mytilus.*

(26) Spath, Trans. Roy. Soc. Edinburgh, vol. lii., pt. i., 1922, p. 94.

(27) Moore, *loc. cit.*, p. 254, pl. xiv., fig. 8; holotype (still preserved in Bath Mus. Coll.), refigured by Etheridge, *loc. cit.* (1892), pl. xxviii., figs. 10, 11.

(28) See Woods, *loc. cit.*, vol. ii., p. 240, pl. xxxix., figs. 7-9.

(29) Kitchin, *loc. cit.*, p. 160, pl. viii., fig. 5.

(30) See Spath, Geol. Mag., vol. lxi., 1924, correlation table (opp. p. 80).

(31) d'Orbigny, *loc. cit.*, p. 380, pl. ccclxxii., figs. 1, 2.

(32) Whiteaves, "Mesozoic Fossils," vol i. (Canadian Geol. Surv.), 1884, p. 221, pl. xxix., fig. 5. This species was recorded "subdivision C of Mr. Dawson's report"; but, to judge from the Ammonites figured from the same "subdivision" many horizons are represented in this assemblage of fossils.

Etheridge[33] placed the two species in the genus *Corimya*, Agassiz. This, however, is synonymous with the pre-established *Thracia*, Leach.

Genus Cyrenopsis, Etheridge, Jr.

Cyrenopsis spp. indet.

Many fragments in the collection no doubt belong to several of the species included by Etheridge[34] in *Cyrenopsis;* but, being fragments, they cannot be determined specifically with any precision.

The genus cannot be regarded as definitely established, for the hinge structure is still very imperfectly known. The present fragments add nothing to our knowledge of the genus.

Genus Fissilunula, Etheridge, Jr.

? Fissilunula clarkei (Moore).

1870. *Cytherea clarkei,* Moore, Q.J.G.S., vol. xxi., p. 250, pl. xiii., fig. 1.
1915. *Fissilunula clarkei,* Newton, Proc. Malac. Soc., vol. xi., p. 223.

This species is doubtfully represented by fragments.

Genus Gari, Schumacher.

Gari elliptica, n. sp.

Pl. i., figs. 7, 8.

1901. *Tatella maranoana,* Etheridge, Jr., Geol. Surv. Q'land, Bull. 13, pl. ii., fig. 8 (only).
1902. *Tatella maranoana,* Etheridge, Jr., Mem. Roy. Soc. S. Austr., ii. (1), pl. ii., fig. 25 (only).

Sp. chars. Shell elongated, length nearly twice the height, inequilateral, equivalve. Outline forming a regular subelliptical curve only very slightly modified in the umbonal regions. Ornamentation by growth striae. Umbones insignificant, pressed close together. Anterior adductor scar deeply impressed and bounded by radial ridges; posterior scar of normal impress. Anterior scar linguiform, narrowing dorsally, with a concave semicircular dorsal boundary. Posterior scar subcircular with a long, narrow, rather deeply impressed attenuation towards the umbo. Pallial sinus large, extending more than half the length of the shell, and with a linear postero-dorsal extension. Hinge-line strengthened by a small medial umbonal thickening.

Remarks. In all features—shape, ornamentation, shape and size of muscle scars, type of pallial sinus, internal anterior radial ridges and small umbonal thickening of the hinge-line—this species agrees perfectly with *Gari,* Schum. (=*Psammobia,* Lam.). Further, there is an indication on the internal mould, figured herewith, that the left valve had one small cardinal tooth fitting between two teeth of the right valve of precisely similar type to the normal *Gari* dentition.

There seems to be not the slightest doubt that the species is a typical *Gari,* and this is of importance since, although many other Cretaceous species have been referred to this genus, their claim to such a place has in no case been definitely established. Until the generic positions of such species are determined it is useless to make comparisons, though it may be pointed out that the Uitenhage, *G. (?) atherstoni,* (Sharpe)[35] which certainly has a strong claim to the genus, is rather similar to *G. elliptica.*

(33) Etheridge, *loc. cit.*, 1892, p. 481; and 1902, (S. Austr.), p. 36.

(34) Etheridge, *loc. cit.*, 1902 (N.S. Wales), p. 28.

(35) Sharpe, *loc cit.* (1856), p. 196, pl. xxii., fig. 11.

As holotype may be taken the specimen figured by Etheridge [36] in 1901.

A glance at the various figures published by Etheridge as *Tatella maranoana* will show that several distinct types have been included under that name. The figure of the holotype, described as *Corbicella (?) maranoana*, Eth. fil.,[37] shows a well-preserved exterior. The other specimen figured under that name in the same volume (pl. xxviii., figs. 2 and 3) is an internal cast, and it is hard to believe that the two are specifically identical. Figures published by Etheridge, in later works, show other different forms covered by the same name. An examination of the present collection has shown that, at least, two genera are included.

The figures published by Etheridge fall into five groups, thus:—

1. Geol. Pal. Q'land (1892), pl. xxvii., figs. 4, 5; *Tatella maranoana* (Eth. fil.).
2. Geol. Pal. Q'land (1892), pl. xxviii., figs. 2, 3; *T.* sp.
3. Q'land Geol. Surv., Bull. 13 (1901), pl. i., fig. 5; *T. (?) aptiana*, n. sp. Q'land Geol. Surv., Bull. 13 (1901), pl. iii., fig. 4. Mem. Roy. Soc. S. Austr. (1902), II. (1), pl. iii., figs. 28, 29.
4. Q'land Geol. Surv., Bull. 13 (1901), pl. ii., fig. 8; *Gari elliptica*, n. sp. Mem. Roy. Soc. S. Austr., II. (1), (1902), pl. ii., fig. 25.
5. Mem. Roy. Soc. S. Austr., II. (1), (1902), pl. ii., fig. 26; *G. (?)* sp.

Genus TATELLA, Etheridge, Jr.

Tatella (?) aptiana, n. sp.

Pl. i., figs. 9, 10.

1901. *Tatella maranoana*, Etheridge, Jr., Q'land Geol. Surv., Bull. 13, pl. i., fig. 5, pl. iii., fig. 4 (only).

1902. *Tatella maranoana*, Etheridge, Jr., Mem. Roy. Soc. S. Austr., ii. (1), pl. iii., figs. 28, 29 (only).

Sp. chars. Shell, thin elongated, subequilateral, equivalve; slightly gaping anteriorly and posteriorly. Dorsal margin almost straight; ventral margin slightly but regularly convex. Surface smooth. Hinge-line with two simple strong cardinal teeth in the right valve and one tooth in the left which fits in between the two former. A small posterior lateral is also present. Posterior cardinal of the right valve larger than the anterior. Hinge-line strengthened by a medial umbonal thickening which gives a bifid appearance to the internal mould of the umbones. Adductor scars subequal; the anterior scar linguiform truncated dorsally; posterior scar drop-shaped attenuated towards the umbo.

As holotype may be taken the specimen figured by Etheridge [38] in 1902.

Remarks. As mentioned above this species must be separated from *T. maranoana*, Eth. fil., and there is a possibility that it may even be generically distinct. The species may be closely compared with *Gari elliptica*. The type of dentition, the details of the muscle scars, the internal anterior ridge, and the thickening of the hinge-plate are similar. Generic differences occur in the shallow pallial sinus and the much more massive teeth. It seems probable, therefore, that *Tatella*, at least as represented by *T. (?) aptiana*, is an offshoot from *Gari*, or *vice versa*. The Middle Jurassic *Quenstedtia* is also very similar; but no species of the latter are known in Upper Jurassic or later beds.

(36) Etheridge, Jr., Geol. Surv. Q'land, Bull. 13, 1901, pl. ii., fig. 8.

(37) Etheridge, Jr., *loc. cit.* (1892), pl. xxvii., figs. 4, 5.

(38) Etheridge, Jr., *loc. cit.*, S. Austr., 1902, pl. iii., figs. 28, 29.

Genus PANOPE, Menard.

PANOPE (?) sp. ind.

Pl. i., fig. 11.

Several specimens are probably referable to *Panope*. One specimen shows, on an internal cast of the umbones, a single central tooth in each valve. There is always considerable difficulty in deciding between such genera as *Panope, Pleuromya, Homomya,* etc., although the recent summaries of Bender[39] have helped to lessen the difficulty.

Gen. et. sp. nov.

Pl. i., fig. 6.

There is one specimen of a genus allied to *Fissilunula,* Eth. fil. It has the same type of shell and the peculiar trisected "lunule," while the ligament groove, nymph and raised marginal thickening of the hinge are also very similar. The genus is, however, edentulous (unless there should be any teeth on the extreme anterior portion of the hinge which is not preserved in this specimen). While the cardinal margin in *Fissilunula* is closed, in this genus there is a large gape similar to the pedal gape in the modern *Tridacna,* where, on account of the anomalous orientation of the animal within the shell, the foot is protruded through the cardinal margin. A cardinal gape may also be seen, *e.g.,* in the Jurassic vulsellid genus *Heligmus;* but in that case it is probably of different significance (a byssal gape). Unfortunately, muscle scars and the shape of the shell are unknown at present, so that a complete generic diagnosis must be postponed until other specimens are known.

Genus NATICA.

Subgenus LUNATIA, Gray.

NATICA (LUNATIA) VARIABILIS, Moore.

Pl. i., fig. 12.

1870. *Natica variabilis,* Moore, Q.J.G.S., xxvi.. p. 256, pl. x., fig. 15.

1915. *Euspira variabilis,* Newton, Proc. Malac. Soc., vol. xi., p. 232, pl. vi., figs. 20-23.

1920. *(Pseudamaura* or *Ampullina) variabilis,* Etheridge, Jr., Q'land Geol. Surv. Pub. 269, p. 12, pl. ii., figs. 39, 41.

This well-known species, abundant in the collection, has been referred by various authors to *Delphinula, Pseudamaura, Ampullina,* and *Euspira. Delphinula,* which is not a member of the *Naticidae,* is ineligible. The reflection of the inner lip, only above the umbilicus, removes it from *Pseudamaura,* and there is no smooth umbilical band as in *Ampullina.* The spire is not so high as in *Euspira,* which, in addition, has no reflection of the inner lip. The features, however, agree entirely with *Lunatia,* Gray, to which subgenus it is here referred.

Of allied species the most similar is perhaps *N. (L.) puerrydonensis,* Stanton,[40] from the Lower Cretaceous (possibly infra-valanginian) of Patagonia, though the Albian *N. rauliniana,* d'Orb., is also similar.[41]

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(39) Bender, Zeit. d. Deutsch. Geol. Gesell., vol. 73 (1922), pp. 24-112.

(40) T. W. Stanton, Rep. Princetown Univ. Exped. to Patagonia, 1901, vol. iv., p. 32, pl. vi., fig. 12.

(41) d'Orbigny, Pal. France. Terr. Cret., vol. ii., p. 160, pl. clxxiv., fig. 1.

Genus VANIKOROPSIS, Meek.

VANIKOROPSIS (?) STUARTI, Etheridge, Jr.

1902. *Vanikoropsis (?) stuarti,* Etheridge, Jr., Mem. Roy. Soc. S. Austr., ii. (1), p. 42, pl. vi., figs. 18-20.

Only one specimen, imperfectly preserved, is in the collection. The generic determination of the species is still uncertain since the aperture is imperfectly known.

Genus DENTALIUM, Linnaeus.

DENTALIUM WOLLUMBILLAENSIS, Etheridge, Jr.

1870. *Dentalium lineatum,* Moore (non Guér.), Q.J.G.S., vol. xxvi., p. 256.

1892. *Dentalium wollumbillaensis,* Etheridge, Jr., Geol. Pal. Q'land, p. 483.

Several broken fragments of this species are present.

Genus DIMITOBELUS, Whitehouse.

DIMITOBELUS CANHAMI (Tate).

Pl. ii., figs. 1-7, 9-11.

1870. *Belemnites australis,* Phillips (pars), Q.J.G.S., vol. xxvi., pl. xvi., figs. 3, 4 (only).

1879. *Belemnites canhani,* Tate, Trans. Phil. Soc. S. Austr. (1878), vol. ii., p. 1.

1924. *Dimitobelus canhami,* Whitehouse, Geol. Mag., vol. lxi., p. 412, text figs. 2, 3.

Sp. chars. Guard clavate, flattened in a dorso-ventral direction. Lateral lines not in the centre of the sides but curving on the ventro-lateral portion. These lines may give place anteriorly to a single dorso-lateral groove, or else to a pair of diverging grooves.(42) Pseudal velous with axial projection generally developed.

Remarks. The species is allied to the *D. superstes* (Hector) of New Zealand (U. Albian), the only extra-Australian species known. That species, however, is more cylindrical, and apparently never has the diverging anterior grooves. Pseudal velous and axial projection developed.
Queensland the species is associated with *Prohysteroceras, Inflaticeras,* and other Upper Albian genera.

Dimitobelus stimulus, n. sp.(43)

Pl. ii., figs. 8, 12-17.

Sp. chars. Guard only very slightly clavate, slightly flattened in a dorso-ventral direction. Lateral lines straight and in the centre of the sides. These lines may give place anteriorly to either a single groove or to a pair of diverging grooves. Pseudal veolus and axial projection developed.

Remarks. This species differs from *D. canhami* in two respects: the guard is less clavate in form and the lateral lines are straight and central. It is very closely related to that species and, like it, generally develops diverging dorso-lateral and ventro-lateral grooves. Both *D. canhami* and *D. stimulus* are represented by a very large number of specimens.

Dimitobelus stimulus, var. **extremis,** n. var.

Pl. ii., figs. 18-20.

This name is proposed for the longer and more cylindrical forms of *D. stimulus.* It is almost equidimensional, though a slight dorso-ventral flattening is still apparent. The lateral lines are straight and strictly central, as in

(42) See Whitehouse, Geol. Mag., vol. lxi., 1924, p. 412, figs. 2, 3.

(43) Referred to previously (Whitehouse, *loc. cit.,* p. 412).

D. stimulus proper. The writer had previously[44] regarded it as a distinct species, but it is probably more correct to regard it merely as a variety of *D. stimulus.*

In conclusion, the writer wishes to thank Prof. J. W. Gregory and the University of Glasgow for the loan of the collection, the University of Queensland and the Sedgwick Museum (Cambridge) for facilities for carrying out the examination, and the British (Natural History) and Bath Museums for permission to examine the Hudlestone and Moore collections, respectively.

DESCRIPTION OF PLATES I. AND II.

(All figures natural size.)

PLATE I.

Figs. 1-3. *Pseudavicula anomala* (Moore). 1. Artificial cast of the external mould of a young specimen (left valve). 2. Hinge-line of a left valve showing long posterior ligament pit. 3. Artificial cast from the umbo of an external mould (right valve) showing the slight flexing of the cardinal margin, giving a rudimentary type of articulation.

Fig. 4. *Modiola cupula,* n. sp. Artificial cast of the external mould of a right valve.

Fig. 5. *Thracia primula,* Hudl. Left valve.

Fig. 6. Gen. et. n. sp. View of right valve from above showing trisected lunule, nymph, posterior ligament pit and "dorsal" gape.

Figs. 7, 8. *Gari elliptica,* n. sp. 7. Internal mould (right valve) showing muscle scars, impression of anterior radial ridge, and pallial sinus with the linear ventral extension. 8. Left valve with shell partly preserved. Impression of anterior radial ridge visible.

Figs. 9, 10. *Tatella (?) aptiana,* n. sp. 9. Internal mould showing "bisected" appearance of umbonal region, muscle scars, impression of anterior radial ridge and shallow pallial sinus. 10. Artificial cast of hinge-line from an internal mould (right valve) showing two cardinal and one lateral teeth and median umbonal thickening.

Fig. 11. *Panope (?)* sp. ind. Artificial cast of hinge-line from an internal mould.

Fig. 12. *Natica (Lunatia) variabilis,* Moore. Specimen showing portion of reflected inner lip above the umbilicus.

PLATE II.

Figs. 1-7, 9-11. *Dimitobelus canhami* (Tate). 1-7. Ventral view of specimens in different stages of growth (fig. 7, of a form transitional to *D. stimulus).* 10. Showing early stage in formation of axial projection. 9. Lateral view of specimen. 10. Showing divergent grooves. 11 *a, b, c.* Same specimen as fig. 4. 11 *b.* Showing curving lateral lines. 11 *c.* View from above showing axial projection.

Figs. 8, 12-17. *Dimitobelus stimulus,* n. sp. 8. Showing early stage in formation of axial projection. 12-16. Ventral views of specimens in varying stages of growth. 14. Holotype refigured in fig. 17 *a, b.* 17 *b.* Lateral view showing central and straight lateral lines.

Figs. 18-20. *Dimitobelus stimulus,* var. *extremis,* nov. Ventral views.

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(44) Whitehouse, *loc. cit.,* p. 412. The name was then incorrectly printed as *extremus.*

NEW AUSTRALIAN LEPIDOPTERA.

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

[Read November 13, 1924.]

Family NOCTUIDAE.

Canthylidia crocopepla, n. sp.

κροκοπεπλος, clothed in saffron.

♂, ♀, 22-24 mm. Head, palpi, antennae, and thorax ochreous-whitish. Abdomen and legs pale ochreous. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen slightly bowed, oblique, ochreous-whitish; markings reddish-orange; a transverse sub-basal fascia; a second fascia at $\frac{1}{4}$, constricted on costa, dilated beneath costa; a third fascia from midcosta to dorsum beyond middle; a finely dentate line from costa beyond this joining third fascia below middle; a narrow subterminal fascia; cilia ochreous-whitish; hindwings with termen slightly indented above middle; ochreous-whitish; a suffused fuscous terminal band more or less developed; cilia ochreous-whitish.

North-West Australia: Kimberley, two specimens received from Mr. L. J. Newman.

Dasygaster oressigenes, n. sp.

ὀρεσσιγενης, mountain-born.

♂, ♀, 36-40 mm. Head and thorax fuscous with sparse grey-whitish irroration; face whitish with a blackish transverse median bar. Palpi whitish irrorated with dark fuscous. Antennae grey; in male bipectinate, pectinations 2. Abdomen and legs dark grey. Forewings elongate-triangular, costa straight, apex round-pointed, termen scarcely oblique, rounded beneath, fuscous obscurely irrorated with whitish; costal edge whitish; a sub-basal fuscous line to fold, twice dentate; antemedian from $\frac{1}{3}$ costa to midtermen, whitish doubly edged with fuscous, strongly dentate, containing a longitudinally elongate brownish-ochreous spot in middle, connected by a fuscous line on fold with sub-basal line; orbicular small, brownish-ochreous outlined with dark fuscous; reniform similar but larger, transversely oval, with a white dot at its lower, and sometimes another at its upper extremity; postmedian line from a fuscous dot on $\frac{3}{5}$ costa, fuscous, edged posteriorly with whitish, bent outwards beneath costa, then finely dentate and bent to end on midtermen joining antemedian, it contains several brownish-ochreous dots; a dark subterminal shade containing short interneural dark-fuscous lines, sharply limited posteriorly, with obtuse projections above and below middle; terminal fascia grey-whitish irrorated with fuscous, with an anterior series of brownish-ochreous and a posterior series of blackish dots, both interneural; cilia fuscous. Hindwings dark grey; cilia grey, apices whitish.

New South Wales: Mount Kosciusko, in December; four specimens received from Mr. G. M. Goldfinch. Type in Coll. Goldfinch.

Dasygaster melambaphes, n. sp.

μελαμβαφης, dark-dyed.

♀, 38 mm. Head and thorax fuscous with slight whitish irroration; face whitish with a transverse fuscous bar above middle. Palpi $1\frac{1}{4}$; fuscous mixed with whitish. Antennae fuscous. Abdomen grey. Legs grey; tarsi fuscous with whitish annulations. Forewings elongate-triangular, costa nearly straight, apex round-pointed; termen scarcely oblique, rounded beneath, crenulate; fuscous with slight whitish irroration; a sub-basal blackish costal dot; a short blackish median streak from base; orbicular pale, longitudinally oval, reniform larger, transversely oval, both outlined and connected by blackish, the latter followed by a blackish spot; claviform represented by a short thick blackish bar, connected by a twice dentate line from its anterior end with dorsum before middle; postmedian line very slender and obscure, blackish, finely dentate; four or five minute whitish dots on posterior half of costa, posterior area with a series of blackish interneural streaks connected with a terminal series of blackish dots; cilia fuscous, extreme apices partly whitish. Hindwings with termen sinuate, crenulate; fuscous, towards base paler; cilia grey, apices whitish.

There are no coloured scales, and no subterminal line.

New South Wales: Mount Kosciusko (4,000 feet), in March; one specimen. Type in Coll. Goldfinch.

Euryschema, n. gen.

εὐρυσχημος, broadly built.

Tongue strong. Palpi moderate, ascending; second joint rough-scaled anteriorly; terminal joint short. Thorax with slight rounded anterior and small bifid posterior crests. Abdomen with a dorsal crest on basal segment. Forewings rather short and broad; neuration normal. Hindwings broad; 5 weakly developed from middle of discocellulars. Posterior tibiae hairy on dorsum.

Near *Syntheta,* Turn., but hindwings with 5 from middle of cell and both wings shorter and broader.

Euryschema tricycla, n. sp.

τρικυκλος, three-ringed.

♀, 32 mm. Head whitish with a few fuscous scales; face with a median, transverse, blackish bar. Palpi whitish with some dark-fuscous irroration. Thorax whitish; collar and an inverted, V-shaped, posterior mark fuscous. Abdomen grey. Legs mostly fuscous; tarsi annulated with ochreous-whitish. Forewings triangular, costa gently arched, apex round-pointed, termen scarcely oblique, rounded beneath; grey, towards base whitish, with dark-fuscous markings, two short oblique lines from costa near base; antemedian from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, slender, dentate, with a strong posterior tooth beneath costa; orbicular circular, rather large, beneath it a similar circle, rather smaller, incomplete anteriorly; reniform transversely oval, filled in with white; a broad median shade, well defined, from midcosta to $\frac{2}{3}$ dorsum, between and touching both orbicular and reniform, angled posteriorly in middle; a suffused dark spot beyond reniform nearly confluent with a similar apical mark; a white costal spot beyond middle followed by several white dots; postmedian mostly obsolete, faintly indicated below middle; an ill-defined subterminal line; three or four short longitudinal streaks running into upper part of termen; a fine terminal line with a larger dot above dorsum; cilia whitish and fuscous with a darker median line. Hindwings grey; cilia grey, apices paler.

Queensland: Toowoomba, in February; one specimen received from Mr. W. B. Barnard.

Bathytricha monticola, n. sp.

monticolus, mountain-dwelling.

♂, 25 mm. Head and thorax brownish. Palpi $1\frac{1}{4}$; dark fuscous mixed with brown-whitish. Antennae brown-whitish; pectinations in male 1. Abdomen and legs whitish-brown. Forewings elongate triangular, costa nearly straight, apex rounded, termen obliquely rounded; brown-whitish with obscure fuscous streaks on veins; a streak from base beneath cell, ending in four streaks on veins; four streaks also on radial veins; a terminal series of interneural fuscous dots; cilia brown-whitish. Hindwings with termen scarcely sinuate; pale grey; cilia ochreous-whitish.

New South Wales: Mount Kosciusko, in December; one specimen. Type in Coll. Goldfinch.

Caradrina niphosticta, n. sp.

νιφοστικτος, snow-spotted.

♂, 28-32 mm. Head and thorax brownish mixed with fuscous. Palpi dark fuscous; terminal joint and apex of second joint whitish-ochreous. Antennae in male slightly serrate towards apex, ciliations $\frac{1}{2}$, fuscous. Abdomen fuscous-brown. Legs fuscous-brown. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen scarcely oblique, rounded beneath; fuscous-brown; with obscure slender fuscous markings and white spots; a short sub-basal line from costa, sometimes followed by a minute white dot; antemedian very slender, transverse, dentate, from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, just crossed by a fine streak from base along fold; sometimes this streak contains a white dot just beyond antemedian; orbicular circular, filled in with white; reniform white, obscurely K-shaped; postmedian very slender, slightly dentate, from midcosta obliquely outwards, then rounded to $\frac{2}{3}$ dorsum; some obscure longitudinal streaks interrupted by paler scales in terminal area; cilia fuscous-brown. Hindwings grey; cilia grey, apices paler.

Allied to *C. leucosticta*, Turn., and *C. adelphodes*, Low. The former differs in the white-spotted termen of forewings, the latter in the white hindwings.

New South Wales: Jervis Bay, in August and March; two specimens received from Mr. L. H. Moss-Robinson.

Caradrina leptochroa, n. sp.

λεπτοχροος, slightly coloured.

♂, 36 mm. Head and thorax ochreous-grey-whitish. Palpi dark fuscous, towards apex ochreous-whitish. Antennae fuscous. Abdomen ochreous-grey-whitish with slight grey irroration. Legs ochreous-grey-whitish; tarsi fuscous with pale annulations. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen scarcely oblique; rounded beneath; ochreous-grey-whitish, posterior part of disc very slightly reddish tinged; a fuscous dot on costa near base; three fuscous dots representing first line, on costa, above middle, and above dorsum; orbicular represented by a white dot, reniform by two very short transverse white streaks; a line of fuscous dots from costa at $\frac{2}{3}$, at first outwards, then nearly transverse to $\frac{2}{3}$ dorsum; an interneural series of fuscous dots close to termen; a terminal series of fuscous dots on veins; cilia ochreous-grey-whitish, bases fuscous. Hindwings with termen scarcely sinuate; whitish suffused with fuscous except towards base; cilia whitish with an interrupted fuscous line in apical part of wing. Underside of hindwing with discal dot, an apical blotch, and a subterminal series of dots fuscous.

New South Wales: Sydney, in February; one specimen. Type in Coll. Goldfinch.

Araeoptera poliobapta, n. sp.

πολιοβαπτος, dyed grey.

♀, 14 mm. Head white; face dark fuscous. Palpi smooth; terminal joint $\frac{1}{3}$; fuscous. Antennae grey, towards base white. Thorax grey, anteriorly suffused with white. Abdomen dark grey. Legs grey-whitish. Forewings elongate-triangular, costa moderately arched, apex round-pointed, termen bowed, strongly oblique; grey; costal half white, except about middle, where the grey area forms a strong rounded projection nearly to costa; fuscous dots on costa at $\frac{1}{8}$ and $\frac{1}{4}$, a larger fuscous spot at middle with central white dot, four grey costal dots between this and apex; a very obscure, incomplete, dentate, fuscous, transverse line at $\frac{1}{4}$; an obscure fuscous ring in anterior part of central grey projection; two irregular, suffused, subapical, grey spots; an interrupted fuscous terminal line; cilia grey. Hindwings with apex round-pointed, termen slightly incurved; grey; cilia grey.

The smooth second joint of palpi, and shape of hindwings are noteworthy points.

Queensland: Montville (1,500 feet), near Nambour, in March; one specimen.

Catoblemma aplecta, Turn.

♂, ♀, 20-24 mm. Head whitish-grey. Palpi $2\frac{1}{2}$; grey more or less tinged with ferruginous. Thorax whitish-grey; collar ferruginous. Abdomen and legs whitish-grey. Forewings triangular, costa nearly straight, slightly sinuate towards apex, apex pointed, termen bowed, slightly oblique; whitish-grey more or less suffused with ferruginous; costal edge ferruginous; a small triangular white spot on costa just before apex, followed by a short, oblique, blackish streak from apex, followed by a short series of blackish subterminal dots; cilia ferruginous, apices pale grey. Hindwings and cilia grey.

I have redescribed this species as the original description was incomplete, owing to the imperfect condition of the type. I have since taken the species frequently at light in my own house and have received others bred from larvae feeding on the scale-insect *Lecanium (Cryptes) baccatum* in Sydney by Mr. W. B. Gurney, and in Brisbane by Mr. H. Hacker.

Queensland: Gympie, in April; Brisbane, in September, October, March, April, and May; Warwick, in October. New South Wales: Sydney, in November.

Sophta hapalopis, n. sp.

ἁπαλωπις, gentle-looking.

♂, 21-24 mm. Head and thorax ochreous-grey. Palpi $1\frac{1}{2}$; ochreous-grey with slight fuscous irroration. Antennae grey; ciliations $\frac{2}{3}$. Abdomen ochreous-grey with slight fuscous irroration. Legs ochreous-whitish. Forewings triangular, costa nearly straight, apex pointed, termen angled on vein 4, slightly excavated above angulation, slightly excavated and oblique below; pale ochreous-grey with a few fuscous scales; a darker median band, broad on costa, where it extends from $\frac{1}{3}$ to $\frac{2}{3}$, much narrower on dorsum; anterior edge narrowly dark fuscous, nearly straight, from $\frac{1}{3}$ costa to mid-dorsum; posterior edge distinct, from costa obliquely outwards, then transverse, then inwardly oblique, to $\frac{2}{3}$ dorsum, in the projection thus formed is a transversely-oval fuscous ring containing two dark-fuscous dots, but in a second example wholly dark fuscous; two suffused, faint-grey lines between median band and termen; a submarginal series of fuscous dots; cilia grey. Hindwings as forewings, but median band broad on dorsum, rapidly narrowing, suffused and disappearing in disc, and without discal ring.

Western Australia: Busselton, in October; two specimens, of which one is in Coll. Goldfinch.

Parallelia simillima, Gn.

Ophiusa simillima, Gn., Noct., iii., p. 266.

Dysgonia simillima, Moore, Lep. Ceyl., iii., p. 178, pl. 170, f. 8.

Parallelia simillima, Hmps., Cat. Lep. Phal., xii., p. 607.

North Queensland: Kuranda, in March; one specimen received from Mr. F. P. Dodd. Also from Java, Philippines, Formosa, Ceylon, and India. Not previously recorded from Australia.

Grammodes odontota, n. sp.

ὀδοντωτος, toothed.

♀, 34 mm. Head, thorax, and antennae grey. Palpi whitish irrorated with grey. Abdomen grey. Legs whitish irrorated with grey. Forewings triangular, costa straight to near apex, apex round-pointed, termen slightly bowed, oblique, slightly crenulate; fuscous with some whitish irroration beneath costa and in terminal area; a grey-whitish patch on base of dorsum; a broad straight white fascia from $\frac{1}{3}$ costa to dorsum before middle, slightly dilated on costa and dorsum, irrorated with fuscous on costa; a slender white fascia from $\frac{2}{3}$ costa, at first obliquely outwards, bent inwards beneath costa and thence nearly straight, but slightly bent inwards at extremity to $\frac{2}{3}$ dorsum, gradually narrowing to a line as it approaches dorsum, with a sharp anterior tooth on vein 3; this is succeeded by a greyish-ochreous line, and this again by a series of posterior blackish teeth, varying in size and sometimes tipped with whitish; a blackish, subapical, costal blotch, anteriorly suffused, defined posteriorly by a whitish line; a short, oblique, wedge-shaped blackish mark from apex; subterminal area partly suffused with whitish so as to appear grey; cilia fuscous with basal and postmedian whitish lines, around apex wholly white. Hindwings with termen gently rounded, slightly waved; fuscous; a white fascia from costa before middle, gradually narrowing to dorsum above tornus; a white submarginal spot above dorsum near tornus; cilia white, on dorsum and for a short distance on midtermen fuscous.

Nearest *G. quaesita*, Swin., but easily distinguished by the anterior tooth on postmedian line.

Western Australia: Perth, one specimen received from Mr. L. J. Newman.

Family SPHINGIDAE.

Macroglossum dohertyi, Roths.

Novitates Zoologicae, 1894, p. 67, pl. v., f. 2, Roths. and Jord., Revision Sphingidae, p. 648.

This species is easily recognised by the presence of a narrow, white, median, transverse fascia and a white subterminal line on forewings.

North Queensland: Prince of Wales Island, Torres Straits, and Cape York, in June and July (H. Elgner); two specimens received from Mr. Geo. Lyell. Also from New Guinea and Amboyna.

Macroglossum stenoxanthum, n. sp.

στενοξανθος, narrowly yellow.

♂, ♀, 58-60 mm. Head and thorax tawny-fuscous. Palpi tawny-fuscous; beneath whitish with a few fuscous scales. Antennae fuscous. Abdomen tawny-fuscous; orange-ochreous spots on lateral surface of 2nd, 3rd, and 4th segments; apices of lateral tufts orange-ochreous; apical tuft fuscous with a few ochreous scales; under-surface wholly pale ochreous mixed with ochreous-brown. Legs tawny-fuscous or brown; anterior coxae whitish-ochreous with a few fuscous scales. Forewings elongate-triangular, costa straight, towards apex gently arched, apex pointed, termen slightly bowed, oblique; dark tawny-fuscous; basal area dark, sharply defined by a straight transverse line from $\frac{1}{3}$ costa to dorsum shortly before middle; beyond this is a paler grey transverse fascia, limited posteriorly by a dark-fuscous sinuate line from midcosta to $\frac{2}{3}$ dorsum; a dark-fuscous transverse shade shortly beyond and parallel to this line; a paler grey transverse shade from $\frac{3}{4}$ costa gradually broadening to lower half of termen and tornus; cilia tawny-fuscous. Hindwings with tornus prominent, termen sinuate; blackish; a rather suffused and rather narrow orange fascia from tornus towards costa before middle, narrowly interrupted at middle and above tornus, its posterior edge nearly straight; dorsal edge orange, cilia blackish, on dorsum partly orange. Underside tawny-fuscous; hindwings with a basal suffusion and a subdorsal blotch orange, and with three ill-defined darker fuscous transverse lines.

Nearest *M. meeki,* R. and J., from New Guinea, but forewings with a subterminal grey shade, without broad blackish subterminal band, hindwings with posterior edge of orange band straight, abdomen without white spots on dorsum of third segment, etc.

North Queensland: Kuranda, near Cairns, in January; two specimens received from Mr. F. P. Dodd. Type in Coll. Lyell.

Family EPIPLEMIDAE.

CHUNDANA LUGUBRIS, Wlk.

C. phaeospila, Turn., Trans. Roy. Soc. S. Austr., 1914, p. 247, is a synonym. There is some variability in the development of the markings of this species.

Northern Territory: Melville Island. North Queensland: Cooktown, Cairns. Also from New Guinea and Borneo.

Family CRAMBIDAE.

Talis diargyra, n. sp.

διαργυρος, silvery right through.

♀, 29 mm. Head and thorax greyish-ochreous. Palpi long (6); grey, lower edge whitish. Antennae fuscous, near base whitish. Abdomen whitish-grey. Legs whitish-grey; anterior pair ochreous-tinged. Forewings narrow, costa straight to near apex, apex pointed, termen slightly sinuate, slightly oblique; 4 and 5 separate; greyish-ochreous; a silvery-white subcostal streak, edged beneath with fuscous, from $\frac{1}{3}$ to near apex; a broader median streak, edged above and beneath with fuscous, from base to beneath end of cell, there deflected parallel to vein 4, not reaching transverse line; a short streak above this from end of cell, parallel to vein 5; an inwardly oblique white streak, edged anteriorly with fuscous, from apex half across disc, there much narrowed and continued as a fine line of white and fuscous scales parallel to termen, ending at tornus; a black dot on tornus and two short black lines running into termen above tornus; a fine fuscous line on termen beneath apex; cilia grey with bases white and a fuscous sub-basal line, on tornus and dorsum wholly grey. Hindwings with 4 and 5 stalked; pale grey; cilia whitish, with pale grey sub-basal line.

Western Australia: Perth, one specimen.

Talis urithrepta, n. sp.

οὐριθρεπτος, mountain-bred.

♂, 34 mm. Head and thorax pale ochreous-grey. Palpi long (5); grey, towards base beneath white. Antennae fuscous; slightly serrate, shortly ciliated ($\frac{1}{3}$). Abdomen pale grey. Legs grey. Forewings elongate-triangular, costa straight, apex pointed, termen sinuate, oblique; 4 and 5 separate; pale ochreous-grey; markings white; a broad subcostal streak in cell, interrupted in middle; a streak from base running beneath cell, then deflected towards tornus, where it joins terminal band; a suffused streak along dorsum; a broad terminal band bisected by a suffused line of ground-colour, but becoming single and much narrower towards apex; terminal edge grey; cilia grey-whitish with a faintly darker sub-basal line. Hindwings with 4 and 5 separate; grey; cilia as forewings.

New South Wales: Mount Kosciusko (6,000 feet), in January; one specimen.

Gen. Tauroscopa, Meyr.

Frons not projecting. Tongue present. Palpi moderately long, porrect, densely clothed with very long hairs beneath; terminal joint concealed in hairs. Maxillary palpi well developed, ending in a dense tuft of long hairs. Thorax and coxae with dense rough hairs beneath. Forewings with 7 separate, 8 and 9 stalked. Hindwings with 4 and 5 separate, connate, or stalked, 6 remote from 7 at origin, 7 anastomosing shortly with 8.

Type *T. gorgopis,* Meyr., from New Zealand. *Oressaula,* Turn., is a synonym. It is related to *Talis,* differing in the great hairiness of palpi and underside, and is represented by several species in New Zealand. Its occurrence on Mount Kosciusko, where it is represented by two species, is an interesting discovery. The genus should be found also on the Tasmanian mountains.

Tauroscopa lachnaea, Turn.

♂. Antennae with paired tufts of long cilia (2). This character is exceptional in the genus.

New South Wales: Mount Kosciusko (5-7,000 feet). Victoria: Mount Hotham (6,000 feet).

Tauroscopa callixutha, n. sp.

καλλιξουθος, beautifully tawny.

♂, ♀, 20-22 mm. Head, palpi, thorax, and abdomen dark fuscous with a few scattered ochreous-yellow scales. Antennae dark fuscous; in male serrate and shortly ciliated ($\frac{1}{2}$). Legs fuscous. Forewings triangular, costa straight, apex round-pointed, termen slightly bowed, slightly oblique; dark fuscous with ochreous irroration and markings; an ochreous basal patch mixed with dark fuscous; a discal spot beneath $\frac{2}{5}$ costa, preceded and followed by interrupted transverse lines, the latter outwardly curved; a fine suffused transverse line, preceded by a dark-fuscous line, from $\frac{4}{5}$ costa, first outwardly curved, then parallel to termen to tornus; a terminal series of dots; cilia fuscous with some whitish scales. Hindwings with termen rounded; ochreous-yellow with some fuscous irroration; costal and dorsal areas and a terminal band mostly fuscous; cilia as forewings.

New South Wales: Mount Kosciusko (5,000 feet), in December; eight specimens received from Mr. G. M. Goldfinch. Type in Coll. Goldfinch.

Family PYRALIDAE.

Endotricha heliopa, Meyr.

E. pyrocaustalis, Low., is a synonym. In colouration it is very similar to *E. pyrosalis,* Gn., but Meyrick clearly indicates the difference between the two species. Hampson identifies this with *E. stilbealis,* Wlk., represented by a female type in the British Museum, but this is doubtful. I think *stilbealis* is probably the same as *pyrosalis.*

Queensland: Brisbane. New South Wales: Sydney, Jervis Bay.

Endotricha desmotona, Low.

Mr. W. B. Barnard has sent me one of each sex taken at Toowoomba, Queensland. They differ from North Queensland and Northern Territory examples in the wings being fuscous, not reddish. Otherwise they are identical, and at most represent a local race. Probably further captures will show intermediates.

Trychnocrana, n. gen.

τρυχνοκρανος, rough-headed.

Tongue strongly developed. Labial palpi long, ascending, exceeding vertex; second joint rough-scaled anteriorly; terminal joint as long and stout as second. Maxillary palpi short, filiform. Head and face rough-scaled. Outer tibial spurs about $\frac{2}{3}$ length of inner spurs. Forewings with 2 from shortly before angle, 3, 4, and 5 approximated from angle, 6 from upper angle, diverging widely from 7, 7 and 8 long-stalked, 9 absent (coincident with 8), 10 from shortly before end of cell, free, 11 from $\frac{3}{4}$, free. Hindwings with 2 from $\frac{3}{4}$, 3 from angle closely approximated to 4, 4 and 5 stalked, 6 and 7 stalked, 7 anastomosing with 12.

Very exceptional in the loss of vein 9 of forewings. It appears to be nearest *Gauna*, Wlk., and *Curena*, Wlk., which are, I think, congeneric.

Trychnocrana abditiva, n. sp.

abditivus, remote, separate.

♀, 26 mm. Head yellow. Labial palpi yellow; basal joint fuscous and white; second joint whitish at base; terminal joint whitish at base and apex. Antennae fuscous annulated with whitish. Thorax fuscous; bases of shoulder-lappets, two anterior, two postmedian, and one posterior spot white. Abdomen grey; a pair of white spots on dorsum of each of first two segments. Legs dark fuscous annulated with white; middle and posterior femora and tibiae mostly white. Forewings elongate-triangular, costa gently arched, apex rounded, termen bowed, oblique; white; markings fuscous; a fine line on costal edge to middle; basal and sub-basal spots; subcostal spots at $\frac{1}{6}$ and middle; dorsum broadly fuscous, its upper edge very irregular, indented before middle, included white spots above dorsum near base, on dorsum at middle and before tornus; a yellowish, triangular costal mark at $\frac{1}{3}$, continuous with a triangular extension of dorsal fuscous area, containing a white dot near its apex; a dark-fuscous median discal spot, shortly beyond second subcostal spot; a suffused fuscous line from $\frac{4}{5}$ costa narrowly connected with an extension of dorsal area, separated by a white line from a small apical blotch; a terminal series of dark-fuscous dots; cilia grey with white bases and an antemedian fuscous line, but almost wholly white towards apex of forewing. Hindwings and cilia pale-grey.

Queensland: National Park (2,500 feet), in December; one specimen.

Amphiderita, n. gen.

ἀμφδηριτος, disputed, doubtful.

Tongue strongly developed. Labial palpi long (3), straight, porrect, thickened with appressed hairs; terminal joint minute, concealed. Maxillary palpi slightly dilated at apex. Forewings with 2 from $\frac{3}{4}$, 3, 4, 5 approximated from angle, 6 from upper angle, 7, 8, 9 stalked, 10 and 11 free. Hindwings with 2 from $\frac{3}{4}$, 3, 4, 5 equidistant from about angle, 6 and 7 connate, 7 touching 12 at a point soon after origin.

Probably nearest to *Bostra*, Wlk., but exceptional in this section of the family by the fact that 7 of the hindwing actually touches 12 at a point, but this may not be constant.

Amphiderita pyrospila, n. sp.

πυροσπιλος, fiery-spotted.

♀, 30 mm. Head purple brownish. Palpi fuscous, lower edge whitish. Antennae brownish. Thorax, abdomen, and legs brownish-fuscous. Forewings triangular, costa nearly straight to just before apex, where it is abruptly arched, apex round-pointed, termen nearly straight, oblique; fuscous; three large, suffused, dark-crimson spots; first spot elongate, broader posteriorly, extending from near base to antemedian line; a fine white transverse line from $\frac{2}{5}$ costa, bent inwards near dorsum; a similar line from $\frac{4}{5}$ costa curving rapidly to termen, enclosing an apical area, which is mostly filled by second spot; the third spot is smaller and just beneath this line; a similar curved line from beneath middle of termen to tornus; the ground-colour beyond antemedian line is paler, inclining to grey; a terminal series of interneural, triangular, fuscous dots; cilia fuscous, bases whitish. Hindwings fuscous-grey; an elongate darker sub-dorsal spot, defined towards tornus by a fine whitish line; a fuscous spot, partly suffused with dark crimson, defined by a fine whitish line, on tornus; terminal dots and cilia as forewings.

New South Wales: Lismore, in October; one specimen.

Macalla peloscia, Turn.

I have received a second male example taken by Mr. W. B. Barnard at Toowoomba, Queensland. It differs from my North Queensland type in having the forewings suffused with greenish instead of reddish, but is certainly the same species. As in *M. conciscella*, Wlk., the male has a small glandular swelling preceded by a slight ridge of scales on costa at $\frac{2}{3}$. Both specimens have two longitudinal dark-fuscous or blackish streaks preceding termen above middle of disc; these were not noticed in my description.

Macalla diaprepes, n. sp.

διαπρεπης, distinguished.

♂, 30-34 mm. Head, palpi, and antennal processes orange-brown mixed with white and fuscous. Antennae brown. Thorax fuscous with two pairs of white spots, in which are a few orange-brown scales. Abdomen grey-whitish irrorated with orange-brown. Legs fuscous-brown annulated with white. Forewings triangular, costa straight to near apex, apex obtuse, termen slightly bowed, slightly oblique; fuscous with white markings and some scattered white scales; veins more or less distinctly outlined with orange-brown; a sub-basal transverse fascia, constricted or interrupted beneath costa, with anterior and posterior tooth about middle; a short transverse mark on $\frac{1}{3}$ costa; a rather broad transverse fascia from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum, containing a fuscous or fuscous and orange-brown bar from costa, and a fuscous line from beneath middle to dorsum; a series of white spots near termen, touching termen in middle, and connected in middle with posterior fascia by a white spot; cilia orange-brown with some fuscous scales and conspicuous white bars. Hindwings grey, towards base paler; cilia grey, apices whitish.

The orange-brown markings vary in degree.

North Queensland: Kuranda, in September; two specimens received from Mr. W. B. Barnard.

Orthaga prionosticha, n. sp.

πριονοστιχος, with serrate line.

♂, ♀, 25-26 mm. Head, thorax, and abdomen whitish-grey. Palpi in male with second joint elongate, exceeding vertex, terminal joint very short; in female obliquely ascending, second joint moderate; whitish-grey mixed with fuscous. Antennae fuscous, basal joint whitish-grey; in male serrate, ciliations $\frac{1}{2}$. Legs whitish-grey mixed with fuscous; tarsi fuscous with whitish-grey annulations. Forewings triangular, costa slightly arched, apex round-pointed, termen slightly bowed, slightly oblique; in male with a subcostal fovea on both upper and lower surface beyond middle, preceded by a ridge of raised scales on upper surface; whitish-grey with some fuscous irroration and suffusion; a median fuscous dot at $\frac{1}{5}$, and a subcostal dot slightly beyond this; a fuscous transverse line from

$\frac{1}{3}$ costa to $\frac{3}{5}$ dorsum, angled outwards beneath costa and above dorsum, sometimes obscure and incomplete; a second line from $\frac{2}{3}$ costa, outwardly oblique, finely dentate, bent inwards in disc, then transverse to $\frac{4}{5}$ dorsum; beyond this some brownish-fuscous suffusion; a terminal series of fuscous dots; cilia whitish, bases obscurely barred with fuscous. Hindwings grey; cilia as forewings.

Queensland: Coolangatta, in January; two specimens received from Mr. W. B. Barnard.

Family TINEODIDAE.

Gen. Tanycnema, Turn.

There is an unfortunate error in my diagnosis of this singular genus. The correct neuration of forewing is 7 separate, 8, 9, 10 stalked, 8 arising before or opposite 10. I have since taken a male example at Lismore, New South Wales. In that sex the middle tibiae have a very dense covering of long hairs on their inner surface culminating in a large apical tuft. Mr. W. B. Barnard has sent me a third example from Toowoomba. In none can I detect any maxillary palpi.

Family PHALONIADAE.

In these Transactions for 1916 I included several genera here, which I now recognise belong to other groups. *Trychnostola* should be referred to the *Copromorphidae; Tanymecica* and *Eusthenica,* I think, to the *Glyphipterygidae.*

Heliocosma melanotypa, n. sp.

μελανοτυπος, with black markings.

♂, 20 mm. Head whitish. Palpi 5; whitish. Antennae pale grey. Thorax pale grey. Abdomen grey; tuft and underside whitish. Legs fuscous; tarsi narrowly annulated with whitish; posterior pair whitish. Forewings rather narrow, posteriorly somewhat dilated, costa gently arched, apex pointed, termen nearly straight, oblique; without costal fold; whitish slightly suffused with grey; basal third of costal edge fuscous; a rather broad suffused inwardly-oblique streak of blackish scales at $\frac{1}{4}$, not reaching margins; a similar blackish line from $\frac{2}{3}$ costa to mid-dorsum; a triangular spot on dorsum at $\frac{3}{4}$; a blackish dot in disc shortly posterior to median line, followed by a fuscous suffusion containing some blackish scales; an inwardly curved narrow blackish fascia from apex to tornus nearly interrupted above middle; cilia white, on apex, midtermen, and tornus fuscous. Hindwings with termen slightly rounded; grey; cilia grey, towards apex whitish-grey.

Victoria: Daytrap, in October; one specimen. Type in Coll. Lyell.

Family TORTRICIDAE.

Isochorista eutypa, n. sp.

εὐτυπος, well-marked.

♀, 18 mm. Head and palpi pale brown. Antennae ochreous-whitish with fine blackish annulations. Thorax brown. Abdomen grey. Legs fuscous; tarsi annulated with ochreous-whitish; posterior pair ochreous-whitish, tarsi with several fuscous rings. Forewings slightly dilated, costa gently arched near base, thence straight, apex round-pointed, termen straight, oblique; whitish-brown; markings fuscous, well defined; four dots on basal $\frac{1}{4}$ of costa; a basal blotch from dorsum to near last two of these dots, its costal edge rounded; a triangular spot on dorsum from $\frac{1}{5}$ to $\frac{2}{5}$; central fascia extending on costa from $\frac{1}{3}$ to middle, constricted above middle of disc, broadly dilated posteriorly beneath constriction, and extending on dorsum from middle to near tornus; a costal dot beyond this; a rounded-rectangular costal blotch, its apex nearly approaching central fascia; a subapical costal dot; an elongate spot on termen below middle; cilia whitish-brown with several fuscous dots. Hindwings with termen scarcely sinuate; grey; cilia grey.

Queensland: Toowoomba, in November; one specimen received from Mr. W. B. Barnard.

Acropolitis lichenica, n. sp.

λειχηνικος, lichen-like.

♀, 24-27 mm. Head white. Palpi 2; second joint with basal and subapical, terminal joint with median, dark-fuscous bars. Antennae grey. Thorax white with some greenish-grey suffusion and a few dark-fuscous scales. Abdomen pale grey. Legs whitish; anterior and middle tibiae and tarsi annulated with fuscous. Forewings suboblong, costa arched near base, thence straight, apex rectangular, termen nearly straight, not oblique; white strigulated more or less with greenish-grey; numerous blackish costal and dorsal dots; a small tuft of scales on dorsum near base; several blackish basal dots; an elongate blackish spot beneath costa near base sometimes confluent with a larger spot on fold, acutely produced posteriorly; this in turn may be confluent with a blotch beneath middle of wing, partly blackish, partly greyish-green, sometimes connected with dorsum by an ochreous suffusion; a triangular blotch on costa before apex, blackish with some white dots on costal edge, its apex reaching middle; cilia white with a median series of blackish dots. Hindwings with termen sinuate; 4 and 5 connate, 6 and 7 stalked; grey; cilia grey.

Queensland: National Park (3,000 feet), in December and March; three specimens.

Batodes conjunctana, Wlk.

B. hemicryptana, Meyr., is a synonym. The species is variable, but I find no constant difference between Queensland examples and those from Victoria and Tasmania.

Queensland: Brisbane, Mount Tambourine, Coolangatta, National Park (2,500 feet), Rosewood, Toowoomba, Nanango, Warwick, Killarney. New South Wales: Tenterfield, Glen Innes, Gosford, Bulli, Mount Kosciusko (4,500 feet). Victoria: Beaconsfield, Gisborne. Tasmania: Launceston, Deloraine, George's Bay.

Batodes euryxutha, n. sp.

εὐρυξουθος, broadly tawny.

♂, ♀, 15-18 mm. Head and palpi fuscous. Antennae fuscous; in male serrate towards apex, shortly ciliate ($\frac{1}{2}$). Thorax pale brown with a broad, anterior, transverse, fuscous bar. Abdomen fuscous. Legs fuscous; tarsi annulated with whitish-ochreous; posterior pair except tarsi whitish-ochreous. Forewings rather broadly dilated, costa gently arched, apex rounded, termen obliquely rounded; in male with a narrow costal fold extending to about $\frac{1}{3}$; pale brown with diffused patches of darker brown; no basal patch, but a fuscous streak on basal part of costa; terminal area beyond a line from $\frac{1}{3}$ costa to tornus fuscous, its anterior edge suffused; a pale oblique band containing a fuscous costal strigula from costa beyond middle becoming indistinct in disc; several oblique strigulae of mixed blackish and brown scales posterior to this, and two brownish-whitish costal dots; cilia fuscous. Hindwings with termen scarcely sinuate; dark grey; cilia dark grey.

It is hardly possible that this is no more than an extreme variation of *B. conjunctana,* from which it differs in the absence of a basal patch, much narrower central fascia with obsolescence of its anterior fold, and widely suffused tawny colouring.

North Queensland: Eungella (2,000 feet, behind Mackay), in September (Goldfinch). Queensland: Brisbane; Mount Tambourine, in November; National Park (3,000 feet), in December and January; five specimens.

Capua mersana, Wlk.

Lower edge of face narrowly white. Some examples of this variable species are extremely like *C. montivagana,* Meyr. The character here given is a useful distinction. In the case of the male the presence of a costal fold is of course sufficient.

Capua gyrobathra, n. sp.

γυροβαθρος, with rounded base.

♀, 21 mm. Head brown-whitish. Palpi 3½; brown-whitish. Antennae whitish. Thorax pale brown. Abdomen grey. Legs ochreous-whitish; anterior tibiae and tarsi barred with fuscous. Forewings suboblong, costa strongly rounded and projecting from base to ⅖, thence sinuate, apex rounded-rectangular, termen obliquely rounded; pale brown; costal edge whitish with fine short fuscous strigulae; cilia pale brown. Hindwings with termen sinuate; grey; cilia grey.

The peculiarly shaped forewings suggest a relationship to *C. alaudana,* Meyr.

Queensland: Bunya Mountains (3,500 feet), in October; one specimen.

Capua parooptera, n. sp.

παρωοπτερος, brown-winged.

♀, 28 mm. Head, thorax, and antennae reddish-brown. Palpi 2; reddish-brown. Abdomen ochreous-grey. Legs whitish-ochreous; anterior pair brown. Forewings oblong, costa strongly arched near base, thence nearly straight, slightly sinuate before apex, apex rectangular, termen straight, not oblique, rounded beneath; reddish-brown with slight darker transverse strigulae; cilia reddish-brown. Hindwings with termen slightly sinuate; greyish-ochreous; cilia pale grey.

Queensland: Southport, in January; one specimen received from Mr. W. B. Barnard.

Capua gongylia, n. sp.

γογγυλιος, rounded.

♀, 20-22 mm. Head and thorax fuscous-brown. Palpi 3; fuscous-brown, whitish beneath towards base. Antennae grey. Abdomen grey-brown. Legs ochreous-whitish; anterior pair grey; anterior and middle tarsi grey with whitish annulations. Forewings oval, costa strongly arched, apex rounded, termen obliquely rounded; pale brown; some slightly darker transverse strigulae in posterior part of disc; cilia fuscous-brown. Hindwings with termen scarcely sinuate; grey, suffused in disc with pale ochreous; cilia grey.

Peculiar in shape of forewings and absence of markings, but appears referable to this genus.

Queensland: Rosewood, in April; Toowoomba; three specimens.

Capua micropolia, n. sp.

μικροπολιος, small grey.

♂, 12 mm. Head and thorax grey. Palpi 2¼; grey. Antennae grey; serrate and very shortly ciliated. Abdomen grey. Legs grey; tarsi annulated with whitish; posterior pair ochreous-whitish. Forewings rather narrow, costa gently arched, apex pointed, termen very obliquely rounded; without costal fold; pale grey with numerous small fuscous strigulae; cilia grey. Hindwings with termen slightly sinuate; pale grey; cilia pale grey.

Queensland: Brisbane, in November; one specimen.

Capua castanitis, n. sp.

καστανιτις, chestnut-brown.

♂, ♀, 18-20 mm. Head and thorax brown. Palpi 3; brown. Antennae grey, towards base brown. Abdomen grey-brown. Legs brown; posterior pair ochreous-whitish. Forewings dilated posteriorly, costa moderately arched to middle, thence straight, apex pointed, termen sinuate, not oblique; in male with a moderate costal fold extending to $\frac{2}{5}$ costa; grey-brown; markings fuscous-brown; a moderate basal patch sometimes well defined, sometimes indistinct; a broad fascia from costa before middle to dorsum beyond middle, gradually dilated towards costa, anteriorly well defined, posteriorly suffused; a small semi-circular blotch on costa beyond $\frac{3}{4}$; some strigulae in posterior part of disc; some of which form a line from tornus to near costal blotch; cilia brown. Hindwings with termen sinuate; grey; towards apex a large suffused pale-orange blotch strigulated with grey; cilia grey.

Queensland: National Park (3,000 feet), in December and March; three specimens.

Capua catoxia, n. sp.

κατοξειος, sharp, pointed.

♀, 15 mm. Head, thorax, and antennae pale grey. Palpi $2\frac{1}{2}$; pale grey. Abdomen grey. Legs whitish; anterior pair grey. Forewings suboblong, costa arched near base, thence straight, apex acute, termen straight, oblique; pale grey; markings fuscous; a moderate basal patch indicated by a posteriorly angulate line; a moderate fascia from costa at $\frac{1}{3}$ to middle of dorsum, anterior edge outwardly curved, posterior edge strongly convex, with a large indentation above middle; a triangular blotch on costa at $\frac{2}{3}$, its apex acute and nearly reaching posterior extremity of fascia; a spot on tornus; a few slender strigulae before apex; cilia pale grey. Hindwings with termen rounded; grey; cilia grey.

Queensland: National Park (3,000 feet), in March; one specimen.

Homona stenophracta, n. sp.

στενοφρακτος, with narrow border.

♂, ♀, 16-18 mm. Head, palpi, and thorax brown. Antennae fuscous; ciliations in male extremely short. Abdomen grey. Legs fuscous; posterior pair ochreous-whitish. Forewings broad, costa strongly arched to middle, thence straight, apex rectangular, termen straight, rounded towards tornus, not oblique; in male without costal fold; brown with fine transverse fuscous strigulae; a broad subterminal fuscous band, very suffused anteriorly, sharply defined posteriorly; a narrow pale-brown terminal fascia; cilia pale brown. Hindwings with termen rounded; ochreous-grey with indistinct darker strigulae; in female with a large, subapical, ochreous suffusion; cilia grey, bases and apices paler and ochreous tinged.

Queensland: Eidsvold, in September (Dr. Thos. Bancroft); Toowoomba, in September, March, and April (Mr. W. B. Barnard).

Barnardiella, n. gen.

Antennae in male thickened with a large dilatation, flattened anteroposteriorly, beyond basal joint. Palpi very long, porrect. Thorax in male with shoulder-flaps enlarged and elongated to reach slightly beyond posterior margin; a lateral pencil of long hairs from posterior margin of thorax on each side. Forewings with all veins present and separate, 2 from $\frac{2}{3}$, 7 to termen. Hindwings with 3 and 4 connate, 5 approximated to them at origin, 6 and 7 closely approximated at origin.

A local derivative of *Tortrix* distinguished by the peculiarities of the male antennae and thorax. I dedicate the genus to Mr. W. B. Barnard, to whose zeal and generosity I owe much in the study of our Lepidoptera.

Barnardiella sciaphila, n. sp.

σκιαφιλος, shade-loving.

♂, 30 mm. Head fuscous. Palpi 4; fuscous with a few paler scales. Antennae fuscous; basal joint stout, beyond this a broad dilatation extending to $\frac{1}{3}$, flattened anteroposteriorly, some serrations towards apex, and moderately long ciliations throughout. Thorax and abdomen fuscous-brown. Legs fuscous. Forewings broadly dilated, costa gently arched, apex rounded-rectangular, termen straight, scarcely oblique; without costal fold; grey-brown with darker dots and strigulae; an inwardly-oblique blackish bar from $\frac{1}{4}$ costa to fold near base, dilated on fold; a fuscous spot on midcosta, a second beyond this; a rather broad, suffused, pale-fuscous line from $\frac{3}{4}$ costa inwardly oblique to middle of disc, there angled outwards to end on dorsum shortly before tornus; subapical and apical costal spots; an irregular, pale-fuscous, subterminal, median spot; cilia brown with a basal series of fuscous dots. Hindwings with termen slightly sinuate; grey with numerous, transverse, fuscous strigulae; a small, blackish, basal area; cilia fuscous.

♀, 30-33 mm. Forewings proportionately longer, costa more strongly arched at base, termen sinuate; colour varying from pale ochreous-grey to fuscous-brown; markings extremely variable in detail, corresponding to those of male but without sub-basal costal bar, in dark examples obsolete. Hindwings without basal blackish area.

The male is described from a single example; but probably this sex is equally variable. This large obscure variable species is a denizen of our mountain jungles.

Queensland: Toowoomba, in February (1 male, type); Bunya Mountains, in May (3 females); all four examples received from Mr. W. B. Barnard.

Tortrix crypsilopha, n. sp.

κρυψιλοφος, with hidden crest.

♀, 30 mm. Head and thorax brownish-fuscous. Palpi 3; brownish-fuscous. Antennae grey. Abdomen dark grey. Legs fuscous; posterior pair grey. Forewings suboblong, costa strongly arched, less so towards apex, apex rectangular, termen sinuate, strongly rounded in middle; grey; a broadly suffused, ferruginous, subcostal streak from base to about $\frac{1}{3}$; a similar, median, longitudinal streak from before middle towards, but not reaching apex; a few darker strigulae in terminal area; cilia ochreous-grey with a darker sub-basal line. Hindwings with apex obtuse, termen rounded; a subapical costal tuft of densely crowded scales on under-surface; grey; cilia grey.

The peculiar tuft on the hindwings may be analogous to that of the female of *Cacoecia australana*.

Queensland: Coolangatta, in January; one specimen received from Mr. W. B. Barnard.

TORTRIX ILLUCIDA, Meyr.

This species should be referred to *Tortrix*, not to *Epichorista*.

Queensland: Eumundi, near Nambour, in October; Mount Tambourine, in November; National Park (3,000 feet), in December and January.

Tortrix leucoptera, n. sp.

λευκοπτερος, white-winged.

♀, 15-18 mm. Head whitish. Palpi $2\frac{1}{4}$; whitish with a few fuscous scales. Antennae pale grey; basal joint whitish. Thorax whitish-grey. Abdomen pale grey. Legs whitish. Forewings suboval, costa moderately and uniformly arched, apex rounded, termen very obliquely rounded; whitish with numerous transverse strigulae of pale grey sometimes faintly greenish tinged; minute fuscous dots on base of costa, on costa slightly beyond base, and on fold near base; similar dots on $\frac{1}{6}$ costa, slightly beneath this, and on fold, representing edge of basal patch; central fascia represented by a small blackish outlined square on midcosta, and an undefined fuscous suffusion on dorsum between middle and tornus, together with several fuscous dots in disc; a series of fuscous dots on apical half of costa and termen; cilia white with a few fuscous points around tornus. Hindwings with termen rounded; white; cilia white.

Queensland: National Park (2,500 to 3,000 feet), in January and March; three specimens.

Tortrix oressinoma, n. sp.

ὀρεσσινομος, haunting the mountain.

♂, 27-28 mm. Head brown. Palpi 3; brown. Antennae grey; with moderate ciliations (1). Thorax grey-brown. Abdomen grey. Legs brown; posterior pair ochreous-whitish. Forewings rather broad, somewhat dilated posteriorly, costa strongly and evenly arched, apex rectangular, termen obliquely rounded; without costal fold; grey suffused with reddish-brown, more so towards dorsum and termen; costal edge reddish-brown; numerous fine fuscous dots; a longitudinal series in cell with one or two above and beneath; a larger dot in mid-disc at $\frac{2}{3}$; a strongly outwardly-curved series from beneath $\frac{2}{3}$ costa to tornus; a subterminal series; cilia grey-brown, apices sometimes ochreous tinged. Hindwings with termen scarcely sinuate; pale grey with faintly darker strigulae; cilia pale grey.

♀, 29 mm. Forewings narrower, not dilated, costa arched near base, thence slightly sinuate, termen slightly sinuate; purplish-brown without markings. Hindwings grey-whitish with faint grey strigulae.

New South Wales: Mount Kosciusko (5,000 feet), in December; 2 male and 1 female examples received from Mr. G. M. Goldfinch, who has the type. I had previously taken 3 female examples at the same locality (3,500 to 5,000 feet), in February and March, which are probably the same species, but have the forewings uniformly reddish-brown.

Tortrix haplophanes, n. sp.

ἁπλοφανης, of simple appearance.

♂, 24-26 mm. Head and thorax grey. Palpi $2\frac{1}{2}$; grey. Antennae grey; ciliations $1\frac{1}{2}$. Abdomen grey; tuft pale ochreous. Legs fuscous; posterior pair mostly ochreous-whitish. Forewings not dilated, costa moderately and uniformly arched, apex pointed, termen nearly straight, oblique; without costal fold; grey suffused with pale ochreous except in central and dorsal areas, which contain numerous very minute fuscous dots; rather larger blackish dots in subcostal area; cilia grey. Hindwings considerably broader than forewings, termen slightly sinuate; pale grey; cilia grey-whitish.

Western Australia: Mundaring, in June; two specimens.

CNEPHASIA RUPICOLANA, Meyr.

Tortrix celatrix, Turn., is a synonym.

Queensland: Stradbroke Island, Mount Tambourine, Toowoomba. New South Wales: Murrurundi, Sydney, Katoomba, Adaminaby. Victoria: Melbourne, Wandin, Gisborne. South Australia: Mount Lofty.

Cnephasia argyrocosma, n. sp.

ἀργυροκοσμος, adorned with silver.

♂, ♀, 17-20 mm. Head blackish with some whitish irroration. Palpi $2\frac{1}{2}$; blackish; inner surface, upper edge, and extreme apex whitish. Antennae blackish; ciliations in male 1. Thorax with a well-developed posterior crest; a central and two anterolateral spots whitish. Abdomen fuscous. Legs dark fuscous irrorated, and tarsi annulated, with ochreous-whitish. Forewings sub-oblong, not dilated, costa moderately arched, apex rounded, termen obliquely rounded; in male without costal fold; blackish; markings whitish mixed with silvery and pale-ochreous scales; a small basal patch containing several costal and discal blackish dots; a costal spot at $\frac{1}{4}$, containing a central black dot, connected by a narrow fascia with a similar spot on dorsum at $\frac{1}{4}$; a transverse wavy bar from mid-dorsum $\frac{2}{3}$ across disc; costal spots similar to first on middle and before apex; a narrow fascia from $\frac{2}{3}$ costa, very slender on costa, dilated in disc, there dividing into sinuate lines running to dorsum at $\frac{2}{3}$ and tornus; three small terminal spots; cilia fuscous with 3 or 4 whitish bars. Hindwings with termen slightly sinuate; grey; cilia grey with a darker basal line.

New South Wales: Mount Kosciusko (5,000 feet), in December; three specimens. Type in Coll. Goldfinch.

Cnephasia bleptodora, n. sp.

βλεπτοδωρος, a seemly gift.

♂, 18 mm. Head whitish-ochreous mixed with fuscous on crown. Palpi $2\frac{1}{2}$; fuscous; apex and upper surface of second joint whitish-ochreous. Antennae fuscous; serrate towards apex with moderate ciliations (1). Thorax dark fuscous. Abdomen grey; tuft and underside ochreous-whitish. Legs dark fuscous annulated with ochreous-whitish; posterior pair wholly ochreous-whitish. Forewings slightly dilated, costa rather strongly and evenly arched, apex pointed, termen slightly bowed, slightly oblique; without costal fold; white with some whitish-ochreous and blackish irroration; markings blackish; basal patch represented by a quadrangular elongate spot on costa from base and a dot on $\frac{1}{5}$ dorsum; median fascia very broad on costa, being completely confluent with costal patch, and extending from $\frac{1}{3}$ to $\frac{4}{5}$, much narrower in disc, from which it is reduced to a curved line which reaches dorsum shortly before tornus; three included paler costal dots; a subapical costal dot; a large triangular terminal spot which includes one or more whitish dots; cilia fuscous, apices whitish with some fuscous bars. Hindwings with termen slightly sinuate; grey with faintly darker mottling; cilia pale grey with a dark sub-basal line.

New South Wales: Stanwell Park, in March; two specimens. Type in Coll. Goldfinch.

Argyrotoxa pompica, n. sp.

πομπικος, showy.

♂, ♀, 18-20 mm. Head dark fuscous; face white. Palpi $1\frac{1}{4}$; white. Antennae dark fuscous; ciliations in male $\frac{1}{2}$. Thorax dark fuscous; shoulder-flaps pale ochreous mixed with fuscous, apices whitish. Abdomen fuscous; extreme base and underside ochreous-tinged. Forewings not dilated, costa moderately and evenly arched, apex round-pointed, termen bowed, oblique; in male with a basal costal fold extending to $\frac{2}{5}$; fuscous mixed with grey, blackish, and a few whitish scales; a large crest of raised blackish scales near base; a large white quadrangular costal spot beyond middle, containing a fuscous costal dot, and connected by a white line with tornus; a large, irregular, blackish and ferruginous spot before termen, with several small similar spots between it and apex and termen; cilia grey with indistinct paler bars, several blackish sub-basal dots on a whitish-ochreous basal line, on tornus whitish. Hindwings with termen rounded; orange; a narrow terminal fuscous band, broader at tornus, and prolonged along dorsum; cilia grey with a fuscous sub-basal line.

Exceptional in the genus by the presence of a costal fold. It is the only Australian species, the two formerly referred here by Meyrick being now referred to *Schoenotenes,* distinguished by the peculiar form of the cell of forewings.

Queensland: Emerald, in September; five specimens received from Mr. W. B. Barnard.

Eboda chlorocosma, n. sp.

χλωροκοσμος, adorned with green.

♂, 16 mm. Head and thorax green. Palpi $1\frac{1}{4}$; whitish. Antennae pale grey; ciliations imperceptible. Abdomen grey. Legs whitish. Forewings slightly dilated posteriorly, costa with two rounded prominences edged with large scales, first near base, second at $\frac{2}{3}$, beyond this excavated, apex very obtusely rounded and displaced, termen rounded, not oblique; without costal fold; very pale grey with sparse irroration of slightly darker scales; a few raised blackish scales about middle of disc; an elongate blotch from base reaching costa beyond first prominence, thence broad, narrowing to a point at commencement of second prominence, bright green broadly edged with fuscous; a broad fuscous line along costa and termen throughout; cilia pale grey. Hindwings with termen sinuate; pale grey tinged with green; cilia pale grey.

New South Wales: Port Macquarie, in April; one specimen. Type in Coll. Goldfinch.

Scyphoceros, n. gen.

σκυφοκερως, cup-horned.

Palpi moderate, ascending, reaching vertex; second joint rough-scaled anteriorly; terminal joint very short. Antennae of male with a fusiform dilatation beyond basal joint excavated anteriorly to form an oval cup, slightly serrate, minutely ciliated. Thorax with small posterior crest. Forewings with tufts of scales; 3 and 4 stalked, 7, 8, 9 stalked, 7 to termen. Hindwings with 3 and 4 stalked, 6 and 7 stalked.

A development of *Dicellitis,* from which it differs in antennal structure of male.

Scyphoceros tholera, n. sp.

θολερος, muddy.

♂, 14 mm. Head and thorax fuscous. Palpi fuscous-brown. Antennae ochreous-whitish finely annulated with fuscous; sub-basal cup fuscous. Abdomen fuscous; tuft and underside ochreous-whitish. Legs ochreous-whitish; anterior and middle tibiae and tarsi annulated with fuscous. Forewings somewhat dilated posteriorly, costa moderately arched, apex round-pointed, termen slightly bowed, slightly oblique; costal fold extending to $\frac{1}{3}$; ochreous-whitish suffused with brown and fuscous; obscure fuscous markings; a small basal patch; six or seven costal dots; median fascia represented by a large ill-defined dorsal blotch, narrowly confluent with a small triangle on costa at $\frac{2}{3}$; an irregular subterminal line, dilated and angled inwards in middle; an interrupted terminal line; cilia fuscous. Hindwings with termen sinuate; grey; cilia grey.

North Queensland: Mourilyan Harbour, in July; one specimen.

Gen. Dicellitis, Meyr.

Palpi rather short, ascending; second joint rough-scaled anteriorly, terminal joint very short. Thorax with a small posterior crest. Forewings with tufts of scales; 3 and 4 connate or stalked, 7, 8, 9 stalked, 7 to termen. Hindwings with 3 and 4 connate or stalked, 5 somewhat approximated, 6 and 7 stalked.

Hitherto confined to a single Indian species.

Dicellitis theticophara, n. sp.

θητικοφαρος, in menial garb.

♂, 13 mm. Head and thorax fuscous. Palpi brown-whitish; a median bar on second joint and whole of terminal joint fuscous. Antennae ochreous-whitish finely annulated with dark fuscous; without basal dilatation and cap. Abdomen fuscous; tuft and underside ochreous-whitish. Legs ochreous-whitish; anterior and middle tibiae and tarsi annulated with fuscous. Forewings somewhat dilated posteriorly, costa moderately arched, apex round-pointed, termen slightly bowed, slightly oblique; costal fold extending to $\frac{1}{3}$; brown-whitish suffused with fuscous; markings fuscous, very obscure; a large basal patch produced on costa to $\frac{1}{3}$; six, incomplete, interrupted, fine transverse lines; a pale area follows basal patch; postmedian half of disc darker; a large supratornal spot; an interrupted terminal line; cilia fuscous. Hindwings with termen sinuate; grey, cilia grey.

This obscure species is not unlike the preceding, with which it agrees structurally except in antennal structure and shorter palpi.

Queensland: Palmwoods, near Nambour, in October; one specimen.

Dicellitis zostrophora, n. sp.

ζωστροφορος, banded, girdled.

♂, 13 mm. Head and thorax brownish. Palpi ochreous-whitish, apex brownish. [Antennae missing.] Abdomen grey. Legs ochreous-whitish. Forewings slightly dilated posteriorly, costa gently arched, apex pointed, termen very obliquely rounded; ochreous-whitish with fuscous irroration; markings fuscous; basal patch undefined, represented by some transverse strigulae; median band, broad, oblique, dilated towards dorsum, from before midcosta to beyond mid-dorsum; a large quadrate spot on costa at $\frac{3}{4}$, nearly confluent with a large erect oblong spot from lower end of termen; a suffused line from costa before apex to termen above middle; cilia ochreous-whitish with a few fuscous scales. Hindwings with termen sinuate; pale grey; cilia pale grey.

North Queensland: Kuranda, in September; one specimen received from Mr. F. P. Dodd.

Trachyptila phaulodes, n. sp.

φαυλωδης, of mean appearance.

♂, 16 mm. Head, thorax, and abdomen grey. Palpi 2; grey. Antennae grey; with rather long ciliations (2). Legs whitish; anterior pair fuscous; anterior and middle tarsi fuscous with whitish annulations. Forewings moderate, not dilated, costa moderately arched, apex round-pointed, termen very obliquely rounded; no costal fold; grey with scanty dark-fuscous irroration mostly on veins; costa with numerous small dark-fuscous costal strigulae; an interrupted dark-fuscous line on fold to about middle of wing; cilia grey-whitish with some dark-fuscous points. Hindwings and cilia grey.

Very similar to *T. melanosticha*, Turn., but with shorter palpi.

Queensland: Brisbane, in August; one specimen.

Colocyttara, n. gen.

κολοκυτταρος, with shortened cell.

Head rough-scaled. Palpi porrect; second joint thickened with rough scales above, and to a less extent beneath, at apex. Thorax with a posterior crest. Forewings with raised tufts of scales; all veins present and separate, 7 to costa. Hindwings without cubital pecten; cell short ($\frac{1}{3}$ to $\frac{1}{2}$), 3 and 4 connate or short-stalked, 5 usually straight, from middle or below middle of cell, sometimes slightly curved towards 4 at origin, but always well separate from that vein, 6 and 7 separate but approximated at origin and for some distance.

Type *C. epidesma,* Low. This genus includes the Australian species hitherto included in *Peronea,* from which it differs in the much shorter cell of hindwing, and structure of vein 5. The three species form a natural group, though there is some range of variation; in *C. epidesma* the cell is $\frac{1}{3}$, and 5 arises from middle; in *C. phaeolopha* the cell is $\frac{1}{3}$, but 5 arises from somewhat below middle; in *C. asperana* the cell is $\frac{1}{2}$, and 5, which is slightly curved, arises from about $\frac{1}{4}$ from lower angle.

Colocyttara phaeolopha, n. sp.

φαιολοφος, dark-crested.

♂, 16 mm. Head fuscous. Palpi 3, second joint widely expanded above at apex; fuscous. Antennae fuscous; ciliations imperceptible. Thorax and abdomen fuscous. Legs ochreous-whitish suffused with fuscous; posterior pair paler. Forewings not dilated, costa gently arched from base, slightly indented before middle, thence nearly straight, apex rounded, termen nearly straight or slightly sinuate, slightly oblique; without costal fold; whitish-brown with numerous transverse dark-fuscous strigulae; basal patch large, fuscous, containing a large crest of raised scales near its posterior edge, which runs from $\frac{1}{5}$ costa to $\frac{1}{3}$ dorsum, and is outwardly curved; an irregular blotch on and beneath fold beyond this, with some fuscous irroration between it and costa; strigulae denser and forming narrow lines before apex and termen; cilia fuscous. Hindwings with termen sinuate; greyish-ochreous, becoming grey towards costa and apex; cilia grey.

Queensland: Brisbane, in August; one specimen.

Family EUCOSMIDAE.

Acroclita stilpna, n. sp.

στιλπνος, glittering.

♀, 15 mm. Head and thorax brown. Palpi 4, densely clothed with long hairs; grey, beneath whitish. Antennae and abdomen fuscous. Legs grey. Forewings narrow, suboblong, costa slightly arched, apex pointed, termen concave, slightly oblique; dark brown; markings silvery-white; a stout median line edged beneath with blackish from base to $\frac{2}{5}$, terminating abruptly; a pair of short oblique whitish streaks on midcosta, of which the first gives rise to a line towards but not quite reaching tornus; three similar pairs at about equal distances between midcosta and apex; the second streak of third pair gives rise to a short line towards midtermen; a suffused and partly interrupted line on dorsum from near base to $\frac{2}{5}$; an erect transverse bar from tornus to middle of disc; a blackish line on lower half of termen; cilia around apex dark brown including a whitish bar beneath apex, thence grey with brassy lustre, but bases silvery-whitish, on tornus whitish. Hindwings with termen scarcely sinuate; grey; cilia pale grey with a darker basal line.

Tasmania: Cradle Mountain, in January; one specimen received from Dr. R. J. Tillyard.

Acroclita confusa, n. sp.

confusus, disorderly, confused.

♂, 12 mm. Head and thorax pale brownish. Palpi $1\frac{1}{2}$; whitish, scales on lower edge of second joint grey. Antennae pale grey. Abdomen grey. Legs ochreous-whitish; tarsi fuscous with ochreous-whitish annulations. Forewings narrow, costa slightly arched, apex pointed, produced, termen strongly sinuate, not oblique; without costal fold; pale brownish, finely strigulated with dark fuscous; costa with strigulae and short oblique streaks dark fuscous; streaks better marked in posterior half, between them short pale streaks, ochreous-whitish on costa, becoming silvery-grey; some irregular dark-fuscous suffusion between dorsum and fold; a dark-fuscous subcostal suffusion from middle to near apex; a fine dark-fuscous line on central part of termen; ocellus represented by an undefined pale area containing a few dark-fuscous scales; cilia grey, on apex fuscous. Hindwings with termen rounded; grey; cilia grey.

Queensland: Brisbane, in March; one specimen.

Acroclita ochronota, n. sp.

ὠχρονωτος, with pale dorsum.

♂, 13 mm. Head, antennae, thorax, and abdomen grey. Palpi 2½; whitish. Legs grey; posterior pair whitish. Forewings narrow, costa nearly straight, apex acute, produced, termen sinuate, not oblique; without costal fold; grey; a number of oblique fuscous costal streaks, those before middle short, beyond middle much longer, short again before apex; a broad streak of paler grey along dorsum from base, edged above interruptedly with fuscous to middle, there it broadly dilates and becomes less defined; ocellus preceded by a blackish discal dot; it consists of two broad pale-grey transverse bars, enclosing an area of fine blackish irroration, posterior bar interrupted by a blackish dot; a fuscous terminal line; cilia grey with some fuscous points, and a strong dark-fuscous apical bar. Hindwings with termen scarcely sinuate; grey; cilia grey.

North Queensland: Townsville, in April; one specimen received from Mr. F. P. Dodd.

Acroclita liturata, n. sp.

lituratus, blotched.

♀, 12-14 mm. Head and thorax fuscous with a few whitish points. Palpi 3; whitish; two bars on outer surface, apex, and lower edge of second joint fuscous. Antennae fuscous. Abdomen grey. Legs dark fuscous with whitish annulations; posterior pair mostly whitish. Forewings narrow, costa nearly straight, apex pointed, termen slightly sinuate, slightly oblique; dark fuscous; costa with six pairs of short white streaks, each separated by a fine dark-fuscous line; a large oblique quadrangular white spot on middle of dorsum, imperfectly separated by fuscous scales into four parallel white lines; ocellus represented by a white tornal area containing a silvery-grey spot and some dark-fuscous irroration; cilia white, on and beneath apex mixed with dark fuscous, towards tornus mixed with grey. Hindwings with termen scarcely sinuate; pale grey; cilia pale grey.

Queensland: Charleville, in September; two specimens.

Eucosma leuconephela, n. sp.

λευκονεφελος, clouded with white.

♂, ♀, 17-18 mm. Head grey-whitish. Palpi 2½; grey; internal surface whitish. Antennae grey; in male thickened and slightly serrate, minutely ciliated. Thorax grey. Abdomen fuscous. Legs fuscous; tarsi slenderly annulated with whitish. Forewings moderately broad, not dilated, costa gently arched, apex pointed, termen sinuate, not oblique; in male with a moderate costal fold reaching nearly to middle; grey, slightly ochreous-tinged except towards base and dorsum; sometimes with whitish irroration along costa; numerous short oblique dark costal streaks in apical ⅜; some intervening white streaks before apex; an oblique rather suffused white bar from above mid-dorsum to beyond middle of disc, where it closely approaches an ill-defined white suffusion in disc; a leaden-grey line from this suffusion and another from near apex of costa meet at tornus; preceding the first of these lines is an elongate minute blackish mark, and two similar marks in area between the lines; cilia grey, broadly white beneath apex. Hindwings scarcely sinuate; fuscous; cilia grey.

New South Wales: Barrington Tops, in December; two specimens. Type in Coll. Goldfinch.

POLYCHROSIS ANCONIA, Meyr.

Epichorista pleurosema, Turn., is a synonym. I had failed to observe the cubital pecten.

North Queensland: Innisfail. Queensland: Eidsvold, Brisbane, Rosewood, Toowoomba, Bunya Mountains (to 3,500 feet), Killarney.

Gen. ANALDES, Turn.

Palpi obliquely ascending; second joint rather long, rough-scaled anteriorly, with a small terminal tuft of scales posteriorly; terminal joint short. Thorax with a strong posterior crest. Forewings with 2 from $\frac{2}{3}$, 3 and 4 approximated from angle, 7, 8, 9 very closely approximated at origin, or connate, sometimes 7 and 8 short-stalked, 7 to termen. Hindwings with 3 and 4 connate, 5 parallel, nearly straight, from near middle of cell, 6 and 7 stalked.

Certainly allied to *Polychrosis*, Rag., but distinct by the neuration. Having now more material, I am redescribing both genus and species. The markings in the male are somewhat obscure, and are best interpreted by those in the female, which are very distinct.

ANALDES HYPOLEPTA, Turn.

♂, 14-16 mm. Head and thorax brown; pectus white. Palpi $1\frac{1}{2}$; fuscous-brown. Antennae pale brown with fine fuscous annulations; ciliations imperceptible. Abdomen pale grey. Legs fuscous; tarsi annulated with whitish; posterior pair whitish. Forewings elongate-triangular, costa nearly straight, apex rounded, termen obliquely rounded; without costal fold; pale grey-brown with fine, fuscous, transverse strigulae on costa and in disc; basal patch obsolete, sometimes indicated by a pale fuscous spot on $\frac{1}{5}$ costa, and another, darker, on fold at $\frac{1}{4}$; a large, undefined, triangular, fuscous spot on costa at $\frac{3}{4}$, connected by irroration with a broad outwardly curved bar from dorsum beyond middle; a grey blotch between dorsal bar and tornus, and another larger between posterior costal spot and termen; several ochreous-whitish spots each divided by a fuscous dot on apical half of costa; an ill-defined grey apical spot with fuscous centre; cilia fuscous, on apex brownish tinged, on tornus grey. Hindwings slightly sinuate; pale grey; cilia pale grey.

♀, 15-16 mm. Forewings grey without brownish tinge; basal patch sometimes distinct, and then with a posterior median tooth on fold; dorsal bar blackish, sharply defined, separated by whitish from posterior costal spot, which is blackish and sharply defined, and is continuous with terminal blotch, which is also blackish; apical spot fuscous and more distinct; cilia wholly fuscous. Hindwings and cilia darker grey.

Queensland: Brisbane, in September, March, and April; Toowoomba, in December; National Park (3,500 to 4,000 feet), in March; six specimens.

Helictophanes metallocosma, n. sp.

μεταλλοκοσμος, with metallic ornament.

♂, 15-16 mm. Head grey. Palpi 3; whitish-brown; inner surface whitish. Antennae grey. Thorax fuscous-brown. Abdomen fuscous. Legs fuscous annulated with whitish; posterior pair mostly whitish. Forewings dilated posteriorly, costa nearly straight to $\frac{3}{4}$, thence moderately arched; apex rounded, termen obliquely rounded; without costal fold; fuscous slightly or extensively suffused with white; a silvery spot on costa at $\frac{1}{3}$, whitish on costal edge, including a ferruginous dot; four, very short, equidistant, oblique streaks on apical third of costa, the first two whitish, the last two silvery; a ferruginous subcostal line crosses the apices of these streaks, edged beneath by a silvery line, both nearly reaching termen; a suffused white or silvery bar from beneath $\frac{2}{3}$ costa to tornus, and a similar blotch on lower half of termen; a white or silvery terminal line; cilia fuscous with grey or whitish bars. Hindwings with termen scarcely sinuate; dark grey; cilia dark grey.

Queensland: Brisbane, in February; Mount Tambourine, in November; two specimens, both in poor condition, differing greatly in amount of white suffusion.

Argyroploce uncimacula, n. sp.

uncimaculus, with hook-shaped mark.

♂, 18 mm. Head and thorax pale brown. Palpi $2\frac{1}{4}$; brown-whitish; two pairs of fuscous dots on outer surface of second joint. Antennae grey; thickened and slightly serrate, minutely ciliated. Forewings somewhat dilated, costa gently arched, apex rounded-rectangular, termen rounded, scarcely oblique; without costal fold; brown-whitish with some fuscous irroration; a small tuft of scales on dorsal edge at $\frac{1}{5}$; three fuscous costal dots, near base, at $\frac{1}{4}$, and midway between; an irregular fuscous spot across fold at $\frac{1}{4}$; central fascia represented by a large, median, triangular, costal blotch, reaching below mid-disc, there turned outwards in a stout, obtuse, J-shaped process; a semicircular, median, fuscous blotch in terminal fourth of disc, its outer edge produced to midtermen; a suffused, transverse, fuscous bar between this and tornus; a fuscous apical spot, from which proceeds a short subterminal line; cilia fuscous, towards tornus brown-whitish. Hindwings with termen rounded; grey; cilia grey.

The markings are suggestive of a *Polychrosis,* but 3 and 4 of hindwings are connate, 7 and 8 separate and approximated for some distance. It appears to be nearest *A. helicana,* Meyr.

Queensland: Brisbane, in January; one specimen.

Argyroploce angustifascia, n. sp.

angustifascius, with narrow band.

♀, 18 mm. Head and thorax pale brownish-grey. Palpi 3; pale grey. Antennae fuscous. Abdomen grey. Legs fuscous annulated with ochreous-whitish; posterior pair wholly ochreous-whitish. Forewings suboblong, not dilated, costa moderately arched, apex bluntly pointed, termen sinuate, not oblique; pale grey-brown with a few darker strigulae; numerous, short, blackish, costal strigulae; basal patch large, represented by a brown blotch with acute posterior angle lying across fold, partly edged with fuscous, and connected by fuscous strigulae with $\frac{1}{5}$ costa and $\frac{1}{3}$ dorsum, and by a sub-basal, fuscous, dorsal spot; central fascia uniformly narrow, partly edged with fuscous, from midcosta to $\frac{3}{4}$ dorsum, pale brown; a small, suffused, brown spot in disc before apex; an elongate fuscous mark on tornus; a terminal series of fuscous dots; cilia pale grey-brown, on tornus fuscous. Hindwings with termen sinuate; 3 and 4 stalked; grey; cilia grey, apices paler and ochreous tinged, except towards tornus and on dorsum.

Queensland: Toowoomba, in March; one specimen received from Mr. W. B. Barnard.

Argyroploce stilpnosticta, n. sp.

στιλπνοστικτος, with glistening spots.

♂, 18 mm. Head and thorax dark fuscous. Palpi 2; fuscous. Antennae fuscous; ciliations $\frac{1}{2}$. Abdomen fuscous. Legs fuscous; tarsi annulated with whitish. Forewings dilated posteriorly, costa slightly bisinuate, apex rounded, termen obliquely rounded; without costal fold; dark fuscous; markings consist of groups of bluish-metallic scales; these are grouped in transverse series of small spots somewhat confusedly arranged, of which there are five before middle; sixth consists of a subcostal and a discal spot; seventh of a curved series of larger spots from $\frac{3}{4}$ costa to tornus; eighth extends submarginally from costa near apex to midtermen; cilia dark fuscous. Hindwings with termen slightly bowed; 3 and 4 short-stalked; grey; cilia grey.

Queensland: National Park (3,000 feet), in March; one specimen.

Oriodryas, n. gen.

ὀρειοδρυας, a mountain woodnymph.

Palpi moderate, ascending; second joint long, densely rough-scaled anteriorly; terminal joint very short, obtuse. Head rough-scaled. Thorax with a small posterior crest. Forewings with 2 from $\frac{2}{3}$, 7, 8, 9 closely approximated at origin, 7 to termen. Hindwings with cubital pecten; 3, 4, 5 approximated at origin, 6 and 7 closely approximated for some distance.

Nearest *Articolla,* Meyr., but with dissimilar neuration of hindwings, and the palpi are altogether different. I at first took it for one of the *Chlidanotidae.*

Oriodryas olbophora, n. sp.

ὀλβοφορος, bringing happiness.

♂, 19 mm. Head blackish; on crown tips of scales whitish. Palpi $1\frac{3}{4}$; white. Antennae fuscous. Thorax blackish; shoulder-flaps mostly white. Abdomen grey. Legs white; anterior femora, annulations on anterior and middle tibiae and tarsi, and posterior tarsi, fuscous. Forewings strongly dilated posteriorly, costa straight, apex very obtusely rounded, termen nearly straight, slightly oblique; without costal fold; white with slight pale-grey suffusion; terminal area partly suffused with silvery scales; numerous blackish and fuscous dots on costa; a large ill-defined blackish spot on base of dorsum to $\frac{1}{4}$, and another smaller on $\frac{1}{3}$ costa representing basal patch; blackish dots on dorsum at $\frac{1}{3}$, middle, and $\frac{2}{5}$; some fuscous suffusion in disc above mid-dorsum; an oblique line of blackish strigulae from beneath $\frac{3}{4}$ costa to termen below middle; termen with some blackish strigulae and preceded by a suffused grey line; cilia pale grey, apices whitish. Hindwings with termen rounded; grey; cilia grey, apices whitish.

Queensland: National Park (3,000 feet), in March; one specimen.

Laspeyresia acrocausta, n. sp.

ἀκροκαυστος, scorched at the apex.

♂, 20 mm. Head and thorax grey. Palpi 3; grey; lower edge and a median spot on outer surface of second joint, and outer surface of terminal joint, fuscous. Antennae grey. Abdomen fuscous. Legs fuscous; posterior pair grey-whitish. Forewings dilated posteriorly, costa moderately arched, apex round-pointed, termen nearly straight, scarcely oblique; without costal fold; grey with slight fuscous irroration; costa with numerous fuscous dots and strigulae; a large apical ferruginous blotch, becoming grey near tornus, its lower half narrowly edged with blackish anteriorly, containing two, short, longitudinal, blackish bars before lower end of termen; cilia fuscous, towards tornus grey with two grey-whitish bars. Hindwings with termen sinuate; grey with numerous, broad, transverse, fuscous strigulae; cilia whitish, bases grey.

A true *Laspeyresia,* although in the only example available 6 and 7 of hindwings are stalked.

Queensland: National Park (3,000 feet), in March; one specimen.

Laspeyresia tetramita, n. sp.

τετραμιτος, with four threads.

♂, 9-10 mm. Head, thorax, and abdomen fuscous; face whitish. Palpi $1\frac{1}{2}$; whitish. Antennae fuscous. Legs whitish; tarsi with fuscous annulations. Forewings somewhat dilated posteriorly, costa moderately arched, apex rounded, termen slightly incised beneath apex, obliquely rounded; without costal fold; grey, with numerous fuscous and whitish streaks from costa and dorsum; costal streaks strongly oblique, the fuscous streaks short towards base, longer in middle, and again shorter and less oblique before apex, the intervening whitish streaks all short, but those towards apex with dull-metallic prolongations; dorsal fuscous streaks long, outwardly curved, a stronger streak from $\frac{2}{5}$ dorsum reaching beyond middle of disc, beyond it four parallel curved whitish streaks; an obscure erect grey metallic bar from tornus, between it and termen sometimes three, short, blackish, longitudinal bars; cilia grey-whitish, a fuscous basal line interrupted at incision. Hindwings with termen rounded; grey; cilia grey-whitish with a fuscous basal line.

North Queensland: Kuranda, in June; two specimens.

Laspeyresia tetrazancla, n. sp.

τετραξαγκλος, with four sickles.

♀, 12-14 mm. Head ochreous grey-whitish; face whitish. Palpi 2; whitish. Antennae fuscous. Thorax fuscous; shoulder-flaps grey. Abdomen fuscous. Legs grey-whitish; tarsi annulated with fuscous. Forewings dilated posteriorly, costa gently arched, apex rounded, termen obliquely rounded; fuscous; costa with seven, short, stout, oblique, whitish streaks between $\frac{1}{4}$ and apex, their apices prolonged by bluish-metallic streaks; four, slightly outwardly curved, whitish streaks, closely approximated from dorsum beyond middle, stout and distinct, reaching nearly to middle of disc; these end in a bluish-metallic suffusion; a broad, erect, violet-metallic bar from tornus, reaching beyond middle, narrowing to a point on tornus; cilia grey with silvery lustre, a blackish basal line. Hindwings with termen rounded; fuscous; cilia whitish with a fuscous basal line.

Northern Territory: Darwin and Melville Island; two specimens received from Mr. G. F. Hill, with the note: "larvae tunnel leaves of 'seven-year bean.'"

Family HYPONOMEUTIDAE.

Ethmia heliomela, Low.

E. olbista, Turn., is a synonym. Mr. Lower received specimens from the Bunya Mountains taken in the same locality and at the same date as my own. The species has not been taken on Mount Tambourine. The faunas of these two mountain ranges are not identical, and form an interesting object for future study. Meanwhile we must be careful to keep our records true.

NOTES ON THE GEOLOGICAL STRUCTURE OF CENTRAL AUSTRALIA.

By L. Keith Ward, B.A., B.E.

[Read May 14, 1925.]

Plates III. to VIII.

I. PREVIOUS GEOLOGICAL INVESTIGATIONS.

Our knowledge of the geological history and structure of the southern part of the Northern Territory is due to the investigations of Mr. H. Y. L. Brown; of Professor R. Tate and Mr. J. A. Watt, the geologists of the Horn Expedition; and of a few individual observers—notably Dr. Chewings, Sir Baldwin Spencer, Mr. P. J. Byrne, Sir Edgeworth David, and Professor Howchin. The four last-mentioned have been concerned specially with the glacial deposits near Crown Point.

Without exception the work that has been carried out hitherto consists of a number of rapid reconnaissance examinations, and no detailed mapping has been attempted. The official geological map of the Northern Territory, due to H. Y. L. Brown, constitutes the only systematic attempt to define the limits of the formations represented; and this map contains also the results of the topographical mapping carried out by the late C. Winnecke. With the help of these very useful foundations it will be possible to attack the structural, stratigraphical, and physiographical problems in a systematic way. And this can be done only by properly equipped parties. The region is an arid one, in which the natural surface waters are for the most part ephemeral and distributed sparsely; wherein artificial water conservation schemes are almost unknown; and in which the development of underground waters is still backward, even along the stock routes that are in constant use. The limited number of water supplies brings about the eating out of natural fodder for a considerable distance round each water, even in the case of those which are situated at a distance from the stock routes used by travelling mobs. Hence a full equipment is required, if geological investigation is to be raised from the stage of route traversing to that of systematic areal mapping. The need for systematic and detailed work away from tracks and routes leading from water to water is felt most keenly by the geologist who, in his reconnaissances, has to travel perforce across wide stretches of sand which mask the structural features and the stratigraphical succession.

The writer's excuse for making this further contribution to the study of the geology of the region lies in the fact that he has had the opportunity of noting the features of some localities not visited by other geologists and of studying the region in the light of all that has been written about it. In this study the conclusion has been reached that some noteworthy differences in interpretation would have resulted, had the earlier investigators approached the area from the northward instead of from the southward. A more satisfactory explanation of several features will be afforded by a party which makes the MacDonnell Ranges the starting place for a systematic study, and works thence to the southward.

References to geological investigations in the regions adjoining the Northern Territory are embodied in the text.

II. THE STRATIGRAPHICAL SUCCESSION.

A. The Fundamental Gneisses and Schists.

The foundation rocks of the region are first seen in place by the traveller from the south who follows the route of the Overland Telegraph Line when he passes through Heavitree Gap, 2 miles to the south of the town of Stuart and about 4 miles south of Alice Springs Telegraph Station.

They consist of a great series of highly altered rocks, many of which, by their lithological characters, show signs of a sedimentary origin. The principal types are quartzites, quartz-mica schists, and gneisses which contain numerous lenses, eyes and bands of pegmatite as well as intrusions of similar material. Quartz veins, some containing tourmaline, traverse the gneisses at many places, and are probably related genetically to the pegmatites. Less common are intrusive amphibolites. There are also basic intrusions of gabbroid type, which are marked, in many cases, by highly ferruginous outcrops, in which spheroidal weathering is noteworthy.

More uncommon are the dense silicified rock-types, which appear to be derived from argillaceous sediments, and in which garnets are to be seen in some places, as, for example, near Simpson's Gap, a few miles to the west of Alice Springs.

These highly metamorphosed rocks constitute the fundamental complex upon which the early Palaeozoic sediments have been laid down. There can be no hesitation in assigning to them a Pre-Cambrian age. They have suffered stresses during the periods preceding those in which the overlying marine sediments were formed, and by which these later rocks have not been affected. The youngest and least altered members of the pre-Cambrian group at Alice Springs are the intrusive dykes of gabbroid character—a feature that has been noted also in the Musgrave and Everard Ranges of northern South Australia.[1] The quartzites of Arltunga are mentioned in a later part of this paper.

The exposures of these Pre-Cambrian rocks reveal characteristics that indicate a deep-seated origin or the deep burial of rocks formed at the surface. Hence there is evidence of strong and deep erosion prior to the Palaeozoic sedimentation, quite apart from the subsequent erosion to which further reference is made below.

B. The Lower Palaeozoic Sediments.

Resting unconformably upon the Pre-Cambrian complex is a great series of sandstones (in part quartzites) and dolomitic limestones which exhibit marked regularity of succession over a very wide area. These sediments are regarded by the writer as constituting one great series, with alternating phases of sandstone and limestone determined by the changes in the conditions of sedimentation during the stages of deposition. The typical succession is well displayed on the southern front of the MacDonnell Ranges immediately to the south of Heavitree Gap and

(1) Geol. Surv. S. Austr., Bull. No. 5, pp. 18, 19.

Mount Gillen. At this place the sedimentary series has been strongly tilted and measurements made by the writer along a meridional line give the following results:—

5. Upper sandstone and quartzite	.. ..	over 550 feet
4. Upper dolomitic limestone	.. ..	7,030 „
3. Middle sandstone and quartzite	.. ..	820 „
2. Lower dolomitic limestone	.. ..	5,500 „
1. Lower sandstone and quartzite	.. ..	750 „
		over 14,650 feet

By reference to the section printed herewith (fig. 2) it will be seen that the thicknesses given in this table are based on clearly defined outcrops of the sandstone or quartzite ridges, whereas the lower and upper dolomitic limestones are

DIAGRAMMATIC
SKETCH SECTIONS ALONG THE
OVERLAND TELEGRAPH LINE
(Not to scale)

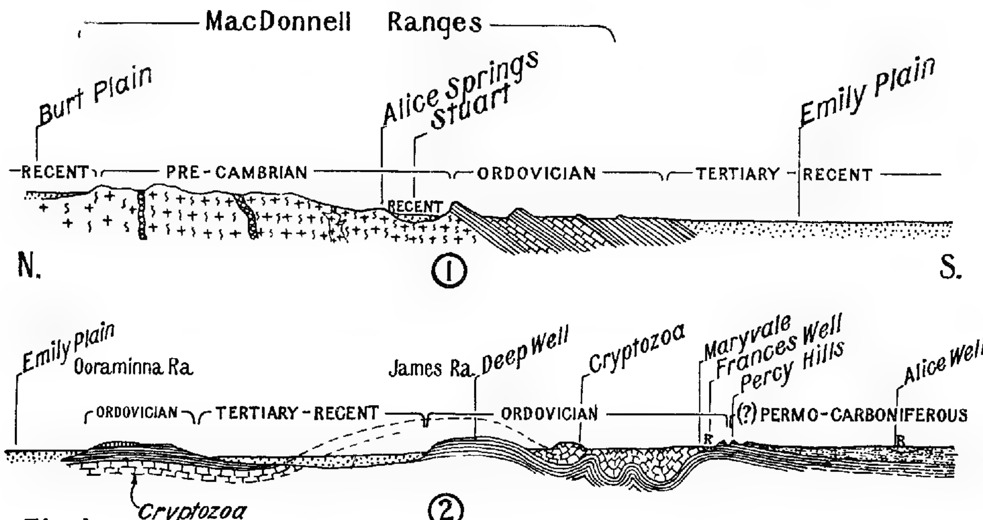


Fig. I

largely concealed beneath alluvium. In the estimation of the thickness of each limestone bed, it has been assumed that these beds extend across the whole width of the valleys occupied by the Police Paddock and the Racecourse (see also fig. 7). This is an assumption that is made tentatively, pending the measurement of other sections, in order to obtain a conception of the thickness of the whole series. Unless there has been some duplication of the beds along the line of the section by strike faulting—and there is no evidence of such faulting having taken place—the total thickness of the series is over 14,650 feet.

The only check measurement made by the writer was made at a place about 4 miles to the south-south-east of Ooraminna Rockhole, in the Ooraminna Range. At this place a dolomitic limestone with *Cryptozoön*, which is possibly identical, stratigraphically, with the lower dolomitic limestone of the section given in fig. 2, was found to have a minimum thickness of 1,200 feet, both upper and lower portions of the outcrop being concealed by alluvium.

It seems probable to the writer that the thicknesses given in the table above to the sandstones and limestones are disproportionately large for the carbonated sediments. It is desirable that other sections be measured at suitable places, such as in the valley of the Ross River, a tributary of the Todd, which crosses the sediments where they are folded into a syncline.

Of the beds included in this series, and occurring along the southern front of the MacDonnell Ranges, no fossil remains were seen in either the lower or the middle sandstone and quartzite, but in the lower dolomitic limestone there is a notable occurrence of the forms assigned to various species of *Cryptozoön*.[2] A sandstone, corresponding probably to the lower sandstone of the section, contains numerous worm-burrows in the eastern part of the James Range, at Deep Well.

In the upper sandstone there are numerous worm burrows, but no other signs of organic life were found by the writer. Unfortunately these tracks of annelids have no stratigraphical value.

The rocks of the series present no very striking lithological characteristics. The sandstones are massive, in part, and in other places flaggy and thin-bedded with a tendency to become shaly. They are pale in colour where exposed in depth, but are coloured deep red at the surface, save where erosion is most rapid. In very many places they are "case-hardened" and converted into dense quartzites. The dolomitic limestones are distinguishable at once in most places, but there are transition beds of red calcareous sandstone at a few localities.

Some stress is placed by the writer on the sequence of these beds shown on the southern front of the MacDonnell Ranges, as in the vicinity of Heavitree Gap and in the Ross River Gorge, for it appears to him that the recognition of this stratigraphical succession seems likely to provide the key to the structure of a very extensive region. The immense thickness of the beds of the series indicates the long persistence of the conditions under which deposition took place, and gives rise to the expectation of a wide lateral extension of the sediments.

So far as personal observations are concerned, the writer would express the opinion that the great series of sandstones and limestones which constitute the Ooraminna and Krichauff Ranges, as well as the eastern portion of the James Range near the Overland Telegraph Line, are identical, stratigraphically, with those of the Heavitree Gap section. The same beds occupy the lower country as far to the southward as Maryvale and Mount Charlotte, on the Hugh River (fig. 1), and there is a small exposure of the series on the Finke River at Polly's Springs, a few miles below Horseshoe Bend (fig. 3). The structure varies from point to point, and different members of the series are exposed to view at different places. The beds are almost horizontal or have relatively low angles of dip in some of the plateaus and ranges, but are steeply inclined at other places where the corrugations caused by folding have been removed by erosion. The structural details will be plain when systematic mapping, starting in the MacDonnell Ranges and working southwards, has been carried out.

From the study of the geological map of the region, by H. Y. L. Brown, and the written accounts of observations by other geologists, it is inferred that the rocks of this series go to build the bulk of the James, Levi, and George Gill Ranges (fig. 6) and extend far southwards beyond the limits of the Northern Territory. Further reference to this matter will be made in a later portion of this paper.

With regard to the age of the rocks of this series, a definite decision is difficult before the palaeontological features and the stratigraphical position of the fossiliferous localities are studied at the same time. It may seem remarkable that there should be a lack of correlation on such an important point. But, as has been indicated above, the regularity and persistence of certain horizons do

(2) Trans. Roy. Soc. S. Austr., vol. xxxviii., 1914, pp. 1-10, pls. i.-v.

not appear to have been recognized at the time when the fossil collections were made, and the sections printed in the report of the Horn Expedition are perplexing. The apocryphal "Map showing the route of the Horn Scientific Exploring Expedition," prepared by the late C. Winnecke and published with a Journal in 1897, but subsequently withdrawn, showed the sites of fossil discoveries, but these sites have no stratigraphical ties, and the fossils described in the report of the Horn Expedition are listed almost entirely without reference to the horizons whence they came.

If the suggested correlation, by the writer, of the rocks forming the southern front of the MacDonnell Ranges with those of the James, Levi, and George Gill Ranges be confirmed by careful stratigraphical mapping, the whole of the series should be regarded as of Ordovician age. This conclusion was reached by the geologists of the Horn Expedition, at least with respect to the lower dolomitic limestone and the lower portion of the middle sandstone and quartzite of the MacDonnell Range where the Finke River crosses the Horn Valley.(3) The Horn Valley is a valley of erosion along the lower dolomitic limestone bed, as may be seen from fig. 9, pl. ii., printed with the geological report of the Horn

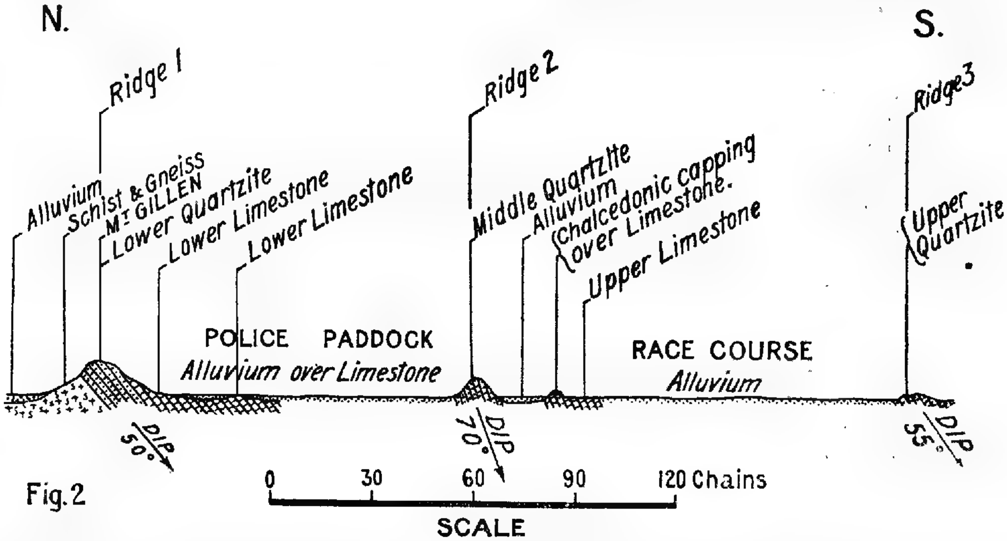


Fig. 2

Expedition, which gives the section through Gill's Pass, immediately to the westward of the Hugh River Gorge.

No fossils have been found yet in the lower sandstone and quartzite, which are, nevertheless, placed by the geologists of the Horn Expedition and the writer in the Ordovician System. There seems to be no reason for the separation of this lower sandstone from the overlying sediments resting conformably upon it. The nature of the sediments has altered with a change of conditions, but the limestones and sandstones seem to be parts of one great series.

If this conclusion be accepted the absence of Cambrian beds above the Pre-Cambrian complex follows, since the lower sandstone rests directly upon the gneisses and schists.

Various opinions have been expressed with regard to the classification of these early Palaeozoic sediments, and the conclusions of different geologists have been summarised by Professor Walter Howchin in a paper presented to this Society, with a description of *Cryptozoön*, discovered by Dr. C. Chewings.(4)

(3) Report of the Horn Expedition, vol. iii., Geology and Botany, p. 47.

(4) Trans. Roy. Soc. S. Austr., vol. xxxviii., 1914, p. 9.

The latter geologist has summed up his conclusions in a paper on the Stratigraphy of Central Australia,[5] and a sketch section from him is included in Professor Howchin's paper. By reference to these accounts it will be seen that Dr. Chewings regards the lower dolomitic limestone and the lower sandstone and quartzite as Cambrian, and that he feels fortified in assigning this age by the discovery of *Cryptozoön* remains.

The writer has visited the locality, near Acacia Well, on the road from Alice Springs to Arltunga, at which Dr. Chewings found the *Cryptozoön*, and found that these remains occur beyond all doubt in the lower dolomitic limestone beds of the series here discussed. The sequence of the formations is shown admirably at this place, and there can be no doubt but that the *Cryptozoön* specimens occur in the lower dolomitic limestone, on the northern margin of a subsequent valley carved in the same limestone, stratigraphically, as that in which the Horn Valley, to the westward, has been produced by erosion. So the *Cryptozoön* specimens occur on the same stratigraphical horizon as *Orthis leviensis*, 10 miles to the west of the Finke River Gorge.[6]

It was pointed out by Professor Howchin, in the paper cited, that the genus *Cryptozoön* is of little value for determining the geological horizon; and, in the writer's judgment, this genus of doubtful affinities cannot affect the determination of the horizon as Ordovician from the evidence of other fossils.

The upper sandstones and quartzites, which tend towards conglomerates in some places, are regarded by the writer as the uppermost members of the series, rather than as members of a separate Post-Ordovician group.

The sands with boulders occurring in the broad plains between the Oraminna Range and the MacDonnell Range on the north, and the James Range on the south, as revealed in the Temple Bar and Indemba Wells, are considered by the writer to be very much younger, though grouped by Dr. C. Chewings with the massive consolidated formation here discussed.

The thickness of the upper sandstones and quartzites of the Ordovician Series is very great indeed, and was estimated by the geologists of the Horn Expedition at not less than 7,000 feet. If this classification is correct and the thickness of the uppermost beds has been estimated accurately, the total thickness of the lower Palaeozoic sediments, which are considered by the writer to be Ordovician in age, is not less than 21,000 feet.

C. The Finke Series of Sediments.

The sedimentary rocks included in this group are pebbly grits, green and white shales and shaly sandstones, coarse cross-bedded pebbly sandstones and grits, and typical tillites with numerous striated boulders.

These rocks were at one time regarded as parts of the Upper Mesozoic group, to which the names of "Desert Sandstone" and "Upper Cretaceous" were applied. Their stratigraphical position appears to have been recognised first by Mr. H. Y. L. Brown, who mapped them separately in 1905.[7] Mr. Brown pointed out in an earlier report that these rocks are sub-Cretaceous.[8] He considered that the porous beds of this series absorbed the drainage from the MacDonnell Ranges and other ranges traversed by the Hugh and Finke Rivers and their tributaries, and thus constituted intake beds of the Great Australian Artesian Basin. This conclusion has received full support and confirmation from more

(5) Trans. Roy. Soc. S. Austr., vol. xxxviii., 1914, pp. 41-52.

(6) Report of the Horn Expedition, vol. iii., Geology and Botany, p. 47.

(7) Report on Geological Explorations in the West and North-west of South Australia, with Map.

(8) Report on Arltunga Gold Field and Hart's Range Mica Field, 1897, p. 12.

recently acquired data concerning the hydraulic surface of the artesian basin[9] and the chemical composition of the water in the different parts of it.[10]

The lowest beds of the series seen by the writer are coarse pebbly grits with sandy argillaceous layers resting unconformably upon the old Palaeozoic sandstone and quartzite at Polly's Springs, near Horseshoe Bend. The grit at this place strikes N. 17° W., and dips eastwards at 10°.

To the north of this outcrop, and probably above the grits stratigraphically (though the recent sand drifts hide the relationship), are white and red shales

DIAGRAMMATIC
SKETCH SECTIONS ALONG THE
OVERLAND TELEGRAPH LINE
(Not to scale)

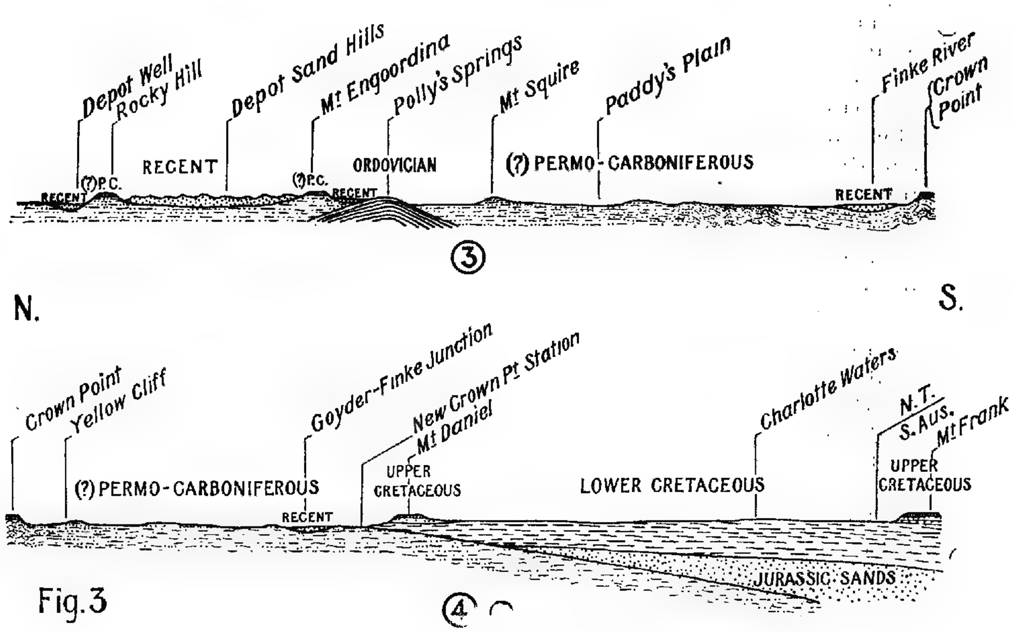


Fig.3

having a thickness of about 100 feet. On these, in turn, rest 70 feet of greenish-grey shales which weather to a deep reddish-brown colour on the face of Mount Engoordina. Above the shale at the latter place is a thickness of at least 100 feet of cross-bedded variegated sandstone and grit, similar in character to that which outcrops on the Goyder River and near Yellow Cliff on the Finke River.

The tillite of Yellow Cliff, Crown Point, and the country immediately to the northward, appears to the writer to be closely related, stratigraphically, to the cross-bedded sandstones. The tillites are coloured purplish and yellow like the sandstones, and at a distance of about three-quarters of a mile to the west-south-west of Yellow Cliff the tillite appears to merge into the cross-bedded sandstone which contains small boulders that have all the appearance of being shaped by glacial action. A full description of the tillite outcrop at Yellow Cliff

(9) Annual Report of the Government Geologist of South Australia for 1921, pl. ii.

(10) R. Lockhart Jack, "The Composition of the Waters of the Great Australian Artesian Basin in South Australia and its significance," Proc. Roy. Soc. S. Austr., vol. xlvii., pp. 316-321.

has been published recently as a result of observations made by Sir Edgeworth David and Professor W. Howchin.[11]

With the tillite are closely associated shaly sandstones which exhibit a notable degree of contortion, ascribed by David and Howchin to contemporaneous pressure of land ice. The tillite of Crown Point is rolled up and contorted to a remarkable degree, and hence it is necessary to regard all signs of dip with extreme caution, much more than would be demanded ordinarily by the nature of the formation.

So far as has been observed, this contortion of the tillite and the associated sandstones occurs along a line bearing north by west, down the course of the creek draining Paddy's Plain and joining the Finke River near Crown Point. Whether the disturbance occurs over any appreciable area to the east and west of this line remains to be determined by areal mapping. No outcrop of the underlying bedrock has been noted along the disturbed zone; but it appears to the writer possible that the buckling of the beds has been caused by some shallow barrier of bedrock that formed an obstacle to the progress of the glacier, or by the melting of the ice along the front of the glacier with the tumultuous deposition of its load of transported sediment and the overthrusting of the deposited material by temporary advances of the ice. On ascending Crown Point it was found that the contortion extended to a vertical height of 270 feet above the flood plain of the Finke River.

On the eastern bank of the Finke River at Cunningham's Gap the glacial beds are essentially horizontal, and so, too, are those constituting the table-topped hill to the north-west of Crown Point, where no variation from the horizontal could be detected with a clinometer.

The traveller from the south first finds the rocks of this group in the neighbourhood of New Crown Point Station, a little below the junction of the Goyder and Finke Rivers. They have been mapped for a considerable distance to the westward along the valley of the Goyder River by H. Y. L. Brown. Northwards, they extend beneath the red sand of the Depôt Sandhills along the Hugh River as far as the Percy Hills to the east of Mount Charlotte. Dr. Chewings has made the observation that the northernmost of the Percy Hills is entirely composed of the older sandstone, containing annelid burrows, of the Ooraminna Range. The writer ascended one of the more southerly hills of the Percy group, and found that the Ordovician sandstone extended upwards for only 40 feet from the base, and that the Finke sandstone rested upon it, constituting the remainder of the hill, which is 170 feet high. The formation extends for some considerable distance to the west of the Hugh River, and the plateau composed of these rocks has been eroded into the characteristic table-topped hills that are familiar in regions where subhorizontal strata have had a like geological history. This physiographical character has misled some early observers, who have classified the rocks of the group with the Desert Sandstone which is on a much higher stratigraphical horizon.

The determination of the age of the Finke Series of sediments is a difficult problem in the absence of palaeontological evidence. One is justified in regarding them, on stratigraphical grounds, as intermediate between the Ordovician and the Lower Cretaceous (Rolling Downs Formation). In the vast interval of time that elapsed between the deposition of the rocks of these two systems, the epoch extending over the upper part of the Carboniferous and the lower part of the Permian periods, was characterized by a world-wide evidence of glacial conditions, probably due to a general lowering of temperature. Moreover, there

(11) Report of Glacial Research Committee, A.A.A.S., Wellington, 1923, vol. xvi., pp. 74-94.

is no large region where these Permo-Carboniferous glacial beds are so well developed as in Australia.

In Western Australia, beds bearing witness of widespread glacial action in Permo-Carboniferous time have been mapped on the Lyons and Irwin Rivers,(12) and similar beds have been found recently on the Fitzroy River. The nearest occurrence, however, to that of Crown Point, is that discovered by Messrs. H. W. B. Talbot and E. de C. Clarke in the region between Laverton and the north-western corner of South Australia.(13) These authors have correlated these Western Australian glacial beds with those of South Australia occurring on at least two different horizons, and assign to the period of glaciation a late Mesozoic

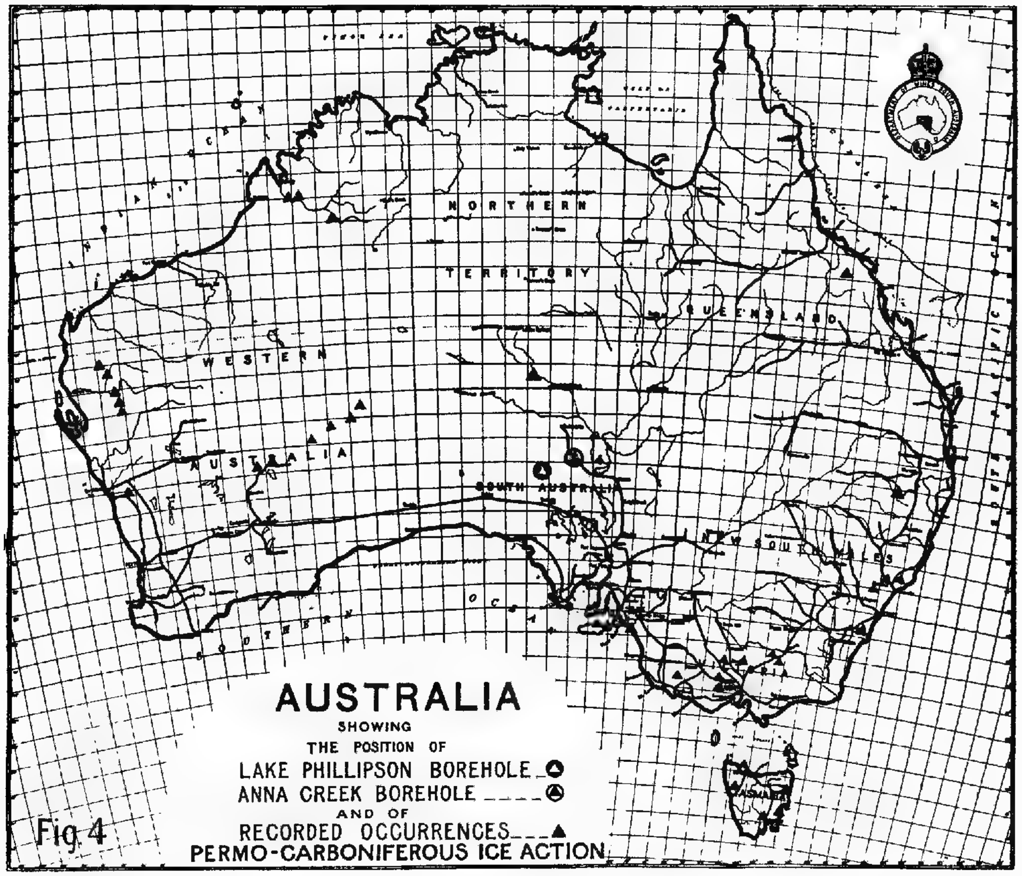


Fig 4

or Tertiary age. But A. Gibb Maitland, in a note appended to a later paper by E. de C. Clarke,(14) is inclined to correlate these beds with boulder beds revealed by boring on the Transcontinental Railway, beneath fossiliferous Miocene and

(12) A. Gibb Maitland, "Relics of the Permo-Carboniferous Ice Age in Western Australia." Anniversary Address, Natural History and Science Society of Western Australia, July 11, 1911.

(13) Geol. Surv. W. Austr., Bulletin No. 75, pp. 105-111, and "The Geological Results of an Expedition to South Australian Border, and some comparisons between Central and Western Australian Geology suggested thereby," Jour. and Proc. Roy. Soc. W. Austr., vol. iii., 1918.

(14) "Note on Occurrence of Boulders, possibly Glaciated, near Leonora and Laverton," Jour. and Proc. Roy. Soc. W. Austr., vol. vi., part i., 1919-1920, pp. 27-32.

Lower Cretaceous rocks. Such a correlation will be seen to be in precise agreement with the stratigraphy recorded for the Crown Point region.

In South Australia, the deep bore near Lake Phillipson (fig. 4) afforded evidence of ice action.[15] The stratigraphical position of these beds is indicated in the section D-D, pl. No. 3, of the Report of the Interstate Conference on Artesian Water, Adelaide, 1921. By reference to that section it will be seen that recent boring operations have shown the Lake Phillipson shales to underlie the water-bearing Jurassic sands of the Great Australian Basin.

During a recent re-examination of the core obtained by a diamond drill from the Anna Creek Bore, R. Lockhart Jack found a small, but perfectly, soled pebble in shale having an angle of dip of 30°. The core in which this apparently glaciated pebble occurred was labelled 711 feet to 802 feet. Stratigraphically, the shale at this spot is placed similarly to the shale in the Lake Phillipson Bore.

The more southerly occurrence of glacial beds in South Australia—on Yorke Peninsula and Kangaroo Island, at Hallett's Cove and in the Inman Valley—are presumed to be of Permo-Carboniferous age, and are certainly Pre-Miocene, but are not associated with fossiliferous beds containing traces of Palaeozoic life. They are correlated with the not very distant glacial beds of Victoria and Tasmania, the age of which has been determined definitely.

In their recent report to the Australasian Association for the Advancement of Science, Sir Edgeworth David and Professor W. Howchin have distinguished clearly between the Crown Point glacial beds and those of later age to which reference will be made below, and have assigned to the Crown Point Series a Permo-Carboniferous age, on the grounds of their lithological resemblance to the beds of which the age is known in the regions far to the south and south-east. In view of the widespread traces of glaciation in Permo-Carboniferous time throughout Australia it seems probable that this correlation is correct; but it is felt by the writer that the case is not yet fully proven, and that we can state confidently only that the glacial beds are Post-Ordovician and sub-Cretaceous (on the evidence near Crown Point), while we can be reasonably sure that they are sub-Jurassic (on the attempted correlation with the boulder-bearing shales of the bores at Lake Phillipson and Anna Creek).

If these glacial deposits are not correlated with other deposits of similar character elsewhere in the Australian region, and if they are regarded as individual occurrences, it is pertinent to enquire at what other epochs of geological time between the Ordovician and the Jurassic have traces of glaciation been found in the record of the rocks; yet it must be admitted that any significance that such evidence may have is not based securely on a satisfactory proof of the causes of glacial epochs. The widespread glaciations of Upper Pre-Cambrian, Permo-Carboniferous, and Pleistocene times are surely due to a world-wide alteration of climatic conditions, rather than to changes at localities of limited extent due to local elevation of the land. But the following signs of more limited glaciations have been recorded:—

Glacial till has been found in Alaska between fossiliferous beds of Middle Silurian age.[16] Definite traces of glaciation have been found in South Africa in the Table Mountain Series, which are placed at the bottom of the Devonian,[17] and which C. Schuchert considers to be possibly of late Silurian age,[18] and contemporaneous with the period of mountain building known as the Caledonian.

(15) H. Y. L. Brown, "Report on Geological Explorations in the West and North-west of South Australia," 1905, p. 5.

(16) E. Kirk, "Palaeozoic Glaciation in Alaska," Am. Jour. Sci., 1918, p. 511.

(17) A. W. Rogers, "On a Glacial Conglomerate in the Table Mountain Sandstone," S. Af. Phil. Soc., vol. xi., 1902.

(18) C. Schuchert, "Climates of Geologic Time," in "The Climatic Factor," p. 277.

Traces of glaciation in the Upper Old Red Sandstone beds are recorded in the north of England,[19] apparently of later date than the South African occurrence mentioned.

Above the Carboniferous and Permian rocks (signs of glaciation in which have been mentioned), comes the Triassic system. In this there are in the United States conglomerates suggesting a glacial origin,[20] but no support is given to this hypothesis by the record of organic life.

At the close of the Triassic period there was a marked mortality in certain groups of organic life, notably with most families of the Ammonites. There are fewer corals and their occurrence is restricted. The insects of the lower beds are dwarf types. A general cooling of the climate at the beginning of the Jurassic period is inferred, and a glacial origin has been suggested for certain Scottish conglomerates of Liassic age.[21]

From these brief references it will be seen that, though signs of glaciation have been recorded at a few localities in the rocks belonging to periods between the Ordovician and Jurassic, no widespread glaciation has taken place other than that of Permo-Carboniferous age. Hence it seems extremely probable that the glacial deposits of Crown Point are to be grouped with the many similar Australian deposits of Permo-Carboniferous time. The discovery of fossil evidence in the central region will be most welcome, and would assist in the solution of this problem.

D. The Jurassic Sands.

From the many boreholes drilled to tap the supplies of water in the Great Australian Artesian Basin it has been found that the Jurassic sands, which outcrop in Queensland on the eastern margin of the basin, extend westwards across the northern part of South Australia and the south-eastern corner of the Northern Territory. So far as is yet known with certainty, there is no outcrop of these sands on the western rim of the basin, but these sands, constituting the immense aquifer of the basin, are known to receive accessions of water from the central region. It has been shown that the hydraulic surface of the basin affords clear proof of a westerly intake area,[22] and that the quality of the water in the extreme western portion of the basin is affected in a pronounced way by the nature of the water absorbed in this region.[23] The water derived from westerly sources is characterised by predominant sulphates in solution, whereas the more easterly waters contain predominant carbonates. The sands are known, from the results of boring operations, to carry fragments of lignitic material wherever samples have been brought to the surface. Possibly this carbonaceous matter may bring about the reduction of the sulphates to sulphides, with consequent precipitation of pyrites.

The water-bearing sands, though not outcropping at any known point, must receive a proportion of the water traversing the main channels of drainage after this water has been absorbed by the Finke Series near the junction of the Goyder and Finke Rivers, and by much younger sands in the valley of Arckaringa Creek, the Alberga River, and Hamilton Creek, where these waterways cross the rim of the basin. In view of the evidence of a notable absorption of water from the area near the Goyder-Finke junction, it seems probable that the Jurassic

(19) Sir A. Geikie, "Textbook of Geology," vol. ii., pp. 1001, 1011.

(20) Chamberlin and Salisbury, "Geology," vol. iii., p. 29.

(21) C. Schuchert, "Climates of Geologic Time," in "The Climatic Factor," p. 281.

(22) Geol. Surv. S. Austr., Bulletin No. 5, p. 45. Annual Report of the Government Geologist of South Australia for 1921, Map of Artesian Basins.

(23) R. Lockhart Jack, "The Composition of the Waters of the Great Australian Artesian Basin in South Australia and its Significance," Trans. Roy. Soc. S. Austr., vol. xlvii., 1923, pp. 316-321.

sands are in direct contact with the porous sandstones of the Finke Series beneath the Lower Cretaceous marine shales of the Rolling Downs Formation (fig. 3).

The thickness of the Jurassic sands is unknown in most parts of the Great Artesian Basin in South Australia, being found only by penetrating the overlying shales in the great majority of the boreholes. Operations ceased as soon as the flow of water was obtained, but near the western margin of the basin the hydraulic surface dips below the ground and subartesian conditions prevail, so that the investigation of the water-bearing beds is more easily made. At Wintinna Bore, on Arckaringa Creek and just to the west of the 134th meridian, the Jurassic sands have a proved thickness of 363 feet, and boring ceased before traversing the whole of the formation. At Charlotte Waters the old borehole, drilled in 1897-1899, entered the Jurassic sands at 614 feet from the surface, and the sands had not been completely traversed when boring ceased at 1,474 feet. This thickness, of 860 feet, is the greatest recorded. The marginal borehole, Stuart's Range No. 1, at 224 feet 6 inches from the surface entered typical Jurassic sands with nodules of pyrites and fragments of lignite. Boring was continued in sand to a depth of 458 feet. At this point grey shale was penetrated and continued to the bottom of the hole at 485 feet. At Stuart's Range No. 2 borehole, about 14 miles to the north-east of No. 1, two beds of sand were proved, with grey shale between them. The upper extended downwards from 47 feet to 253 feet, and the lower from 343 feet to 486 feet. Below this lower sand the borehole penetrated shale (with a 6-feet bed of sand at 831-837 feet) to the bottom of the hole at 1,000 feet from the surface.

E. The Lower Cretaceous Marine Shales (Rolling Downs Formation).

Resting immediately upon the Jurassic sands, and acting as the impervious cover, which confines the artesian water, are the dense blue shales which contain thin calcareous beds and were deposited under marine conditions. These shales are known from the boreholes in South Australia and the Northern Territory as well as from outcrops at localities where erosion has removed the overlying strata. Many fossils have been collected from some outcrops.

The extent of this formation determines the limits of the basin within which artesian water (under pressure greater than that of the atmosphere) exists. Beyond its limits ground water (not under pressure) may be found in the upper portions of the aquifer of the basin, but this water will not rise if struck in a well or bore. The marine shales are 494 feet in thickness at Charlotte Waters and probably thin out towards the north and west. They have not been recorded beyond the neighbourhood of Mount Daniel (fig. 3).

One interesting feature of the terrain occupied by this impervious formation is the noteworthy development of a surface drainage system. The surface waters of this region, on the occasions of the infrequent falls of rain, are carried towards the central depression of Lake Eyre; but beyond the limits of the basin, where also the drainage is internal, the watercourses are relatively few and short or discontinuous.

F. The Middle Cretaceous Lignitic Shales.

In many of the boreholes that have been drilled in South Australia to tap the artesian water of the Great Australian Basin a considerable thickness of shales associated with lignite have been found to overlie the marine blue shales which rest on the water-bearing sands. These upper shales have a greenish-grey colour that is distinct from that of the marine shales below them. They are somewhat arenaceous in part, and artesian water is obtained from them in the far north-eastern corner of South Australia, on Cordillo Downs.[24] The thick-

[24] Geol. Surv. S. Austr., Bulletin No. 11, pp. 13-18.

ness of this formation is greatest, so far as is yet known, at Patchawarra Bore, near the eastern boundary of South Australia, where it is 3,533 feet. To the south and west the thickness diminishes, but is still considerable in the Lake Eyre and Lake Frome regions.[25] To the southward of Lake Frome the lignitic shales overlap the marine shales, but to the westward of Lake Eyre these upper beds thin out and disappear. So far as is known they do not extend into the Northern Territory, as they have not been found in the boreholes at Charlotte Waters and Anacoora (50 miles east of Charlotte Waters). The characteristic upper shales were penetrated, however, by the Hamilton Creek, Breaden, and Oodnadatta boreholes.

G. The Upper Cretaceous ("Desert Sandstone") Series.

Resting upon the Cretaceous shales is a series of pale-coloured clays, claystones, and sands, or argillaceous sandstones with thin beds of impure limestone, having immense lateral extent. Some of these sediments are white, others yellow to reddish. Superficially the rocks of this series (as well as those of other series) have been altered by secondary silicification. The characteristic outcrops are therefore capped with a dense and hard crust of flinty quartzite and porcellanite; or, where denudation has been active, strewn with the "gibbers" resulting from the disintegration of this capping. No measurements of the full thickness of this series near the Overland Telegraph Line are available, and the boreholes have been located in the valleys or depressions produced by the partial removal of the constituent beds by erosion. In the Cordillo Downs area, in the far north-eastern part of South Australia, the full thickness of the series has been found to be about 360 feet,[26] and in that area the uppermost third consists of arenaceous beds, the middle third of argillaceous beds, and the lowest portion is both argillaceous and arenaceous. It is not known whether a similar succession exists in the region lying to the westward.

The rocks of this series contain marine fossils and also fragments of silicified wood at a number of places widely scattered. They were deposited during a period of marine transgression which extended as far to the westward as the 133rd meridian of east longitude in the country drained by the Alberga River—far beyond the boundaries of the Great Australian Artesian Basin. The formation was at one time essentially continuous across the region between the artesian basin and that part of the Transcontinental Railway which extends from Tarcoola to Woocalla. Only the higher land, such as the Peake and Denison Ranges, stood above the level to which sedimentation reached, but subsequent denudation, following upon elevation, has removed a great part of the formation; in many places the remnants only of the plateau remain. In other places residual peaks (such as McDouall Peak) mark its former extent, and, in yet other places, beds of characteristic lithological composition, with or without siliceous capping, are found resting on the older formations. These Upper Cretaceous rocks may be traced northwards into the Northern Territory near Charlotte Waters, but do not appear to extend along the Overland Telegraph Line beyond the area round Mount Daniel. Possibly Mount Townsend should be included in this group, with the plateau remnants farther to the east.

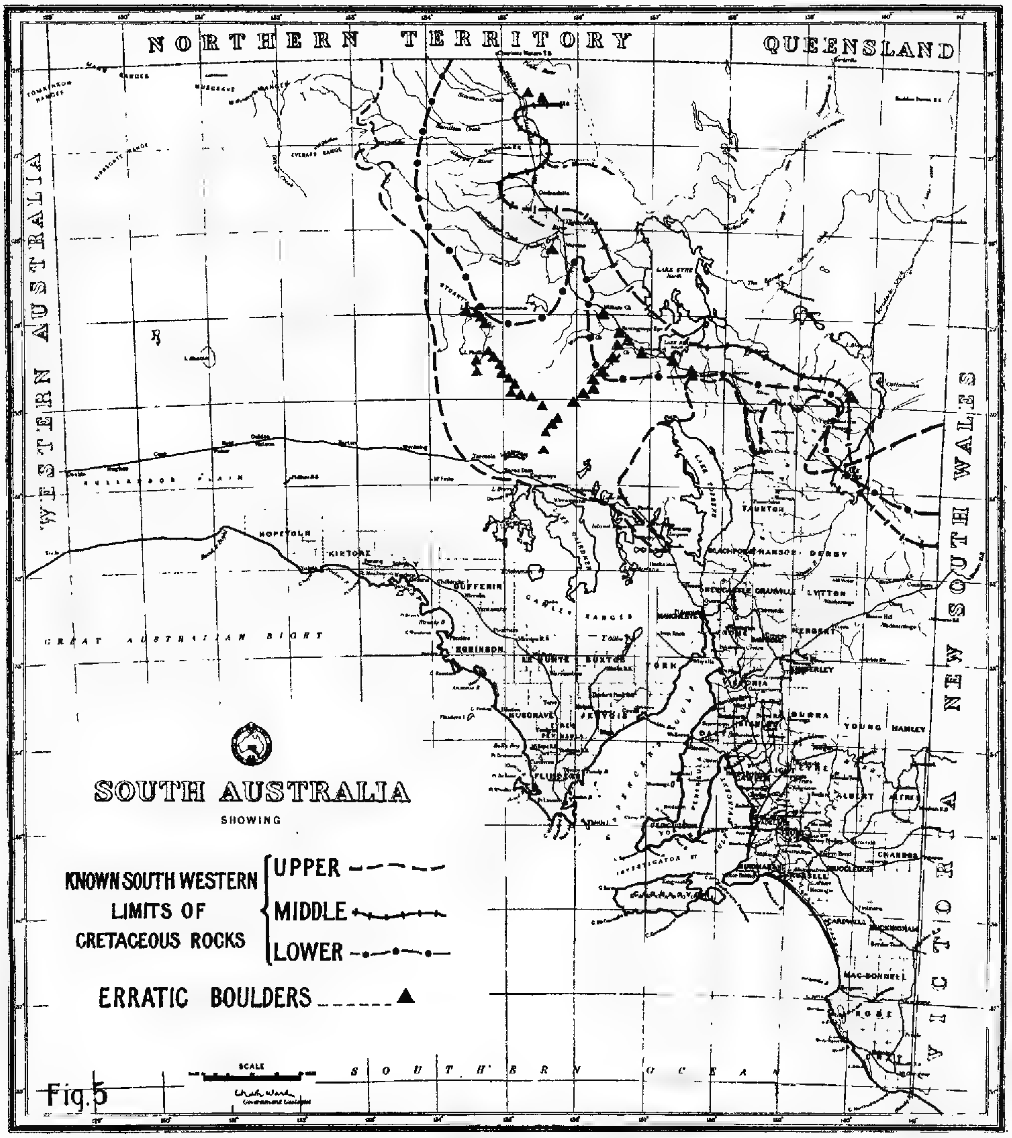
One of the most interesting features of this series of sediments is the very widespread occurrence, within its limits, of boulders that appear to be true glacial erratics. A glacial origin for the boulders was indicated by H. Y. L. Brown, who remarked on their wide distribution in his annual report for 1894. References

(25) See sections, pls. 3 and 3a, Report of the Third Interstate Conference on Artesian Water, 1921.

(26) Geol. Surv. S. Austr., Bulletin No. 11, p. 13.

to these erratics in official publications are summarized elsewhere.[27] Their location is shown on the map, fig. 5.

The existence of the erratics near Dalhousie Station has been recognised recently by Sir Edgeworth David and Professor Walter Howchin, whose report is published in the record of the Glacial Research Committee of the Australasian



Association for the Advancement of Science.[28] In this report the authors express the opinion that the glaciation was later than Lower Cretaceous, and probably Upper Cretaceous. From his own observations near the Dalhousie Mound Springs and the Duckponds (a few miles south-east of Blood's Creek borehole), and from more recent observations made in conjunction with his colleague, Mr. R.

(27) Geol. Surv. S. Austr., Bulletin No. 5, pp. 42-44.

(28) Proc. A.A.A.S., vol. xvi., 1924, pp. 74-94.

Lockhart Jack, in the region between the Great Artesian Basin and the Transcontinental Railway, the writer places the glaciation definitely in the later part of the Upper Cretaceous period. While it may happen that the more resistant erratics remain after the removal of the formation in which they were embedded, and be found resting upon Lower Cretaceous shales, as does happen at Dalhousie, at Blanche Cup, near Beresford Hill, and on the Stuart's Range opal field, it is significant that these boulders are found also resting on the Upper Cretaceous rocks in many places, as at Dalhousie (in part), Stuart's Range, Mount Eba Station, Arkeeta Claypans, and the country drained by Woorong Creek. At many of the latter places the erratics have been noted far beyond the limits of the Lower Cretaceous shales, as may be seen from the plan printed as fig. 5. The boulders are in some cases very large, up to 150 lbs. in weight; they consist of rocks (quartz, quartzite, felspar porphyry, greenstone, granite, and gneiss) outcropping at considerable distances, and they are angular, subangular, and waterworn. Some of the boulders appear to have been soled, and many have the outlines characteristic of glaciated boulders, though the only one found hitherto with glacial striae is that recorded by Sir Edgeworth David and Professor Howchin. There can be no doubt of their glacial origin, and the writer would place the glacial horizon high up in the Upper Cretaceous.

Looking for correlative evidence elsewhere in the world as to glacial conditions at a corresponding period, we may note the following occurrences and deductions:—

The evidence for a warm temperate climate, uniformly distributed, with well-marked seasonal changes, is well established for the earlier part of Cretaceous time.[29] During the Upper Cretaceous, life, generally, indicates a warm climate with climatic zones not so marked as those of to-day, yet a glacial origin has been suggested for the boulder beds constituting the lower portion of the Flysch formation of the eastern Alpine region of Europe.[30] These beds are probably of Upper Cretaceous age.

Evidence of local glaciation, at the end of the Cretaceous period or the beginning of the Eocene, has been recorded by W. W. Atwood in respect of the San Juan Mountains of Colorado, where beds of tillite, 80-100 feet thick, containing boulders that have been brought from a distance of 40 miles, give proof of alpine and piedmont glaciers.[31] The occurrence of such tillites in elevated regions is not contradictory to the evidence of general climatic conditions at lower altitudes, and it is considered, from the study of botanical and zoological evidence, that the climate of Upper Cretaceous time continued, with some slight reduction of temperature, into the Lower Tertiary epoch.

If a glacial origin for the boulders distributed over the Upper Cretaceous terrain in South Australia be correct, it would seem that they were distributed by floating ice in the Upper Cretaceous sea. The source of the icebergs would appear to be the western and southern shores of that sea.

The rocks represented in the erratics are found in the MacDonnell and Musgrave Ranges, and in the area extending for 50 miles to the north-west of Tarcoola. More distant sources, for the felspar porphyry, are the Gawler Ranges in South Australia and the Warburton Range in Western Australia (lat. 26° S., long. 127° E.). The highest land masses at the close of Cretaceous time, were the regions embracing the Musgrave and Gawler Ranges, so far as is known, and it seems proper to look to these regions for the source of the erratics.

(29) C. Schuchert, "Climates of Geologic Time," in "The Climatic Factor." F. H. Knowlton, "Evolution of Geologic Climates," Bull. Geol. Soc. America, vol. 30, pp. 520-528. C. E. P. Brooks, "The Evolution of Climate," p. 37.

(30) Chamberlin and Salisbury, Geology, vol. iii., pp. 172 and 218.

(31) Pirsson and Schuchert, Textbook of Geology, p. 913.

H. The Fluviatile Deposits.

The broad valleys crossed by the Overland Telegraph Line between the eastern portion of the James Range and Ooraminna Range, and between Ooraminna Range and the MacDonnell Ranges, are filled to a considerable depth by unconsolidated sediments of fluviatile origin.

Indemba Well, about 15½ miles north of Deep Well, was sunk in the southerly valley of the two mentioned above, to a depth of 240 feet, and the bottom was still in the sand and gravel. A crust of travertine limestone reached from the surface to 12 feet, and the rest of the sinking was done through an ashy-grey sand containing some mica and waterworn stones. The travertine at this place occurs in a strip about 8 chains in width.

Temple Bar Well, on the creek of the same name, about 12 miles to the south of the town of Stuart (Alice Springs), was sunk to a depth of 250 feet. Except for an argillaceous bed, cut at 60 feet from the surface, all the sinking was carried out in river wash with boulders, and the full thickness of the formation was not penetrated. The broad valley which stretches far to the westward along the southern front of the MacDonnell Ranges is filled with similar fluviatile material. At a few places there is a travertine capping similar to that at the site of Indemba Well. The rivers leaving the ranges—the Jay, the Hugh, and the Finke—have cut their way down through these old river gravels, and characteristic terraces indicate the stages of dissection.

Other fluviatile gravels are deposited where the streams encounter natural obstacles in their paths to the southward; as, for example, in the case of the Todd River above Heavitree Gap, and of the Hugh River to the north of Mount Charlotte and the Percy Hills. High-level gravels occur also along the course of the Hugh River near Alice Well.

I. The Aeolian Deposits.

Covering immense areas with a mantle, and, in places, such as the Depôt Sandhills north of Horseshoe Bend on the Finke River, heaped up in great parallel dunes, are the aeolian sands. These have a characteristic Indian red colour, and are, on the whole, stationary. Large trees (*Casuarina decaisneana*, the "desert oak") grow in the interdune valleys of the Depôt Sandhills, and smaller shrubs on the crests of the dunes. Nor are there signs of dead vegetation on the windward side of the dunes, such as may be seen after the passage of "marching" dunes.

The crests rise to a height of about 50 feet above the troughs, and the crests are half a mile or less apart. The trend of the Depôt dunes is N.W.-S.E., with the steeper fall on the north-eastern slopes.

It seems probable that these sand ridges, like those occurring at the eastern edge of the Nullarbor Plain, accumulated under climatic conditions rather different from those of to-day. Their mobility has been arrested under the present-day system of atmospheric circulation.

J. The Siliceous Capping.

Although not a stratigraphical unit, the capping of dense chalcedonic quartzite merits separate mention in much the same way as the sediments described above. For its wide lateral extent and general uniformity of character have led, in the past, to the belief that it occupied a definite stratigraphical position at the top of the Mesozoic system. It seems certain that the silicified crust was identified with the Desert Sandstone far beyond the limits of the Upper Cretaceous terrain, and that the Upper Cretaceous rocks were on that account considered to extend far to the northward.

The sediments of the Finke Series are capped with the same siliceous crust as the younger rocks to the southward; as, for example, at Crown Point and thence northward, as far as the formation can be traced, on the Percy Hills. The general appearance of the remnants of the plateau which was silicified superficially is identical, whether the rocks of the plateau are Upper Cretaceous or of the Finke Series (? Permo-Carboniferous). This similarity is due merely to the action of the forces of erosion upon one physiographical unit which embraces formations on different stratigraphical horizons.

Similar cappings are found in some places on the Ordovician rocks also. Typical occurrences are those of the Ooraminna Range, of the capping on the

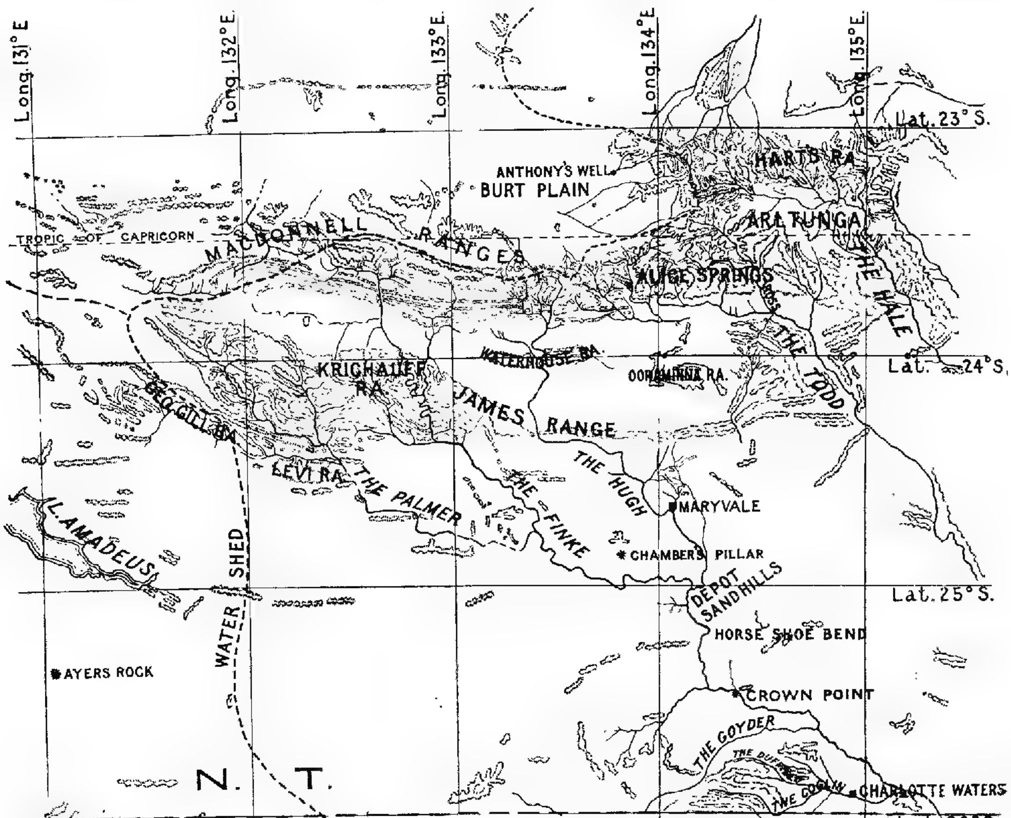


Fig. 6 MAP OF PORTION OF THE NORTHERN TERRITORY

upper limestone immediately to the south of the middle quartzite of the MacDonnell Range Series (fig. 2), of the capping of the lower limestones in this series at Jessie Gap, and of the eastern end of the James Range, to the east of Deep Well and along Phillipson's Creek. An interesting structural feature connected with this superficial silicification is the occurrence of "dykes" of the chalcedonic quartzite on the Ooraminna Range and the James Range near Deep Well. At these places the impregnation of the rock with silica has proceeded downwards along the major joint planes. Subsequent weathering has removed the softer and more friable sandstone, and the dense secondary siliceous material stands out in bold relief, just as igneous dykes do, where their enclosing rocks are more easily eroded,

III. PROBLEMS OF CORRELATION AND THE EVOLUTION OF THE GEOLOGICAL STRUCTURE.

The sequence of events, which has resulted in the structural features of the present day, may be briefly outlined in the following way:—

The oldest sedimentary rocks which are present in the region have not been mapped in sufficient detail for the Pre-Cambrian history to be written up in full. There is evidence, in the lithological character of the rocks, of more than one period of sedimentation. The ore-bearing quartzites of Arltunga,[32] 340 feet in thickness, are perhaps the uppermost of the Pre-Cambrian sediments in the MacDonnell Ranges. All of these rocks have suffered deep burial, and have been invaded by igneous material. The auriferous veins and the pegmatites carrying mica and beryl were probably introduced during this epoch.

It is not yet possible to establish a close correlation of these oldest sediments of the MacDonnell Ranges with the formations of the region to the south and east of the Musgrave Ranges. Possibly the Arltunga quartzites are to be regarded as the equivalents of the lowest sediments formerly considered to be Cambrian in the Musgrave Range region.[33] It is now considered that these old sediments, with their tillites, should be more properly classified as Upper Pre-Cambrian.

On lithological grounds, the metamorphic grit of Ayers Rock, and the coarse conglomerate of Mount Olga, to the south of Lake Amadeus, should be grouped with the Pre-Cambrian rocks.

Following upon the elevation of the central region, before the opening of the Palaeozoic era, there was prolonged denudation, which seems to the writer to have extended throughout the Cambrian period.

A subsequent transgression of the sea, in Ordovician time, brought about the deposition of an immensely thick series of sediments. Of these, the siliceous members, with their numerous ripple marks, were deposited in shallow water on the margin of an area that was probably subsiding rapidly. The dolomitic limestones were probably deposited in somewhat deeper water. The Ordovician sea spread far to the southward and westward, where the sediments deposited within its limits may be traced, in the absence of a covering mantle of younger rocks. It has been indicated above that the rocks of the MacDonnell Ranges, to all of which the writer ascribes an Ordovician age, extend across the region occupied by the Waterhouse, Krichauff, George Gill, Levi, Ooraminna and James Ranges; and outcrop also at Mount Charlotte and Polly's Springs (south of Horseshoe Bend) (see figs. 1 and 6).

In South Australia rocks of corresponding lithological characteristics have been mapped on the western margin of the Great Artesian Basin at Mount Johns, Chambers Bluff, and Mount Chandler, on the head of Arckaringa Creek, and on Ammaroodinna Creek.

Isolated remnants of a once-continuous formation occur far to the westward. Schneider Hill, Mount Bonyboninna,[34] and many hills in the far north-western corner of South Australia[35] constitute links with the more continuous outcrops of the Townsend Range in Western Australia.[36]

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(32) H. Y. L. Brown, "Report on the White Range Gold Mines, Arltunga Goldfield," 1902.

(33) Geol. Surv. S. Austr., Bulletin No. 5, pp. 19-23, and section facing p. 46.

(34) Geol. Surv. S. Austr., Bulletin No. 5, pl. ii.

(35) Map of the Elder Scientific Exploring Expedition, 1891-2.

(36) Geol. Surv. W. Austr., Bulletin No. 75. H. W. B. Talbot and E. de C. Clarke, "The Geological Results of an Expedition to South Australian Border and some Comparisons between Central and Western Australian Geology suggested thereby," Proc. Roy. Soc. W. Austr., vol. iii.

The broad dissected plateau on the western side of the Spencer's Gulf-Lake Torrens Rift, with its numerous flat-topped outliers near Iron Knob and Port Augusta West, has long been regarded by H. Y. L. Brown as a probable southerly extension of the same series. The evidence now available, though no fossils have been found hitherto in this region, certainly supports Brown's hypothesis, which is based on lithological features. If this correlation proves correct, it is reasonable to expect that Ordovician rocks will be found to the eastward of the Torrens Rift, among the old sediments of the Flinders Range.

In neither the Northern Territory nor South Australia have there been found volcanic rocks associated with the sediments, such as have been noted by Messrs. Talbot and Clarke at the base of the Ordovician series of the Townsend Range.

At some period following upon the Ordovician, and prior to the deposition of the Finke Series of sediments (? Permo-Carboniferous), there were notable earth movements within the Ordovician terrain, followed by extensive erosion. The crustal movements were in part radial—resulting in the elevation of the bed of the Ordovician sea, and in part tangential—producing the bending and fracture of the Ordovician rocks.

Of the folds due to these crustal movements the most prominent to-day is the great anticlinal fold of the MacDonnell Ranges, with its axis approximately east and west for a distance of at least 150 miles. The northern limb of the fold is lost by erosion to the north of Alice Springs, where it might otherwise have been expected to occur; but to the westward of Alice Springs, the northwards-dipping sediments are visible, and Simpson's Gap is corroded through the ridge composed of the basal Ordovician quartzite, just as Heavitree Gap has been cut down through the same bed on the southern limb of the great fold. A series of measured sections across the ranges at intervals of a few miles is wanted to check the measurements of thickness given on an earlier page of this paper and to furnish details with regard to the folding.

The axis of this great fold maintains its easterly course as far as Mount Undoolya, where it is broken and bent abruptly to a course bearing N. 40° E. towards Mount Benstead. Abrupt alterations of strike at points where there are breaks in the range are noticeable as far to the eastward as Love's Creek Station.

In the eastern portion of the MacDonnell Ranges—in that portion which has been named the Fergusson Range—there is a well-defined synclinal fold across which the Ross River has cut its way.

Folding in other parts of the MacDonnell and other ranges to the southward has been indicated in the Report of the Horn Expedition.[37] Some of the folds produced features of high relief at such places as the area lying to the east of Mount Burrell, between Maryvale Station and the James Range near Deep Well, where now the planed-down edges of the folded rocks exhibit few prominences (fig. 1).

It seems probable that some of the present features of relief have been determined in part by strike-faulting that may have accompanied the Post-Ordovician elevation and folding; as, for example, along the northern fronts of the Waterhouse and Krichauff Ranges (fig. 6). The presence or absence of such faulting will be determinable when areal mapping of the Ordovician sediments has been carried out.

These crustal movements were followed by a long period during which the central portion of Australia remained elevated above the sea and subject to subaerial denudation. No trace of Silurian nor of Devonian sedimentation is known. The deposits here grouped and described as the Finke Series may have been laid

(37) The Horn Expedition, vol. iii., Geology and Botany, pls. i. and ii.

down on a sea shore of Permo-Carboniferous time. The greenish shales at the base of Mount Engoordina, at Horseshoe Bend on the Finke River, are ripple marked. These sediments rest upon the Ordovician foundations, and do not occur, so far as known, at any places but those where the Ordovician rocks were worn down by erosion to relatively low levels. The localization of the glacial deposits of the series near Crown Point awaits the explanation that areal mapping may provide.

Perhaps the most interesting feature of this period of sedimentation, during which the rocks of the Finke Series were deposited, is the indication of the beginning of the great central Australian depression. The rocks of the Finke Series, together with the supposed glacial deposits revealed by the Lake Phillipson and Anna Creek Bores, appear to have been formed on the western margin of a central Australian sea which occupied a broad depression that persisted through the Mesozoic era. They are separated now, and appear to have been separated at the time of their formation from the Western Australian glacial beds by a continental mass extending southwards from the Musgrave Ranges. There is, moreover, no sign of connection between the Finke beds and the glacial deposits in the southern part of South Australia.

Upon the Permo-Carboniferous sediments, and probably after slight elevation which caused a contraction of the area of deposition, the Jurassic sands were laid down in a broad lake. Then followed a downward movement which resulted, in Lower Cretaceous time, in the formation of a great inland sea. The marine sediments of this period overlapped the Jurassic sands at many places round the margin of the central depression, as, for example, in the Lake Frome district and near Charlotte Waters. But near Stuart's Range, on the upper Arckaringa Creek, and probably also on the Alberga River and Hamilton Creek near the 134th meridian of east longitude, there was no such overlap, and the Jurassic sands are covered only by the Upper Cretaceous and by Recent unconsolidated sands.

After this great marine transgression, during which the shales and limestones of the Rolling Downs Formation were deposited, the connection of the inland waters with the ocean seems to have been broken. But the depression still existed and sedimentation continued, the shales being associated with lignitic beds. From the distribution and thickness of these beds, here termed Middle Cretaceous, it may be inferred that the mediterranean depression was deepest in the far north-eastern corner of South Australia, where the Patchawarra borehole proved the beds to have a thickness of over 3,500 feet (between 345 and 3,878 feet from the surface,[38] and that the downward movement in the Lake Frome region was still in progress while the beds were being formed, for there is a well-marked overlap (fig. 5) of the Middle over the Lower Cretaceous beds, proved by boring operations.[39] On the west, there may have been a pause in the downward movement, and even a slight elevation, since the Middle Cretaceous sediments do not extend so far westwards as those of the Rolling Downs Formation.

While the latter stages of the filling of the central depression were in progress there was some erosion of the marginal portion of the marine shales of Lower Cretaceous age, so that their outcrops show low angles of dip.

At the termination of this period of sedimentation, in fresh or brackish water, there was another downward movement which resulted in marine transgression far beyond the limits of the Lower and Middle Cretaceous basins. This Upper Cretaceous sea was limited by the high lands of the Musgrave and Everard Ranges in the northern part of South Australia, and did not extend far into the

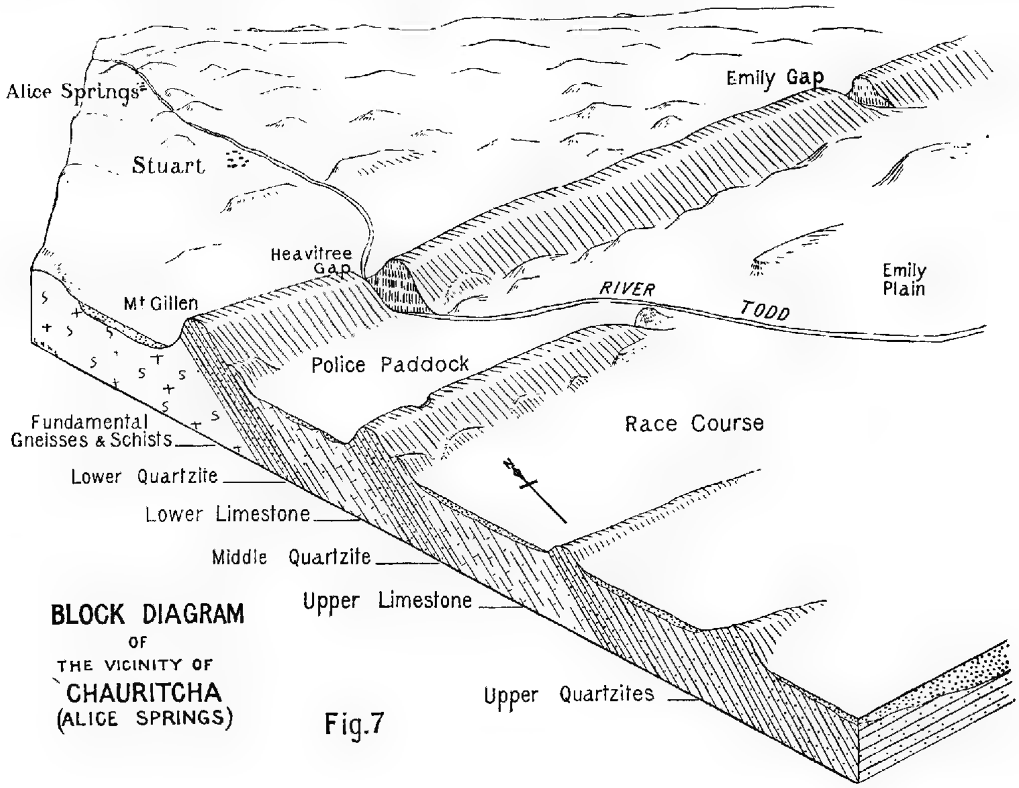
(38) Geol. Surv. S. Austr., Bulletin No. 11, p. 11.

(39) Report of the Third Interstate Conference on Artesian Water, 1921, pls. 3 and 3a.

Northern Territory, but, to the south of Stuart's Range, it stretched to the Transcontinental Railway between Tarcoola and Woocalla. Its limits beyond the Flinders Range, in the Lake Frome region, may have been wider than is indicated in the map showing the extension of the rocks (fig. 5).

Reference has been made above to the probable distribution of numerous erratic boulders by floating ice in the Upper Cretaceous sea, and to the source of these boulders.

With the aggregation of these late Mesozoic rocks the processes of sedimentation on a large scale came to an end. Elevation of the whole central region followed. The sea retreated from continental Australia and throughout the Tertiary period to the present day the interior of Australia has been subject to continuous subaerial denudation. The Mesozoic rocks, on elevation above sea level, formed a broad plateau region which extended northwards in one unbroken physiographical unit over the terrain occupied by the Finke Series of sediments,



BLOCK DIAGRAM OF THE VICINITY OF CHAURITCHA (ALICE SPRINGS)

Fig.7

and possibly also over the older rocks of the MacDonnell and other ranges. At the present time the remnants of this plateau slope gently towards the Lake Eyre depression, whither the drainage trends. The dissection of this plateau has been in progress over an immensely long period, and the bulk of rock matter removed by erosion is very great indeed. It is not possible to account satisfactorily for the vast amount of material removed without postulating one or more outlets from the central depression. The action of the wind in removing material has surely been insufficient. Yet the Lake Eyre basin of to-day is not filled, as we know from boring operations in the Great Artesian Basin, with a great thickness of post-Mesozoic sands large enough to account for the erosion of the Permo-Carboniferous and Mesozoic rocks. We are not in a position to say whether the great sandy region occupying so large a portion of eastern Western Australia and western South Australia has derived its sands from the central region. If the drainage formerly trended in that direction, its traces have been obliterated, so far as we know now, by the later stages of progressive denudation.

Far back in the Tertiary period the climatic conditions of the central region favoured the extraordinary development of a siliceous crust, which formed over the Upper Cretaceous, the Finke Series, and even the Ordovician sediments, and which is visible to-day on the residual fragments of the dissected plateau. It seems probable that induration of the surface, by the introduction of ferruginous and siliceous cement, is still taking place; as, for example, in the flats and depressions to the north-north-west of McDouall Peak Station and to the east and north-east of Lake Wirrida. This superficial silicification has been noted not only in the form of cappings on the sedimentary rocks of the arid region, but also on the outcrops of the lodes,[40] and, in these latter cases, at least, the process has been in operation until recent times.

The physiographical features of to-day represent the algebraic sum of the processes thus briefly outlined. The great folded mountain range of the MacDonnells shows well-marked signs of maturity. The traveller approaching Alice Springs from the south is confronted by what appears to be a great rock wall or rampart. The wall seems to him to be extraordinarily regular in height and to be unbroken for a distance of many miles. The chief notch in the wall seen from a distance is Emily Gap, but the continuity is broken farther to the eastward near Mount Undoolya. From a closer viewpoint, the small conical hill, known as Mount Blatherskite, is seen to occur at a structural break at the end of one prominent wall (formed by the middle quartzite, fig. 7), and a somewhat higher wall is seen behind it. Farther to the westward are two other walls of quartzite, to the south of the inner two. The gap known as Heavitree Gap in the lower quartzite is not seen clearly until the traveller has rounded the end of the second wall. When once the walls of tilted quartzite have been passed the topographical features change abruptly, and the regular outlines of the sediments give place to the irregular rounded contours of the crystalline rocks. There are other features of the sediments, beside the even height of the walls, that call for brief mention. The southern faces of the two main ramparts are well-defined dip slopes, and on the northern front of each is a typical strike scarp.

The regularity of the longitudinal profile of the ridges points to an earlier cycle of erosion in which the region was reduced to a peneplain; some of the highest peaks of the MacDonnell Ranges standing, no doubt, in relief above the general level. A subsequent uplift of the highlands revived the forces of erosion, and a second cycle began. This later cycle has reached a stage of maturity, as may be seen from the perfect development of longitudinal valleys along the limestone beds between the more resistant quartzites. The longitudinal valleys are reduced almost entirely to base level and make accordant junctions with the transverse valleys, but in the case of those valleys seen by the writer the course of the consequent transverse streams has not been diverted to follow the subsequent valleys. There may be instances of such adjustments of the drainage in the MacDonnell Ranges, but none were observed.

The drainage of the MacDonnell Range region (fig. 6) is not simple. Part finds its way into the plains on the northern side of the ranges by the channels of relatively small streams, rising close to the Tropic of Capricorn. The chief of these are the Darwent, the Dashwood, the Charley, Hamilton Creek, Six-mile Creek, and Harry Creek. A very small part of the drainage trends towards the depression of Lake Amadeus from the George Gill Range at the extreme western portion of the highlands.

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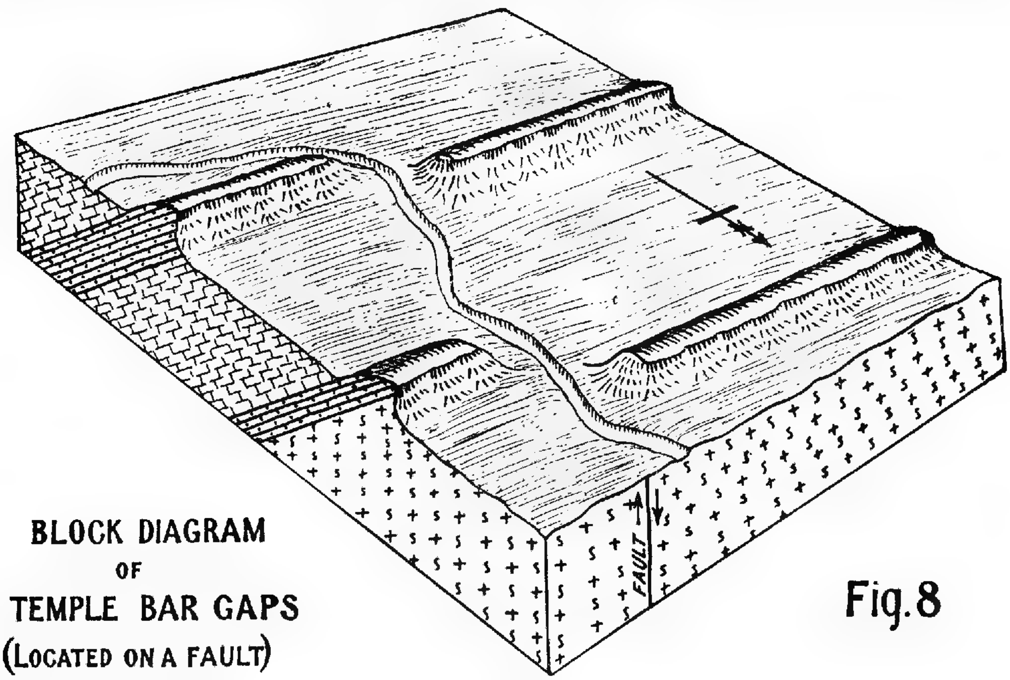
(40) Geol. Surv. S. Austr., Report No. 3, p. 9.

The largest part is carried southwards towards the Lake Eyre depression by the channels of the Palmer, the Finke, the Hugh, the Jay, the Todd, and the Hale. The divide of this largest basin has moved westwards and northwards on account of the lower level of the centre of the basin. The levels taken recently in connection with the survey of the North-South Transcontinental Railway show that the Emily Plain, at Temple Bar Creek on the southern side of the MacDonnell Ranges, is 1,806 feet above sea level, whereas the Burt Plain, at Six-mile Creek on the northern side of the ranges, is 2,363 feet above sea level. There is consequently a considerable portion of the northern part of the ranges drained by the southwards-flowing stream. The field offers promise of interesting results when the details of the physiography relating to stream-capture are worked out.

It has been pointed out above that the peneplanation of the MacDonnell Ranges was followed by an uplift which rejuvenated the streams. This inter-



BLOCK DIAGRAM OF TEMPLE BAR GAPS (LOCATED ON A FAULT)

Fig. 8

ruption in the physiographical development may have been that which raised the bed of the Upper Cretaceous sea and restored continental conditions in Central Australia. The rejuvenated streams, operating upon rocks of varying resistance, cut down steep-sided gaps through the ridges of hard quartzite which were gradually etched out in strong relief. These gaps are a noteworthy feature of the ranges, and it is interesting to observe that their location has been determined in some cases by the position of fault fractures, whereas in other cases there is no sign of dislocation with its weak resistance to stream erosion.

Examples of typical gaps, where the stream has cut its way downwards through an unbroken quartzite formation, are the Heavitree Gap, Emily Gap, and Simpson's Gap. All three are located in the lower quartzite (fig. 7), the last-named being on the northern limb of the anticline and the other two on the southern limb.

On the other hand, at Temple Bar, where the Roe or Temple Bar Creek cuts through the ranges, there is a displacement of the ridges to the northward on the western side of a fault, and the drainage channel follows the breaks (fig. 8). Other cases of gaps located on fractures may be seen on each side of Mount Undoolya, that on the eastern side being situated at a point where the strike of the quartzite changes abruptly by 50°. There are other gaps at structural breaks in the ridges still farther to the east.

At a few points the formation of gaps has been arrested, and the notches remain in the ridges. A typical case is that indicated in the block diagram shown as fig. 7.

To the south of the MacDonnell Ranges the course of the Finke River through the Krichauff Range is remarkably circuitous, although the walls of the gorge are steep. The rock structure does not cause the meandering of the channel, for the structure is that of a flat dome, the centre of which is close to the crest called Hermannsburg. The rock is reddish sandstone. The explanation of the meandering course of the river lies in the earlier physiographical history of the region. At a time when the area occupied by the Krichauff Range was base levelled—probably at the close of the Mesozoic area—the old Finke River was crossing its flood plain in a meandering course. But when the uplift came the meandering stream was rejuvenated and cut its gorge downwards into the solid rock while still preserving the plan of its bed. Thus the Finke River gorge of to-day through the Krichauff Range is an "entrenched" or "incised" meander. The process of entrenchment was not quite continuous, for the main gorge and its tributaries show signs of a pause when base level was reached temporarily and lateral erosion began. At this period the high-level gravels of the Missionaries' Plain, north of the Krichauff Range, were deposited. The subsequent rejuvenation of the river caused the deepening of the gorge and the formation of terraces in the gravel deposits to be seen near the Mission Station on the northern side of the range. The deep and narrow canyon of Palm Creek, a small western tributary of the Finke notable for its preservation of living cycads and palms, was formed during the later stages of entrenchment.

These notes on the evolution of the geological structure are set forth in the hope that they will be amplified, and corrected where necessary, in the light of systematic and detailed surveys.

The study of the development of the valleys and drainage systems should be extended through rainy periods, for it is difficult to work out the evolution of intermittent streams in the dry periods of present climatic conditions when water-gaps become temporarily air-gaps and low divides cannot be defined exactly.

Although the writer has had occasion to express views that differ from those expressed by others who have dealt with the geology of Central Australia, he is keenly appreciative of the help afforded to him by these earlier accounts. All differences in the interpretation of the sequence of events will disappear when a thorough survey has been made.

DESCRIPTION OF PLATES III. TO VIII.

The description will be found under each block on the Plates.

THE FLORA AND FAUNA OF NUYTS ARCHIPELAGO AND THE INVESTIGATOR GROUP.

No. 17.—THE SCORPIONS, WITH DESCRIPTIONS OF SOME SPECIES FROM OTHER LOCALITIES IN SOUTH AUSTRALIA.

By L. Glauert, F.G.S.[1]
(Communicated by Professor F. Wood Jones.)

[Read May 14, 1925.]

The scorpions which form the subject of this paper were collected by Professor F. Wood Jones, of Adelaide, at various localities in South Australia. Of the four species represented in the collection three have long been known to occur in South Australia, but one of these, *Lychas marmoreus*, is represented in the series before me by a form previously recorded from a limited area near Geraldton, in Western Australia. The fourth species, *Lychas truncatus*, n. sp., is remarkable for the short truncated tooth under the aculeus; it is a desert form having the typical desert colouration and seems to be confined to the interior of South Australia and Victoria. There are several fine specimens of this scorpion in the collection of the National Museum, Melbourne, one of which has been selected as the type.

I am under an obligation to Professor Wood Jones for the opportunity of examining this small but very interesting collection.

Lychas marmoreus splendens, Kr.

Lychas marmoreus splendens, Kraepelin, 1916, Ark. Zool. K. Svensk. Vetensk. Ak. x., No. 2, p. 28.

Locality.—Black Rock Island (4), Greenly Island (2).

Remarks.—Professor K. Kraepelin, in his revision of the forms of *Lychas marmoreus* (C. L. Koch), states that the range of this subspecies appears to be restricted to "Northampton and Eradu, near Geraldton, Western Australia." I have seen specimens from Moora, Tammin, and Euro in Western Australia in addition to these South Australian specimens.

The two smaller individuals, from Black Rock Island, have 17-17 teeth to the pectines.

Lychas truncatus, n. sp.

Colour.—Trunk uniform tawny, ocular areas blackish, limbs and tail yellowish, hand and fingers uniform with no indications of darker markings, fourth segment of the tail and vesicle rather darker; under surface uniform pale yellow. *Carapace* dull, covered with coarse granulation, keels granular, moderately prominent, superciliary crest well marked, coarsely granular, extending forward for a distance equal to the horizontal diameter of the eye; median sulcus granular, a row of larger granules along the posterior border of the carapace. Frontal notch wide and shallow, frontal lobes slightly rounded. *Tergites* dull, covered with granules which increase in size towards the posterior border of each segment; median keel subdenticulate, obsolescent on the first tergite, chiefly developed on the hinder portion of the next five; last tergite with posteriorly abbreviated subdenticulate median keel and four strongly granular lateral keels,

[1] Communicated by permission of the Trustees of the Western Australian Museum, Perth.

the granules on which increase in size posteriorly, submarginal terminal granule not enlarged. *Sternites,* the anterior ones smooth and shining, the last rather dull, with a few very fine granules and four subdenticulate keels which do not reach the anterior margin, the inner pair persisting to the posterior margin. *Tail,* first three segments with ten keels, fourth with eight keels and strong indications of the accessory keels; dorsal and supero-lateral keels with granules increasing in size posteriorly, terminal granule somewhat enlarged on the first three segments, infero-lateral and ventral keels finely and regularly granular, dorsal inter-carinal spaces shining, with a few coarse granules, the other inter-carinal spaces dull, with smaller granules; fifth segment with five granular keels; dorsal inter-carinal surface convex, sulcus not pronounced, smooth, with a few large granules; lateral and ventral surfaces shining with larger and smaller granules. *Vesicle* short, swollen, shining and keelless, the sulci obsolescent, with a number of large pores. *Aculeus* curved, stout, almost as long as the vesicle. Tooth under the aculeus short, strong, conical and truncated, wider than high, without any trace of a dorsal tubercle, the basal diameter of the tooth less than its distance from the base of the aculeus. *Pedipalpi* normal, hand swollen, wider than the brachium, smooth and shining, without traces of keels or granulation on its upper surface; fingers long, curved, smooth, with a smooth keel on the fixed finger, the movable finger not more than twice the length of the hand, basal series of teeth with two enlarged external lateral teeth. *Legs* keeled, the inter-carinal spaces dull, finely granular. *Pectines* with 22-27 teeth.

Dimensions.—Total length 38·5 mm., trunk 14·5, tail 24, length of hand 5·5, less than the first two caudal segments.

Distribution.—Victoria (Pyramid Hill), South Australia (Miller's Creek and Cooper's Creek).

The *type* is in the National Museum, Melbourne.

Urodacus manicatus (Thorell).

Ioctonus manicatus, Thorell, 1876, A.M.N.H. (4), xvii., p. 14; Thorell, 1877, Atti. Soc. Ital., xix., p. 261.

Urodacus novae-hollandiae, Keyserling (not Peters), 1885, Arachn. Austr., ii., p. 34.

Urodacus abruptus, Pocock, 1888, A.M.N.H. (6), ii., p. 174.

Urodacus keyserlingi, Pocock, 1891, A.M.N.H. (6), viii., p. 245.

Urodacus manicatus, Kraepelin, 1908, Fauna Suedwest Austr., ii., lief. 7, p. 97.

Locality. -Kangaroo Island (2).

Remarks.—The specimens, a male and a female, show no points of difference from the mainland form of the species, but the length of the female (with distended abdomen) is remarkable, being 63 mm., or 8 mm. in excess of the maximum given by Kraepelin. The male has 16-17 teeth to the pectines, and the female 11-11. The range of the species extends from New South Wales through Victoria to South Australia. Whether it enters Western Australia is doubtful. Kraepelin states that it occurs there, but I have failed to find it among the hundred or more specimens of *Urodacus* which I have received from all parts of the south of Western Australia. On the other hand, the *Urodacus,* so plentiful in the vicinity of Eucla, is *U. novae-hollandiae;* this suggests that *U. manicatus* does not reach the western boundary of South Australia.

The presence of *U. manicatus* on Kangaroo Island, where *Cercophonius squama* also occurs, is significant, for in Tasmania the latter species is the sole representative of the Scorpionidea.

UrODACUS YASCHENKOI (Birula).

Hemihoplopus yaschenkoi, Birula, 1904, Ann. Mus. Acad. Sci. St. Petersb., viii., No. 12, Nouvelles.

Urodacus yaschenkoi, Kraepelin, 1908, Fauna Suedwest Austr., ii., lief. 7, p. 95.

Locality.—Miller's Creek and Cooper's Creek.

Remarks.—Two females in the collection undoubtedly belong to this species; they agree with the description in all essential features, having a rounded brachium with 16-17 trichobothria, an irregular terminal group of 5-7 trichobothria on the lower surface of the hand, minute inner terminal claws on the third and fourth legs, 7 spines on the dorsal surface of the tarsus of the first leg, 14 teeth to the pectines, and the fifth caudal segment and the vesicle darker than the rest of the body.

THE VANADIUM CONTENT OF CERTAIN TITANIFEROUS IRON ORES OF SOUTH AUSTRALIA.

By A. R. Alderman, B.Sc.

(Communicated by Sir Douglas Mawson.)

[Read June 11, 1925.]

The presence of small quantities of vanadium in some titaniferous iron ores has long been known. It was from such a source that the element vanadium was first definitely recognised by Sefström in pig iron derived from the titanium-bearing ores of Taberg, in Sweden.

A high titanium content is a notable feature of a wide range of igneous rocks in South Australia; in fact, this facies delineates a considerable region of the State as a petrographical province.

The abnormal occurrence in the State of such highly vanadiferous formations as that at Radium Hill, Olary, and that of the Edelweiss Mine, near Burra, suggests that any facts relating to the further occurrence of vanadium in connection with the iron ores of this petrographical province should be of interest.

Although vanadium is known to occur in iron ores which are not titaniferous in other parts of the world, such occurrences are considerably less frequent than in the titanium-bearing types.

In view of the value of vanadium for use in special steels and alloys, and the relative scarcity of rich ores of this element, it is possible that the richer varieties of these vanadium-bearing iron ores may be of economic value. Goodwin[1] found that it was possible to reduce 90 per cent. of the vanadium with the iron, by using a flux of silica instead of lime, when reducing such an ore in the electric furnace.

In order to investigate the bearing which these facts have on the South Australian occurrences of such ores, partial analyses were made of a number of specimens from various parts of the State.

Particulars and Analyses of Ores.

I. Specimen from a large deposit of ilmenite situated 13 miles N.N.E. of Olary, near the "Graphite Locality." Genetically this deposit appears to be connected with a body of basic igneous rock resembling dolerite, as judged on the hand specimen.

On analysis the specimens gave high percentages of titanium and vanadium.

	Per cent.
Titanium dioxide (TiO_2)	35·37
Iron (calculated as Fe)	46·88
Vanadium pentoxide (V_2O_5)	0·59

II. Ilmenite from a quartz-ilmenite pegmatite situated on the sea front, three-quarters of a mile south of the "Little Gorge" near Normanville. This occurrence is particularly interesting on account of its proximity to the monazite-bearing pegmatite at the "Little Gorge," described by R. Grenfell Thomas.[2]

	Per cent.
Titanium dioxide (TiO_2)	17·07
Iron (Fe)	59·30
Vanadium pentoxide (V_2O_5)	0·29

(1) "A Method of Smelting Titaniferous Iron Ore," the Hon. Advisory Council for Sci. and Ind. Research, Report No. 8, Ottawa, 1921.

(2) Trans. Roy. Soc. S. Austr., vol. xlviii., 1924, p. 258.

III. A large quartz-ilmenite pegmatite, situated about two miles south of the apatite mine, Old Boolcoomatta Station, near Olary. Specimens show great variability in vanadium content. An average figure is as follows:—

	Per cent.
Titanium dioxide (TiO_2)	14·36
Iron (Fe)	57·60
Vanadium pentoxide (V_2O_5)	0·16

It is interesting to note that a sample of sphene, occurring in a pegmatite, situated a few yards distant from this pegmatite, gave not the slightest trace of vanadium, although it was quite apparent in the ilmenite.

IV. Iron ore from a southern extension of the Radium Hill lode, near Olary. The ore was crushed to suitable fineness and the heavier constituents separated by "panning" and subjected to partial analysis as follows:—

	Per cent.
Titanium dioxide (TiO_2)	60·76
Iron (Fe)	28·58
Vanadium pentoxide (V_2O_5)	0·84

The high percentage of titanium suggests that the ore consists of a mixture of rutile and ilmenite. In view of the relatively high proportion of vanadium and its relation with the carnotite-bearing ore, nearby, it is notable that the ore gives no trace of uranium.

V. A sample from Blackfellows' Creek, Hundred of Kuitpo. This sample consists of a very variable mixture of magnetite and true ilmenite, and occurs as veins and stringers in gneiss. On analysis this sample was found to contain:—

	Per cent.
Titanium dioxide (TiO_2)	13·05
Iron (Fe)	65·01
Vanadium pentoxide (V_2O_5)	0·25

VI. A sample of clastic ilmenite from the ilmenitic grits at the base of the Adelaide Series at Mylor. The sample contained much quartz and felspar sand grains mechanically mixed:—

	Per cent.
Titanium dioxide (TiO_2)	12·22
Iron (Fe)	52·81
Vanadium pentoxide (V_2O_5)	0·14

VII. Iron ore from a large barytes-hematite-magnetite lode formation, situated 13 miles N.W. of Olary, on Outalpa Station. On analysis this sample showed a complete absence of both titanium and vanadium.

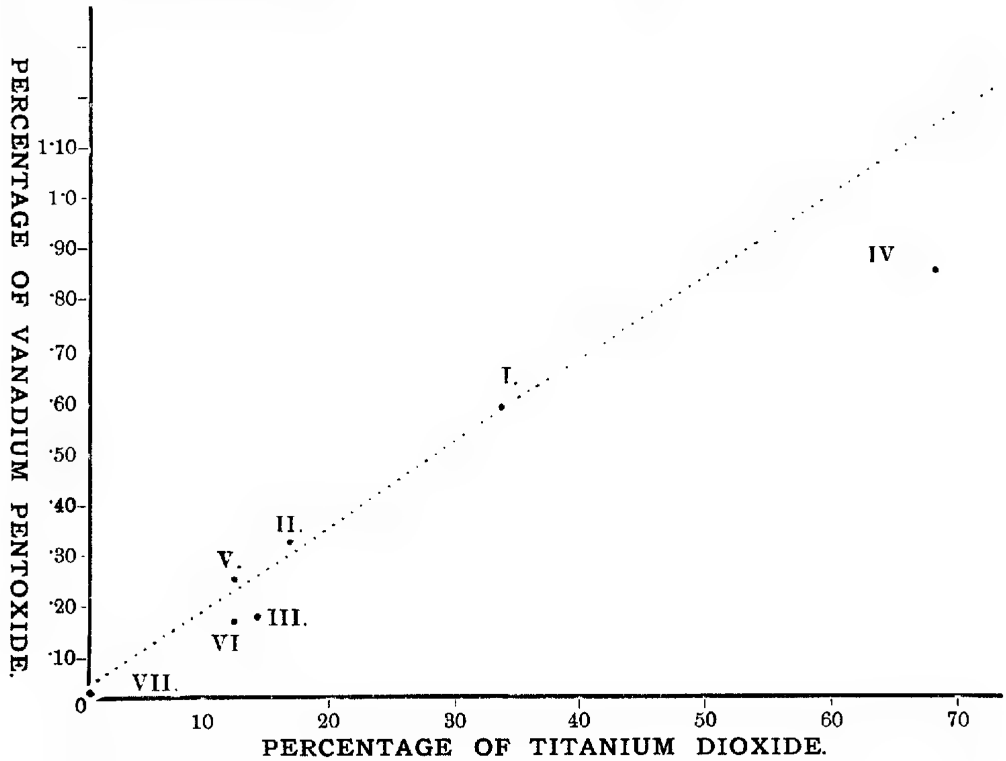
Vanadium determinations were also made by the writer on several other occurrences of ilmenite. Of these, a sample from a pegmatite situated 20 miles north of Olary, near Bimba Hill, contained 0·25 per cent. of vanadium pentoxide. A specimen from a pegmatite near Aldgate contained 0·14 per cent. V_2O_5. Other iron ores examined proved to be both non-titaniferous and non-vanadic.

It is interesting to record that the rutile from the "Little Gorge" at Normanville contains a notable amount of vanadium pentoxide, *viz.*, 0·27 per cent.

Analyses made of certain ilmenitic ores from the main workings at Radium Hill disclose up to 2 per cent. of vanadium pentoxide. These samples were washed free of carnotite before analysis.

Comparison of Analyses.

The results given above may conveniently be compared by plotting, under the respective numbers of the samples, the percentages of titanium dioxide and vanadium pentoxide on rectangular co-ordinates. In the following diagram the percentage of titania has been plotted as an abscissa and that of vanadium pentoxide as an ordinate:—



It is noticeable from the diagram that the percentage of vanadium pentoxide is roughly proportional to that of the titanium dioxide. Pope[3] found in investigating certain iron ores of Ontario, that the ratio between vanadic oxide and titanium dioxide was always in the region of 1 to 28; but he found that this relationship was not borne out by results obtained from ores of other districts. Certainly in South Australia the ratio would be much lower, roughly about 1 to 60.

Summary.

The titanium-bearing iron ores occurring in South Australia are almost invariably found to contain small amounts of the rare metal vanadium. The quantity of vanadic oxide present is often roughly proportional to the amount of titania in the mineral, and sometimes comprises more than a half of 1 per cent. of the ore.

On the other hand, occurrences of vanadium in South Australian non-titaniferous iron ores are, so far, practically unknown.

In conclusion, the thanks of the writer are due to Prof. Sir Douglas Mawson, not only for the facilities granted which made this work possible, but also for his many helpful suggestions.

(3) Trans. Am. Inst. Min. Eng., vol. 29, 1899, pp. 395-397.

NOTES ON CERTAIN SOUTH AUSTRALIAN FOSSILIFEROUS TERRESTRIAL FORMATIONS OF RECENT AGE.

By F. Chapman, A.L.S., F.R.M.S., and D. Mawson, Kt., F.R.S.

[Read June 11, 1925.]

Plate IX.

This paper deals with several localities in the State where sedimentary deposits have been met with containing the fossilised remains of fresh water mollusca and water plants. All the forms are still existing, so that the beds are of Recent age. This is further borne out by their arrangement and relation to present topography.

Of these, three small basins situated in the Middle North, roughly between the Burra and Truro, are of interest in drawing attention to the fact that alterations have, in Recent times, been effected in the grades of the main lines of drainage of that area. The ponding of some areas and canyon cutting noted in others suggests slow general meridional uplift associated with slight differential warping.

The movements here indicated, however, are on a smaller scale than such as have already been described[1] from the neighbourhood of Orroroo, further to the north-west. In that locality, *Chara* remains are described as a feature of the lacustrine formation. Traces of the remains of mollusca are also reported, but are apparently too badly preserved to be identified. The present recorded occurrences, however, yield abundant shells in a good state of preservation. The specific localities are referred to in the following notes.

The Burra Creek Localities.

A traverse[2] of the Burra Creek, made three years ago, resulted in the discovery of several ancient ponded areas along its course. The length examined extended for over 30 miles, from the Burra down stream to the extinction of the creek in the Tertiary area of the Murray flats leading to Morgan. At intervals along its course water weeds were met with, and a very common form among them is *Chara*.[3] From the remains of, and through the agency of this *Chara*, calcareous tufa is now actively forming in the river channel in many places.

In connection with the subject of this communication, two areas came specially under notice. The more remote of these is in the vicinity of the boundary between the Hundreds of Bright and Bundey. In that locality, for a couple of miles to the west of the boundary and about a mile to the east, the Burra Creek traverses a plain that owes its flatness to the accumulation of old river sediments. Along this length, the highly inclined Pre-Cambrian rocks which form the bed of the stream, elsewhere, rarely appear, the river banks being deeply incised in horizontally arranged boulder-beds, gravel beds, clays, silts and marl, interbedded in which are *Chara* remains and a strong horizon of travertine limestone, the

(1) "Description of an old Lake Area in Pekina Creek, and its relation to Recent Geological Changes," by W. Howchin, F.G.S., Trans. Roy. Soc. S. Austr., vol. xxxiii., pp. 253-261.

(2) In this field work assistance was rendered by Mr. C. T. Madigan, B.E., M.A., and several advanced students of Adelaide University.

(3) From an examination of some fragmentary and ill-preserved remains of this *Chara*, Professor T. G. B. Osborn, D.Sc., concludes that it is probably *C. fragilis*.

latter indicating a former land surface. This accumulation obviously represents deposition in an area that has become relatively depressed or ponded during the existence of the Burra Creek. The flat expanse may be traced far on either side of the present watercourse, and represents what was a region of depression of at least several square miles in area. The exposed thickness of the accumulation is regularly about 25 feet, and, in places, the bottom of the formation has not been reached by the present stream bed.

Down stream from this area of accumulation, the Burra Creek carves its way across the underlying steeply-dipping Pre-Cambrian formation and is deeply entrenched in a rocky gorge. Old river gravels are here met with on the flanks, at the top of this gorge, as much as 65 feet above the present river level.

The other locality is much nearer the Burra, at the double ox-bow bend in the vicinity of the Thirty Pound Pool, in the Hundred of Apoinga. The prevailing rocks thereabouts are Proterozoic sediments. These strike N. 30° W. magnetic, and are very steeply inclined. The Burra Creek traverses limestones before arriving at the Thirty Pound Pool, but at that point reaches a slate formation which, being more resistant to river erosion, has diverted the creek along the strike to the north for half a mile before it succeeds in crossing again to the east. It soon meets a harder slate formation and is again deflected along the strike to the south. In this way a double ox-bow bend has developed. In that neighbourhood there is considerable topographical relief and the river is entrenched to the extent of several hundred feet below the hill tops thereabouts.

Backward cutting is actively in progress at the present time, indicated by the presence of a waterfall situated in the middle bend of the double ox-bow. Along the whole of this middle limb, the river is entrenched in lacustrine sediments, apparently of Recent age. Two distinct terraces of erosion are marked. The full depth is not revealed; but in one spot a depth of 20 feet is shown, beginning with coarse conglomerate on bed rock below and passing upwards into grey sticky clay richly studded with shells of fresh water mollusca. Of the latter a number of examples were collected as follows:—

Fam. CYRENIDAE.

Genus Corbicula, Megerle.

Corbicula angasi, Prime.

Corbicula angasi, Prime, 1863, Cat. Corb., p. 4, and 1869-70, Gen. *Corbicula*, No. 1; Id., 1864, Journ. Conch., vol. xii., p. 151, pl. vii., fig. 6; Clessin, 1879, in Martyn and Chemnitz Syst. Con. Cab., vol. ix., pt. iii., p. 205, pl. xxxviii., fig. 3; Reeve, 1878, Conch. Icon., *Cyrena*, pl. xvii., fig. 90.

Corbicula rivina, Clessin, 1879, in Martyn and Chemnitz Syst. Con Cab., vol. ix., pt. iii., p. 139, pl. xxv., figs. 3, 4.

Corbicula angasi, Prime, E. A. Smith, 1882, Journ. Linn. Soc. Lond., Zool., vol. xvi., p. 302.

Observations.—The series comprises 15 examples, and shows all gradations in size and variations in outline, of a single variable species.

In the neanic and ephebic stages the valves are more roundly ovate than in the gerontic, where the shell lengthens in proportion to the width and the umbo is more prominent. The dorsal margin in the gerontic forms has more sloping sides. In the coarser lamellation of the shell surface the fully grown individuals have a resemblance to *C. ovalina*, Deshayes, a shell recorded from Port Essington, though that species has a straighter ventral edge and less prominent beaks.

That *Corbicula angasi* is a most variable species is convincingly seen in a large collection of shells obtained by Mr. C. J. Gabriel from one spot in the reservoir at Studley Park, Kew, Victoria. These shells range from the comparatively short and almost subquadrate valves to the long-ovate, mature forms. We have had further assurance of identification by Mr. Chas. Hedley, who has separately determined them as *C. angasi*.

Fam. PLANORBIDAE.

Genus BULLINUS, Oken.

BULLINUS ACUTISPIRA, Tryon, sp.

Physa acutispira, Tryon, 1866, Amer. Journ. Conch., vol. ii., p. 9, pl. ii., fig. 10; Tate and Brazier, 1881, Proc. Linn. Soc. N.S. Wales, vol. vi., p. 557; Smith, E. A., 1882, Journ. Linn. Soc. Lond., Zool., vol. xvi., p. 282, pl. vi., fig. 16; Clessin, 1885, Conch. Cab., vol. i., Abth., xvii., p. 242, pl. xxxiv., fig. 1.

Bullinus acutispira, Tryon, sp., Hedley, 1917, Rec. Austr. Mus., vol. xii., p. 5, pl. i., figs. 11, 12, pl. ii., fig. 16; Chapman, 1919, Proc. Roy. Soc. Vict., vol. xxxii., p. 26, pl. iii., fig. 4.

Observations.—Both examples found here resemble the variety of *B. acutispira* figured by Hedley *(loc. supra cit.*, 1917) on pl. i., found at Portland, Victoria.

Fam. SUCCINEIDAE.

Genus SUCCINEA, Pfeiffer.

SUCCINEA AUSTRALIS, Ferussac.

Succinea australis, Ferussac, 1821, Tabl. Syst., vol. ii.; Ferussac in Quoy and Gaimard, 1832, Voy. "Astrolabe," vol. ii., p. 150, pl. xiii., figs. 19-23.

Succinea legrandi, Cox, 1871, Legrand, Coll. Mon. (in Deshaye's Hist. Nat. Moll., vol. ii., p. 137, pl. xi., fig. 11).

Succinea australis, Ferussac, May, 1921, Check List Moll. Tas., p. 91; Id., 1923, Ill. Index Tas. Shells, pl. xlii., fig. 2.

Observations.—This species, represented here by one example, is usually found under moist land surface conditions, as, for example, amongst wet grass.

Professor Tate described a species collected by the Horn Expedition (1896, p. 207, pl. xix., fig. 21) under the name *Succinea interioris*. It is doubtful whether this is more than a varietal form of the widely distributed and variable species, *S. australis*. In any case, it differs from the Burra Creek example in its longer and more acutely turreted shell.

DUTTON.

Recently, while geologically mapping the Hundred of Dutton, Mr. P. S. Hossfeld, B.Sc., located an area formerly occupied by ponded water, situated at and around the town of Dutton. He estimates the original area of the lake as about one and a half miles from west to east and three miles from north to south. The recent depositions in this area, which are almost horizontal and rest upon highly inclined rocks of Proterozoic age, have been cut across by the main line of present drainage, namely, Pine Creek, which flows from west to east. Though the creek is deeply entrenched, it has failed to reach the bottom of these recent deposits in their deeper portions. The strata exposed consist of boulder and gravel beds, clays, silts, and marls with some bands of tufaceous limestone rich in remains of *Chara*. Molluscan remains of fresh-water species are moderately common, distributed throughout the more calcareous beds. Forms occurring in three specimens selected by Mr. Hossfeld are as follow:—

1. A tufaceous limestone formed of a mass of encrusted, reed-like plant remains, amongst which the *Chara* is evident, and containing numerous shells belonging to the genera *Bithinella* and *Coxiella*.

Fam. HYDROBIIDAE.

Genus BITHINELLA, Moquin-Tandon.

BITHINELLA NIGRA, Quoy and Gaimard, sp.

Paludina nigra, Quoy and Gaimard, 1835, Voy. "Astrolabe," vol. iii., p. 174, pl. lviii., figs. 9-12.

Potamopyrgus nigra, Q. and G., sp., May, 1921, Check List Moll. Tas., p. 56; Id., 1923, Index, pl. xxvi., fig. 3.

Observations.—This small fresh-water shell is quite common and typical in this rock.

Fam. TRUNCATELLIDAE.

Genus COXIELLA, E. A. Smith.

COXIELLA STRIATA, Sowerby, sp.

Truncatella striata, J. de C. Sowerby, 1842; Reeve, Conch. Syst., vol. ii., p. 94, pl. clxxxii., fig. 4.

Blandfordia striatula, Cox, 1868, Mon. Austr. Land Shells, p. 95, pl. xv., figs. 13*a-c*.

Coxiella confusa, E. A. Smith, 1898, Proc. Malac. Soc., vol. iii., p. 76; Gatliff, 1905, Vict. Nat., vol. xxii., p. 14.

Coxiella striatula, Menke, sp., Chapman, 1919, Proc. Roy. Soc. Vict., vol. xxxii., p. 25, pl. iii., fig. 3.

Truncatella filosa, Sow. *(nom. nud.)*, Hedley, 1923, Vict. Nat., vol. xl., p. 76.

Observations.—This species here occurs abundantly in the same material with *Bithinella nigra*, although, curiously, *Coxiella* has a preference for brackish conditions. *C. striata* is easily separated from the more typically South Australian form, *C. gilesi*, the latter having broader and more inflated whorls.

2. A fine loessial silt containing a small percentage of clay. Microscopically examined, the sediment consists of fine quartz sand, somewhat rounded, probably of aeolian origin, with a few shell flakes and occasional spicules of fresh-water sponges. In this material the following mollusca were found:—

   Bithinella nigra, Q. and G., sp. Seven examples.
   Coxiella striata, Sow., sp. A few broken shells.
   Succinea australis, Ferussac. A medium-sized example.

3. Another specimen of fine silt rocks yielded four examples of *Succinea australis*, Ferussac.

Observations.—One of these, in its slightly more elongated spire and more ovate aperture, approaches Tate's *Succinea interioris* from Central South Australia and near Rockhampton, Queensland. It is, however, undoubtedly conspecific in other characters with *S. australis*, as in the shell texture and shape of the earlier whorls. The remaining specimens are typical.

PATSEY'S SPRING.

Located in the Flinders Range, about 18 miles from Copley on the road to Mount Searle, is a seepage known as Patsey's Spring. This is adjacent to the mail coach track, on the flank of a prominent ridge which rises to heights of several hundred feet above the level of the spring itself, which is some 1,430 feet above sea level.

The ranges thereabouts are constituted of highly inclined limestones, calcareous slates, purple slates, and quartzites which are probably of early Cambrian age. In a small depression in the face of the range, in the locality of the spring, is a Recent formation, of very local development, resting unconformably upon the older rocks.

This Recent deposit consists of a horizontally distributed boulder bed passing upwards into finer material and eventually into a buff-coloured limestone, the whole reaching a thickness of about 20 feet. It represents an accumulation in a creek bed or depression. The limestone, which is of a travertine variety, is partly or wholly deposited from the spring waters, which in the past may have been ponded to an extent not indicated by present conditions.

Sparsely distributed through the dense limestone are remains of *Coxiella striata*, Sow., sp.

DESCRIPTION OF PLATE IX.

Fig. 1. View of the old river terrace at the waterfall on the Burra Creek just below the Thirty Pound Pool. Two terrace levels are indicated. The rocky spur in the background is composed of Proterozoic limestones and slates.

Fig. 2. View in the bed of the Burra Creek, Hundred of Bright, near the boundary of the Hundred of Bundey. The creek has here cut through a recent formation accumulated in a ponded stage of the river development. These clay and marl beds contain also tufaceous *Chara* limestone.

A NEW SOUTH AUSTRALIAN DORMOUSE OPOSSUM.

By Frederic Wood Jones, D.Sc., F.Z.S.,
Professor of Anatomy in the University of Adelaide.

[Read July 9, 1925.]

The little Dormouse Opossums of the Genus *Dromicia* have a very wide distribution in Australasia; but this distribution, though wide in a geographical sense, is curiously confined to what may be termed the margins of the Australasian marsupial area. One species occurs in New Guinea, two in Tasmania, and one is found upon the mainland of Australia.

With regard to the mainland form, *D. concinna*, there is in the literature some confusion concerning the actual distribution. In discussing the genus, Oldfield Thomas gave the continental range as "Western Australia" (Catalogue of the Marsupialia and Monotremata in the Collection of the British Museum, 1888, p. 141), but by this expression he apparently intended to indicate the western portion of the continent rather than the actual State, for in dealing with the species (p. 147) he defines the range as "South and Western Australia," and records three specimens in the collection as coming from this State.

In South Australia, *D. concinna* has a wide range. It is by no means rare in Kangaroo Island; it is present in most districts in which native bush remains in the southern portion of the State, and it even extends into the mulga and saltbush of the north, having been taken by Mr. A. G. Bolam among the saltbush at Ooldea. So far as I am aware, Mr. Bolam's specimen is the first ever obtained upon the saltbush plains, and it is an extremely interesting record. This Nullarbor Plains example is in every way typical and differs in no feature from those obtained in the "black-boy" country of Kangaroo Island, in the ti-tree of the South-East, or in the bush of the Mount Lofty Ranges.

Dromicia nana is confined to Tasmania. In 1863 Krefft described a species which he named *D. unicolor,* from the neighbourhood of Sydney. By Oldfield Thomas this species is said to be the same as *D. nana*, and this author suggests that Krefft's animals had escaped from captivity. There are certain measurements given by Krefft which almost seem to preclude his supposition being correct; but without further facts being available it is impossible to decide the matter. It is, at any rate, certain that Krefft's specimens do not represent the new species described here, for he gives a total head and body length of 6½ inches, which considerably exceeds the measurements of the average specimens of *D. nana*, and is almost double those of the new species. With the exception of Krefft's doubtful species, no other species of the *nana* group has been recorded from the mainland. The new species here described was captured at Millicent, in the South-East, and I am indebted to Dr. Rolland, of that town, for the type (male adult) specimen.

The whole genus *Dromicia* is very naturally divided into two sections by reference to the dentition.

In the one section, the last premolar of the lower jaw is a well-developed tooth which is as high as, or higher, than the molars; and in the other section, this tooth is a minute one, being as small as, or smaller than, the two anterior premolars. In the second section there is only one described species, *D. concinna* (Gould, 1845), which also differs from the other members of the genus in having the hairs of the ventral surface of the body pure white from base to tip.

In the first section, characterised by the well-developed last lower premolars, are two species, *D. lepida* (Thomas, 1888), and *D. caudata* (Milne-Edwards, 1877), which possess four molars, and one species, *D. nana* (Desmarest, 1817), which, like *D. concinna,* possesses only three molars above and below.

The new species described here falls into the same group as *D. nana*, for it has a well-developed last lower premolar and only three molars.

A differential table for the species may be summarised as follows:—

A. Hairs of ventral surface grey at the base. Last lower premolars well developed and as high as the molars.	
B. Molars 4/4.	
C. Size large. Head and body *circ.* 100. Tail long *circ.* 140 ..	*D. caudata*
CC. Size small. Head and body *circ.* 70. Tail *circ.* 75 ..	*D. lepida*
BB. Molars 3/3.	
D. Size large. Head and body *circ.* 100. Tail longer than head and body	*D. nana*
DD. Size smaller. Head and body *circ.* 90. Tail shorter than head and body	*D. britta*
AA. Hairs of the ventral surface white throughout. Last lower premolar minute and no larger than the two anterior premolars	*D. concinna*

Dromicia britta, n. sp.

General colouration and appearance much as in *D. nana,* but at once distinguished from that species by its smaller size, greyer colouration, and shorter tail.

General colour greyish—almost mouse-grey—on the dorsal surface. The colouration is more sombre than that of any other member of the genus, the fawn colour of *D. nana* and the bright brown of *D. concinna* being wholly lacking. The pelage is short, soft, and dense. Individual hairs of the mid-dorsal region measure only 5-6 mm., whereas in the corresponding region of *D. nana* the hairs are double that length. Each individual hair of the dorsal surface is dark smoke-grey at the base and for almost the whole of its length, only the immediate tip being pale grey. The face is slightly lighter than the rest of the dorsal surface of the body. The region around the eye is dark, and this dark area is carried forwards slightly in advance of the anterior canthus of the eye, but does not continue as a dark whisker mark as it does in *D. nana.*

The ventral surface and the inner aspect of the limbs are pale grey, the hairs being smoky-grey at the base and pale grey at the tip. The darker grey of the dorsal surface and the paler grey of the ventral surface merge gradually into each other, there being no definite line of demarcation.

The tail is shorter than the head and body; the basal fifth is clothed with a continuation of the general body hairs, the remaining four-fifths being covered with short, closely adpressed, shining, dark hairs. Basal incrassation is only slightly developed.

The rhinarium is dusky-brown in colour, finely tesselated, and sharply delimited. It is grooved in the middle line. The facial vibrissae are well developed, the longest member of the mysticial set measuring 17 mm. All the facial vibrissae are black in their entire length: the ulnar vibrissae, of which there are two, are white. The ears are long, membranous in texture, and dusky-brown in colour. The pes is remarkably small, being actually no larger than that of *D. concinna* and considerably smaller than that of *D. nana.* The manus and pes are clothed with grey hairs, the manus being darker than the pes; details of the palm and sole as in other members of the genus.

Skull, in general, like that of *D. nana,* but smaller in all measurements. Dentition as in *D. nana,* but teeth considerably smaller. In the skull of the type specimen, which is an adult male, the upper anterior premolar is more reduced than the corresponding tooth in *D. nana* and is present as a minute rudiment only upon the right side.

Dimensions.	Adult ♂ type	Dimensions of Skull.	Adult ♂ type
Head and body	90	Basal length	22
Rhinarium to eye	10	Zygomatic breadth	16·8
Ear	17	Nasals length	7·3
Lower leg	21	Interorbital breadth	4·5
Pes	11	Palate length	12
Tail	80	Molar series	3·2

Table of comparative dimensions of *D. britta, D. nana,* and *D. concinna.*

	D. britta.	*D. nana.*		*D. concinna.*	
Head and body	90	100	97	80	77
Rhinarium to eye	10	11	11·3	8·8	8·5
Ear	17	17·4	17	12	12
Lower leg	21	26	27	21	20
Pes	11	14·7	16	12·2	12
Tail	80	104	111	89	82
Basal length of skull	22	23·6	23	19·6	19·5
Zygomatic breadth	16·8	16·9	17·5	14	14
Nasals length	7·3	9	10	7·5	7·5
Interorbital constriction	4·5	4·7	5	4·1	4
Palate length	12	13	13	10·5	10
Molar series	3·2	4	4	2·8	2·8

Type specimen, an adult male from Millicent forwarded by Dr. Rolland. Other specimens have since been obtained, but so far none have been available for examination.

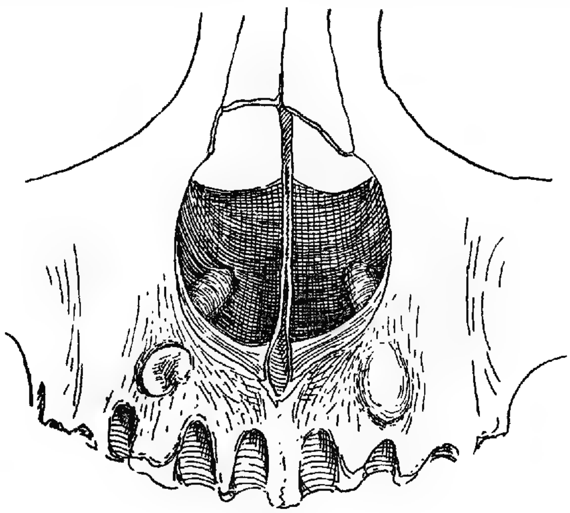
A DENTAL ANOMALY IN THE SKULL OF AN AUSTRALIAN ABORIGINAL.

By T. D. Campbell, D.D.Sc.

[Read July 9, 1925.]

The skull which presents the dental irregularity is probably that of a female, who, judging from the degree of synostosis of the cranial sutures, was of somewhat advanced age. The mandible is missing. All the teeth have been lost from the jaw *post mortem* with the exception of the unerupted canines, but the presence of the unabsorbed alveoli shows that the remaining members of the dental series were fairly normal in position.

In the case of the right canine, the cuspal portion of the tooth is missing and may possibly have protruded slightly through the soft tissues during life. This part of the crown appears to have been broken off and not destroyed by carious action.



Diagrammatic outline showing positions of Malposed Teeth.

A portion only of the labial surface of the left canine is uncovered by bone, and it is unlikely that the crown of this tooth emerged through the soft tissues. The tip of its cusp lies close to the remaining portion of the lateral incisor socket.

In both instances the coronal portions of these teeth present themselves on the facial surfaces of the maxillae about one centimetre above their normal situations in the alveolar arch. The teeth, instead of occupying their somewhat vertical positions in the maxillae, lie horizontally and parallel with the floor of the nasal fossa. The positions of the root portions of the teeth are clearly seen, for they lie in the plates of bone which form the nasal surfaces of the maxillae. The ridges of bone covering the roots are seen lying antero-posteriorly on each side of the floor of the nasal chamber. The accompanying diagrammatic illustration shows the situation of the teeth.

Radiographic examination of the specimen clearly showed the presence of the teeth.

The occurrence of unerupted canines in an Australian skull is interesting and somewhat unusual; such an anomaly has not previously been met with by the present writer in the examination of a large series of Australian skulls, the results of which have recently been published.[1]

The present condition of the alveolar arch gives no clue as to any probable cause of the malposition of these teeth. The bony septa between each of the incisor sockets and those anterior to the first premolar sockets are all thicker than is usual, so that the four anterior teeth were spaced to occupy the arch region of six teeth. The crowns of the canines during the early stages of their formation were possibly deflected somewhat from their usual positions; this, together with a lack of correlation between the subsequent rate of tooth development and that of the immediately associated osseous structures, would ultimately give rise to marked malposition of the teeth.

Another interesting feature presented by the maxillary region of this specimen is the persistence of the premaxillo-maxillary suture. Although the cranial sutures show partial obliteration, indicating somewhat advanced age, the palatal sutures are still well defined and the premaxillo-maxillary suture is still patent, extending each side of the incisive canal about eight millimetres. Records have shown the persistence of this suture to occur fairly often in young adults, and occasionally in adults; but its presence at an age so advanced as that indicated by the present specimen is unusual.

The writer is indebted to Dr. A. A. Lendon for placing the specimen at his disposal for the purpose of description.

(1) "Dentition and Palate of the Australian Aboriginal," University of Adelaide Publications, No. 1.

RADIO-ACTIVE ILMENITE, NEAR MOUNT PAINTER, NORTHERN FLINDERS RANGE.

By A. C. Broughton.

[Read July 9, 1925.]

The mineral referred to in these notes occurs in the ranges which terminate the northerly chain of mountains that run from Cape Jervis in the south to the Cretaceous basin in the north. Fragments on the slope of a rocky ridge first directed attention to the occurrence of this mineral in the district and led to the discovery of the mineral *in situ*. The first pieces discovered varied in size from a small walnut to an average-sized peach, but subsequently fragments weighing up to 1 lb. were found. The conchoidal fracture of the first piece found, together with its weight, distinguished it immediately from black tourmaline which occurs in the vicinity.

A faint yellow powder on the fractured surface of the original fragment suggested the radio-active, uranium-potassium-vanadate mineral, carnotite. Submitting this fragment to an electroscopic examination for radio activity it was determined to be radio-active. Later work on the same piece indicated the radio-activity to be equal to 2·1 per cent. uranium oxide (U_3O_8).

This confirmation of its radio-activity suggested the possibility of a uranium content in the mineral, and on submitting it to chemical analysis the presence of both uranium and vanadium in the ilmenite was demonstrated.

A sample of the material was forwarded to the South Australian Government Assayer (Mr. W. S. Chapman) for chemical analysis, and the assay gave:—

Titanium dioxide (TiO_2)	34·1 per cent.
Iron (Fe)	17·8 ,, ,,
Uranium-uranic oxide (U_3O_8) ..	3·7 ,, ,,
Vanadium	Present

The majority of the fragments scattered on the hillside have the greyish decomposition product, leucoxene, showing distinctly along three directions of cleavage and on tabular faces; whereas the deep canary-yellow of the carnotite occurs on the conchoidally fractured faces which are comparatively free from the leucoxene.

Many of the fragments collected showed a thick tabular or platy character, although a few were irregular and massive in form. A number of pieces were attached to either quartz or felspar, or the two combined, suggesting an origin in acid plutonic rocks.

When the ilmenite was ultimately located *in situ* it was found to occur in mica-schist, in granulitic felspar and quartz formations, and in coarsely crystallised typical pegmatites. It also occurs in gneiss encircled with a well-developed flow-structure, as though it offered resistance to the movement or re-arrangement of the substance of the enveloping minerals.

At three distinct places, separated by several hundred feet from each other, the ilmenite occurs more profusely scattered on the hill where mica-schist has rotted to soft soil in which rabbits burrow and on which euros camp, a feature that is in contrast to the hard, rugged, boulder-strewn country characteristic of the richer ilmenite-shedding rocks.

At first sight it might appear that the enrichment of the ilmenite was due to the softer disintegrating rocks discarding the included titanium-iron mineral, but closer examination discloses that there is an enrichment of ilmenite in the mica-schists where they are in contact with the more acid pegmatites.

The greatest proportion of the local country rock consists of a quartz and felspar formation which contains sporadic ilmenite. It is entirely crystalline. Through it veins of much more coarsely crystallised quartz and felspar occur in which the ilmenite exists in a much greater ratio. The field occurrence of the entire formation suggests an acid magma which crystallised out as a quartz-felspar body, after secreting basic centres of mica which is typically biotite; or else the acid magma enveloped blocks of pre-existing rocks, converting them into mica-schist.

Whichever action produced the schists, a later pneumatolitic phase injected the ilmenite-bearing pegmatites into the parent magma, producing an ilmenite enrichment at the contact of the pegmatites and the schists, as well as permitting a greater ratio of the titanium-iron mineral to be distributed within the veins of the pegmatites themselves.

The occurrence described herein exists about a half mile from, and 10° S. of W. from Mount Gee, and about one and a half miles, and 5° N. of W. from Mount Painter, in the district which is referred to by Sir Douglas Mawson on pp. 376-387 of vol. xlvii. of the Transactions of this Society.

THE FLORA OF THE NORTH-EAST CORNER OF SOUTH AUSTRALIA, NORTH OF COOPER'S CREEK.

By J. B. Cleland, J. M. Black, and L. Reese.

[Read July 9, 1925.]

One of us (L. R.), during a visit to Adelaide in 1923, was asked to collect specimens of the various plants growing in his district (Minnie Downs) for the Herbarium of the Field Naturalists' Section. Minnie Downs is situated on the Birdsville Track near the Queensland border. During 1924, 178 specimens were forwarded, and of these 118 were identified and determined by another of us (J. M. B.). The remaining specimens were either duplicates or consisted of insufficient material to allow of accurate determination. Accompanying the specimens were notes as to the soils in which the plants grew, their heights, and information as to their value as food for stock or horses or use in any other way.

In May, 1924, another of us (J. B. C.) had an opportunity, through the courtesy of the Beltana Pastoral Co., of paying a visit to Cordillo Downs, which is situated in the extreme north-eastern corner of South Australia, being 90 miles north of Innamincka, on the Cooper, bounded to the north and east by Queensland. The journey there was made in the company of Mr. Reid, the general manager, and of Mr. R. L. Jack, Assistant Government Geologist. Starting by motor car from Beltana, the railway line was followed to Mount Lyndhurst siding. Thence the road lay eastwards to Mount Lyndhurst Station, Murnpeowie, Blanchewater, Mount Hopeless Station, and the Lakes Crossing between Lakes Blanche and Callabonna. Here the first sandhill country was encountered, accompanied by a marked change in the flora. Strzelecki Creek was struck near Carraweena, and its bed was followed in a north-easterly direction, through Tinga Tingana to Innamincka, on the Cooper. Thence the route lay almost due north to Cordillo. The distance thus travelled by motor car was 416 miles. A visit was paid from Cordillo to Arrabury Station, due east, some 20 miles, just over the Queensland border. Through the kindness of Mr. and Mrs. Murray at Cordillo, special opportunities were given for the collecting of natural history specimens. The return journey followed the same route, except that Farina was the railway town finally reached. Every opportunity was taken, on both the up and down journeys, to collect specimens of the plants. During the nine days spent at Cordillo itself 205 species of plants were obtained. Forty-one additional species were found on the way up or the way down, outside the area defined in this paper. The localities of plants found on these journeys, but outside the area, are inserted in this paper in brackets.

The number of plants collected by L. R. and J. B. C. in the north-east corner of the State is, so far, 253. With the 40 plants outside the area, 292 species are mentioned in this paper.

J. M. B. is responsible for the identifications of the various plants. The collections have resulted in the finding of two species new to science, *viz.*, a *Cyperus* by J. B. C. and a *Ranunculus* by L. R. There is also probably a new *Eremophila* and a new *Lepidium*. Several new records for the State have also resulted, and some species, listed as probably occurring because previously found close to our borders, have now actually been collected in South Australia.

The new species founded on these collections and described, or about to be described elsewhere, are *Cyperus Clelandii*, J. M. Black; *Ranunculus pentandrus*, Black; *Lepidium* (n. sp. probably), collected by L. R.; and *Eremophila* (n. sp. probably), collected by J. B. C. and previously by Dr. MacGillivray.

New varieties comprise: *Eragrostis interrupta*, var. *densiflora*, Black, and *Cassia Sturtii*, var. *planipes*, Black, both collected by J. B. C.

New records for the State are twelve in number:—*Cynodon ciliaris*, *Bulbostylis capillaris*, *Blennodia eremigena*, *Neptunia monosperma*, *Indigophera enneaphylla*, *Tephrosia sphaerospora*, *Swainsona laxa*, var. *rigida*, *Owenia acidula*, and *Eucalyptus pyrophora*, all collected by J. B. C.; *Babbagia scleroptera*, *Amaranthus macrocarpus*, and *Sesbania aegyptiaca*, collected by L. R.

J. B. C. is responsible for the notes on the distribution of plants at Cordillo, and Mr. R. L. Jack has kindly supplied a short account of the soils of this part, which is included in his own words, as follow:—

THE SOILS NORTH OF LAKE CROSSING TO CORDILLO.

There are three types:—

(1) The desert sandstone and its derivatives.
(2) The sandhill country.
(3) The silts of the Strzelecki flood plain.

(1) The desert sandstone, or Upper Cretaceous, is an approximately horizontal series of arenaceous and argillaceous rocks. While it was still continuous the upper crust became silicified, so that with incomplete erosion table-topped hills are left. With more complete erosion the tabular crust breaks up into siliceous stones which gradually become rounded by insolation, polished by sand blast, and acquire a patina of iron oxide. The table tops are very stony and the soil is fairly thin, and may be argillaceous or arenaceous. The steep slopes of the table hills expose semi-decomposed angular white and yellow shale fragments and beds of sandstone more or less indurated. The rolling tableland country has a mantle of gibbers, but beneath it the soil is red and deep, generally argillaceous. The main creeks are well defined and tributary creeks appear to have at one time excavated thin valleys a little deeper, and then with the drying of the climate these small valleys have silted up with loamy soil without gibbers. In the rolling gibber country small depressions also fill with soil. Towards the outermost limits of the desert sandstone, where it has been planed down, silt and loams from the outwash overlie the gibbers and are encroached on in their turn by the sandhill country.

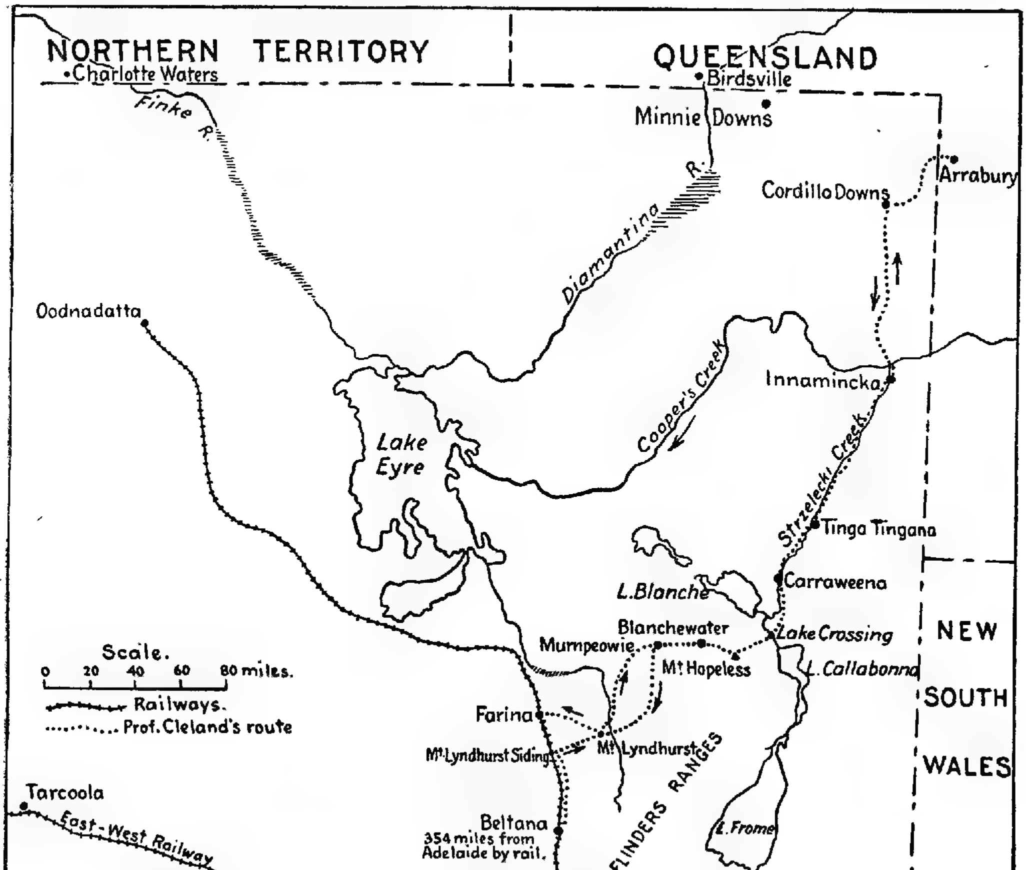
(2) The sandhill country is made up of successive waves of yellowish to reddish sandhills, essentially siliceous, and iron stained. The intervening flats may range from loam to claypans, and are formed in part (near the desert sandstone) by the outwash plain above referred to, and in part by the collection of dust by rain-wash of the finer particles from the sandhills. They are yellowish to reddish.

(3) The Strzelecki flood plain. This is a fine grey silt, apparently fairly argillaceous, brought down in the highest flood waters of Cooper's Creek.

R. LOCKHART JACK.

The vegetation on Cordillo Station may be divided into three main types, *viz.*, that of the gibber country and flat-topped hills, (2) that of the sandhills, and (3) that of the creeks and adjacent flood-lands. The first of these may be roughly described as consisting, in part, of undulating plains and slopes covered with the stony gibbers with occasional flat-topped hills rising some 150 feet, or so, above the surrounding surface and capped with the hard crust of the desert sandstone not yet weathered into gibbers. In the second type, the sandhills rise perhaps 80 feet from the plain, are of varying colours from dirty whitish to a brilliant brick-red or terra-cotta, and show a few scattered shrubs and under-shrubs. Between the sandhills are flat claypans, where the sand has been blown off or fine silt has formed an impermeable floor. These claypans are sometimes of large size, a mile or more in length. The third type commences with depressions which gather the water when it comes and pass it into creeklets, and these collect into creeks sometimes of considerable size and in places with permanent waterholes.

(1) The presence of the gibbers undoubtedly exercises a very important influence on the vegetation. (I am indebted to Mr. Jack for directing my attention to this aspect.) It is this gibber country that after rain yields grass (chiefly Mitchell grass) in abundance, and constitutes the best sheep country. The rain falling on the stones, passes down their sides and sinks into friable soil penetrating beneath the stones themselves. Geologists consider that the stones practically act as a coarse mulch. Beneath them the moisture is conserved, and this is accentuated by the friable tendency of the soil between. Mr. Jack points out also that the shadow cast by the stone protects the adjacent soil for so many hours



of the day against direct sunlight. As the soil itself is an exceedingly fertile one, it is not surprising that grass and herbage should arise after rain, and it is also obvious that the luxuriance of this is greater, from the water-conserving action of the gibbers, than would be the case were the surface stone free. The stones also assist in giving stability to the soil.

On the undulating gibber downs, depressions of two kinds occur—little saucer-shaped depressions of a few yards in diameter with relatively impervious bottoms and without outlets, and longitudinal depressions representing abortive watercourses, or actually, the commencement of small tributaries that eventually descend to a main creek. In both these, the gibbers are few and the effect of rain is to feed these areas from the adjacent slopes. In the circular depressions, nardoo is often found; in the incipient creeks Mitchell and a few other grasses and herbs luxuriate.

Widely distributed over the gibber surface is *Bassia lanicuspis,* a hirsute saltbush, a few inches high. Equally distributed is the Mitchell grass, but this tends to luxuriate more particularly along the depressions. Another widely distributed grass, though in less abundance, is a *Pappophorum.* Two other grasses are occasionally met with.

During J. B. C.'s visit, the gibber slopes were almost completely devoid of plant life, looking in the distance like recently ploughed dark-brown soil. Only an occasional, usually dried up, remnant of the flora that appears after rain remained. The writer has therefore no clear idea of the abundance in quality and in quantity of plant life under favourable conditions. The Mitchell grass is said to grow luxuriantly and entirely covers the brown gibbers from sight. These stony downs, Sturt's Stony Desert, as seen by him in drought time, form the best of sheep-grazing country. Only the following plants were collected:—The grasses *Tragus racemosus, Sporobolus actinocladus, Pappophorum* sp., *Cynodon ciliaris,* and *Astrebla pectinata* (Mitchell grass); *Bassia lanicuspis, Atriplex spongiosum, Portulaca oleracea,* and in depressions, nardoo *(Marsilia Drummondii).*

(2) The vegetation on the more or less shifting sandhills is meagre but very characteristic. On the summits, where the sand is finest, the vegetation may consist merely of widely-sundered xerophytic shrubs. Lower portions may be more fertile. The effect of traffic in conserving moisture was often shown by plants growing and being in flower only along the tracks over the lower sandhills. The most striking plants on the higher sandhills are the Asclepiad, *Cynanchum floribundum,* a tufted low bush with thin glossy leaves; *Leschenaultia divaricata* and *Scaevola depauperata,* low intricate wiry stiff leafless shrubs, almost impossible to differentiate from each other except when in flower; the somewhat wiry cane grass *Spinifex paradoxus;* the grass *Plagiosetum refractum; Aristida stipoides; Eriachne aristida;* the porcupine grass *Triodia; Eragrostis* sp., with sand particles clustered on the hairs of the roots; *Grevillea stenobotrya; Ptilotus latifolius; Didymotheca ramulosa;* a succulent *Calandrinia; Acacia Murrayana, A. ligulata,* the handsome *A. dictyophleba; Cassia pleurocarpa;* the bird flower, *Crotalaria Cunninghamii,* abundant; *C. dissitiflora,* abundant; *Tribulus hystrix; Dodonea attenuata* (probably); *Adriana glabrata; Euphorbia Wheeleri; E. eremophila; Solanum ellipticum; Helichrysum ambiguum; H. apiculatum; Siloxerus pusillus; Trichodesma zeylanicum; Owenia acidula* and *Newcastlia cephalantha.*

(3) The watercourses and flooded flats and their neighbourhood had, as might have been expected, by far the most abundant flora. The three nardoos and *Triglochin calcitrapa* were necessarily found in drying waterholes. Nearly all of the 42 species of grass collected at Cordillo were gathered in or on watercourses and flats and often formed a tall and luxuriant vegetation. The chief exceptions to this habitat have already been mentioned in the sandhills vegetation. The 8 Cyperaceae and the *Crinum* also only occurred in parts liable to flood. *Grevillea striata* and *Hakea Ivoryi* are found on the flats. Lignum grows on flats definitely liable to flood. Most of the 15 Chenopodiaceae grow near these lower parts or a little further back. *Polanisia viscosa* was found along a dry watercourse. The Red Mulga *(Acacia cyperophylla)* was an abundant and striking shrub along many watercourses. *A. Cambagei,* the stinking wattle or gidya, was much less abundant. *A. stenophylla* was round a waterhole. *A. farnesiana* grew on the flats, as did most of the Cassias. *Bauhinia* occurred near watercourses, *Vigna lanceolata, Neptunia monosperma, Psoralea patens,* and *Aeschynomene indica* on their banks. *Atalaya* and *Heterodendron* were found on the flats. Most of the mallows were near watercourses. *Solanum esuriale* and *Nicotiana*

were on the sandy soil near their edge. *Eucalyptus rostrata* grew in or near permanent water; Coolebah and Bloodwood on the flats. The Eremophilas were found on the flats. The two melons grew on the banks of watercourses, *Scaevola ovalifolia* on a flat.

The flora of this district is strikingly different from that of the southern parts of the State. It happened that, when one of us (J. B. C.) made the journey to Cordillo, he was engaged in collecting the plants of the Encounter Bay district. For the north-east corner of the State we have tabulated about 253 species of plants, of which only about two or three are introduced. In the Encounter Bay district, over 600 species have been collected, of which about 100 are introduced. On comparing the lists, it is seen that only about 28 species are common to the two districts. These include, of grasses, *Themeda triandra, Panicum gracile (sensu lato), Pappophorum nigricans* (probably occurs in the Encounter Bay area), and *Cynodon dactylon* (couch grass); *Heleocharis acuta; Loranthus exocarpi; Muehlenbeckia Cunninghamii; Rhagodia nutans; Atriplex Muelleri; Salsola kali; Trichinium alopecuroideum; Portulaca oleracea; Pittosporum phillyreoides* (possibly occurs in the Encounter Bay district); *Acacia ligulata; Psoralea patens; Lotus australia*, represented by a variety in the North; *Euphorbia Drummondii; Lavatera plebeja; Eucalyptus rostrata; Convolvulus erubescens; Nicotiana suaveolens; Mimulus repens; Wahlenbergia gracilis; Senecio lautus; Centipeda Cunninghamii; Gnaphalium luteo-album; Helichrysum apiculatum;* and *Sonchus oleraceus* (introduced). These are all widely distributed species in Australia and would form an interesting study to the students of "Age and Area."

No ferns (excluding three species of *Marsilia)* have yet been collected in the north-east, as against 9 species *(Marsilia* has not been recorded) for Encounter Bay. Forty-six species of grasses have already been found in the north-east and 49 are known for Encounter Bay, the total for the State being about 190. Yet only four occur in both these localities. It may be noted that a number of the grasses at Encounter Bay are introduced. The north-east is rich in species of *Andropogon, Panicum, Aristida, Sporobolus, Eragrostis,* and *Chloris,* of which genera Encounter Bay possesses no species or single species only. *Stipa* replaces Aristida at Encounter Bay.

Eleven species of Cyperaceae occur in the north-east, chiefly species of *Cyperus* and *Fimbristylis.* Forty-one species, out of about 91 known for the State, are found at Encounter Bay, belonging chiefly to the genera *Cyperus, Schoenus, Scirpus, Cladium, Lepidosperma,* and *Carex.* Only one species *(Heleocharis acuta)* is so far common to both localities.

No orchids have yet been found in the north-east, Flinders Range being the nearest definite locality for them (Dr. Rogers). No Liliaceae have beeen collected, though probably one at least occurs. No Juncaceae, Casuarinacae, Rutaceae, Rhamnaceae, or Epacridaceae have been recorded.

The north-east has 11 species of *Acacia,* the Encounter Bay district the same number. *A. ligulata* is common to the two. *A. Victoriae* of the north-east occurs as far south as Brighton, and *A. salicina* also occurs in the south. The Caesalpinioidea, represented by 7 species in the north-east, are absent from Encounter Bay. The Papilionate flora is quite distinct in the two localities. Only one species is common to both, though a varietal difference occurs in another species. Eighteen species are found in the north-east; 27 native species and a number of introduced clovers, etc., in the Encounter Bay area. In the former we get *Crotolaria, Indigofera, Psoralea, Sesbania,* and *Swainsona,* in the latter, more particularly *Daviesia, Pultenaea,* and *Dillwynia.*

The Eremophilas are a notable feature of the desert flora, entirely absent in the Encounter Bay district.

MARSILIACEAE:—

(1) *Marsilia Brownii,* A. Br., Cooper's Creek at Innamincka.

(2) *M. Drummondii,* A. Br., Nardoo, Cordillo; flooded country, 3 or 4 inches high, seeds ground or rather pounded to meal and eaten by the natives, Minnie Downs (No. 121).

(3) *M. hirsuta,* R. Br., Cordillo; [between Caraweena and Lakes Crossing; Mount Hopeless].

SCHEUCHZERIACEAE:—

(1) *Triglochin calcitrapa,* Hook., on damp soil in a watercourse, Cordillo.

GRAMINEAE:—

(1) *Pollinia fulva,* (R. Br.) Benth., Sugar Grass, in watercourse, Cordillo.

(2) *Andropogon intermedius,* R. Br., Blue Grass, Toorawatchy waterhole.

(3) *A. annulatus,* Forsk., in watercourse at Cordillo.

(4) *A. annulatus,* var. *humilis,* Benth., in sandy loam, 6 inches high, Minnie Downs (No. 7).

(5) *A. Gryllus,* L., in watercourse at Cordillo, 4 to 5 feet high; in sand liable to floods, not in any quantity, Minnie Downs (No. 42).

(6) *Themeda triandra,* Forsk., in watercourse at Cordillo.

(7) *Iseilema membranacea,* (Lindl.) Anderss., in watercourses at Cordillo and Toorawatchy waterhole; Minnie Downs (No. 5).

(8) *Tragus racemosus,* (L.) Haller, Small Burr Grass, on gibber plains, Cordillo; sandy flats, 8 inches high, Minnie Downs (No. 53).

(9) *Eriochloa punctata* (L.), Hamilt., var. *acrotricha,* Benth., in watercourse at Cordillo; in sandy loam, 18 inches to 2 feet high, splendid stock feed, Minnie Downs (Nos. 1 and 127).

(10) *Panicum decompositum,* R. Br., along watercourses at Cordillo and Toorawatchy; "Pepper" or "Popper Grass," in flooded country, 18 inches to 2 feet high, practically useless for fodder, aboriginals gather the seed and grind it, Minnie Downs (No. 6).

(11) [*P. Novae-hollandiae* (Beauv.), comb. nov. (*P. reversum,* F. v. M.), Strzelecki Creek near Carraweena.]

(12) *P. gracile,* R. Br., Toorawatchy waterhole.

(13) *P. Brownii,* Roem. et Schult. (*P. leucophaeum,* Benth. non H. B. et K.), in watercourse, Cordillo.

(14) *P. notochthonum,* Domin (*P. helopus,* Benth. non Trin.), in garden at Cordillo.

(15) *P. crus-galli,* L., Cockspur Grass, in creeks at Cordillo and Toorawatchy; Sorghum, 5 to 8 feet high, on flooded flats, grows plentifully after summer floods and must be cut at the right time for hay. At Monkira a lot of cattle died when fed on it in the drought. Sometimes it causes heavy scouring, at others stock improve on it. I have ridden through miles of it and have tied it over my head when sitting on horseback (L. R.). Minnie Downs (No. 26). This is var. *aristata,* Wirtgen.

(16) *Plagiosetum refractum,* (F. v. M.) Benth., in the sandhills, Cordillo.

(17) *Spinifex paradoxus,* (R. Br.) Benth., in the sandhills, Cordillo; Sandhills Cane Grass, a good stand-by in dry times, Minnie Downs (No. 132).

(18) *Aristida stipoides,* R. Br., in the sandhills 25 miles south of Cordillo.

(19) *A. arenaria,* Gaudich., Cordillo, Toorawatchy, Innamincka; Fly Spear Grass, in sand, 12 inches high, used by the natives to spear flies. They put a small piece of meat on their knee with the fore-finger of the left hand about 3 inches away. On it they rest one of the darts from the top of the grass and flip it with the second finger of the right hand. They amuse themselves sometimes for hours at this and get quite a number of flies. Minnie Downs (No. 108).

(20) *A. ramosa,* R. Br., near watercourses at Cordillo and 20 miles south.
(21) *A. calycina,* R. Br., Cordillo.
(22) *Sporobolus virginicus,* (L.) Kunth., var. *pallidus,* Benth., Lake Grass, on lakes or flooded country, 2 feet high, Minnie Downs (No. 161).
(23) *S. actinocladus,* F. v. M., on gibber plains, Cordillo.
(24) *S. Lindleyi,* Benth., in watercourse, Cordillo; [Nilpena].
(25) *Eriachne aristidea,* F. v. M., in sandhills, Cordillo and south thereof.
(26) *E. ovata,* Nees, var. *pallida,* Benth., Cordillo; in sandy loam and swamps, 2 to 3 feet high, Minnie Downs (Nos. 46, 58).
(27) *Pappophorum nigricans,* R. Br., Cordillo, Innamincka.
(28) *P. avenaceum,* Lindl., Cordillo; [Mount Lyndhurst].
(29) *Triodia,* probably *T. pungens,* R. Br., sandhills, Cordillo; Spinifex, good for making a fire on a wet day, Minnie Downs (No. 133).
(30) [*Diplachne fusca* (L.) Beauv., var. *Muelleri,* (Benth.) Lakes Crossing; Murnpeowie.]
(31) *Eragrostis interrupta,* (Lamk.) Beauv., var. *tenuissima,* Stapf., in creeks, Cordillo and Toorawatchy.
(32) *E. interrupta,* Beauv., var. *densiflora,* J. M. Black, Toorawatchy waterhole.
(33) *E. leptocarpa,* Benth., along creeks, Cordillo and south thereof.
(34) *E. pilosa,* (L.) Beauv., Toorawatchy.
(35) *E. concinna,* Steud., Cordillo, Toorawatchy.
(36) *E. eriopoda,* Benth., in sand, 2 feet, Minnie Downs (No. 70).
(37) *E. setifolia,* Nees, near watercourses, Cordillo, Toorawatchy; Innamincka; in sand, 12 or 18 inches high, Minnie Downs (No. 41); [near Carraweena.]
(38) *E. Dielsii,* Pilger, Cordillo and south thereof; good feed, Minnie Downs (No. 3); [Lakes Crossing; Mount Lyndhurst, and between here and Murnpeowie].
(39) *E.* sp. (not in flower), in sandhills, Cordillo, with sand clustering on the thick hairs of the roots.
(40) *Glyceria ramigera,* F. v. M., Cane Grass, flats south of Cordillo; claypans, 6 to 8 feet, eaten by stock, Minnie Downs (No. 77); [between Carraweena and Lakes Crossing].
(41) *Cynodon dactylon,* Rich., Couch Grass, Cordillo.
(42) *C. ciliaris,* Benth., on gibber plains, Cordillo, new record for the State.
(43) *Chloris divaricata,* R. Br., var. *minor,* J. M. Black, near watercourses, Cordillo.
(44) *Ch. acicularis,* Lindl., Spider Grass, in watercourses, Cordillo.
(45) *Ch. scariosa,* F. v. M., in watercourses, Cordillo.
(46) *Astrebla pectinata,* F. v. M., Mitchell Grass, Cordillo; Minnie Downs (No. 4).
(47) *Dactyloctenium aegyptium,* (L.) Willd., Cordillo, Toorawatchy; Button Grass, 12 inches high, in sandy loam, very sweet horse feed, Minnie Downs (No. 2); [near Carraweena and between here and Lake Crossing].
(48) *Leptochloa digitata,* (R. Br.) J. M. Black, Toorawatchy.

CYPERACEAE:—

(1) *Cyperus pygmaeus,* Rottb., Toorawatchy and 40 miles north of Innamincka; [Burnie Burnie near Innamincka].
(2) *C. squarrosus,* L., in sand, 6 or 7 inches high, Minnie Downs (No. 37).
(3) [*C. vaginatus,* R. Br., var. *densiflorus,* Benth., Akalana Crossing, Strzelecki Creek.]
(4) *C. difformis,* L., Cordillo.

(5) *C. Iria,* L., in watercourses, Cordillo and Toorawatchy; in sand, 6 to 12 inches high, Minnie Downs (Nos. 39, 40).

(6) *C. rotundus,* L., Cordillo, Toorawatchy; Balsam or Nut Grass, 2 or 3 feet high, Minnie Downs (No. 43); [probably Mount Hopeless].

(7) *C. Clelandii,* J. M. Black. This new species was found at Cordillo.

(8) *Heleocharis acuta,* R. Br., in watercourses, Cordillo; in swamps, 12 inches high, Minnie Downs (No. 64).

(9) *Fimbristylis diphylla,* Vahl., in watercourse, Cordillo.

(10) *Bulbostylis capillaris,* (L.) C. B. Clarke; in watercourse, Cordillo, a first record for the State.

(11) [*Scirpus littoralis,* Schrad., in bore-stream, Murnpeowie.]

AMARYLLIDACEAE :—

(1) *Crinum pedunculatum,* R. Br., probably, not in flower, Cordillo; flooded country, 1 foot to 18 inches. Cattle are very fond of the leaves, it will grow a foot and flower in three weeks, being one of the fastest growing plants in the district, but there is not much of it. Minnie Downs (No. 169); [near Carraweena].

PROTEACEAE :—

(1) *Hakea Ivoryi,* Bailey, Corkwood, Cordillo west; *H. Ivoryi (H. intermedia,* Ew. et Davies), in sandy soil, 14 feet high, supposed to grow on water-bearing country, eaten by camels, Minnie Downs (No. 176).

(2) *H. leucoptera,* R. Br., Needlewood, Cordillo; on stony downs and in sand, 16 feet high, the leaves are good for making a fire on a wet day, used for making smoking pipes, supposed to have water in the roots sufficient to yield a drink, Minnie Downs (Nos. 89 and 142); [banks of the Strzelecki Creek, the roots radiate outwards superficially and are very porous, the orifices of the pores being just recognisable by the naked eye. By setting fire to the tree, Mr. Patterson, of Tinga Tingana, says the water is driven into the roots, whence it may be obtained by tearing them up and standing short lengths in a receptacle.]

(3) *Grevillea stenobotrya,* F. v. M. Cordillo west, Arrabury (Q'land).

(4) *G. striata,* R. Br., Beefwood, Cordillo west; in any soil, up to 40 feet high, wood splendid for yard building, especially for gates, in a drought if cut down cattle and horses will eat it, but they do not care for it, Minnie Downs (No. 97); [Upper Strzelecki; Tinga Tingana on Lower Strzelecki].

SANTALACEAE :—

(1) *Santalum lanceolatum,* R. Br., Plum or Cherry, in sandy loam, 20 feet high, the fruits are eaten by the aborigines, and emus, camels, and goats are very fond of the leaves, Minnie Downs (No. 28); Cordillo and south thereof.

LORANTHACEAE :—

(1) *Loranthus exocarpi,* Behr., on *Acacia farnesiana,* tubular portion of perianth yellow, berries yellowish-red, Cordillo; on "white wood" *(Atalaya hemiglauca),* tubular portion of perianth red, between Cordillo and Innamincka; on *Eremophila Freelingii* and *E. Dalyana,* red form, Innamincka; [on *Hakea leucoptera* and *Atalaya hemiglauca,* red form, Tinga; between Mount Lyndhurst and Murnpeowie].

(2) *L. linearifolius,* Hook. (probably), on *Acacia tetragonophylla* (Dead Finish), Cordillo; [on the same species of Acacia, 18 miles west of Murnpeowie].

(3) *L. Maidenii,* Blakely, on Red Mulga *(Acacia cyperophylla),* Cordillo.

(4) *L. dictyophlebus,* F. v. M., perhaps (and, if so, new for the State), on the Broad-leafed Pitchuri Willow *(Acacia* sp.), Minnie Downs (No. 140).

POLYGONACEAE:—

(1) *Muehlenbeckia Cunninghamii,* (Meisn.) F. v. M., Lignum, on flats, Cordillo; on flooded country, 8 or 10 feet high, Minnie Downs (Nos. 75 and 135).
(2) [*M. coccoloboides,* J. M. Black, Sandhills Lignum, near Carraweena, Lower Strzelecki.]

CHENOPODIACEAE:—

(1) *Rhagodia spinescens,* R. Br., var. *deltophylla,* F. v. M., Cordillo.
(2) *Rh. nutans,* R. Br., Cordillo.
(3) *Chenopodium nitrariaceum,* F. v. M., 25 miles south of Cordillo.
(4) *Ch. carinatum,* R. Br., Keeled Goosefoot, in sandy loam, 6 or 8 inches high, Minnie Downs (No. 13).
(5) *Ch. auricomum,* Lindl., Golden Goosefoot, on flats, Cordillo.
(6) *Dysphania littoralis,* R. Br., Cordillo.
(7) *Atriplex angulatum,* Benth., Cordillo; [Mount Lyndhurst].
(8) *A. velutinellum,* F. v. M., Cordillo and between here and Innamincka; 6 feet high, eaten by stock, Minnie Downs (No. 68); [Tinga].
(9) *A. rhagodioides,* F. v. M. (perhaps), Blue Bush, on flooded flats, 3 or 4 feet high, good stock feed, very fattening, Minnie Downs (No. 49).
(10) *A. Muelleri,* Benth., between Cordillo and Innamincka.
(11) [*A. leptocarpum,* F. v. M., Slender-fruited Saltbush, near Carraweena; Tinga.]
(12) [*A. limbatum,* Benth., var. *sexifidum,* Black, Tinga; Mount Lyndhurst.]
(13) [*A. halimoides,* Lindl., var. *conduplicatum,* F. v. M. et Tate, between Carraweena and Lakes Crossing.]
(14) *A. spongiosum,* F. v. M., grows on gibber country, Cordillo; Annual Saltbush, about 8 inches or a foot high, Minnie Downs (No. 38); [near Carraweena].
(15) *Bassia uniflora,* (R. Br.) F. v. M., in sand, 6 inches high, Minnie Downs (No. 69).
(16) [*B. uniflora,* var. *incongruens,* J. M. Black, Mount Lyndhurst.]
(17) *B. bicornis,* (Lindl.) F. v. M., Cordillo and 25 miles south; Goat Head, on sand flats, 18 inches or 2 feet high, eaten by camels, very painful if a spine sticks in one's hand, Minnie Downs (No. 80).
(18) *B. brachyptera,* (F. v. M.) R. H. Anders. Cordillo.
(19) [*B. paradoxa,* (R. Br.) F. v. M., between Mount Lyndhurst and Murnpeowie.]
(20) [*B. biflora,* (R. Br.) F. v. M., Mount Lyndhurst.]
(21) [*B. decurrens,* J. M. Black, near Carraweena; Lakes Crossing.]
(22) *B. lanicuspis,* F. v. M., grows on gibber country, Cordillo and between here and Innamincka.
(23) [*B. divaricata,* (R. Br.), F. v. M., Tinga.]
(24) *B. echinopsila,* F. v. M., on tableland red soil, 6 inches high, Minnie Downs (No. 136)—a first record for South Australia.
(25) *B.* sp., near *B. glabra,* Cordillo.
(26) [*Babbagia dipterocarpa,* F. v. M., Lakes Crossing.]
(27) [*B. acroptera,* F. v. M. et Tate, Lakes Crossing; Mount Lyndhurst.]
(28) *B. scleroptera,* F. v. M., Squash Bush, in red loam, 6 to 8 inches high, Minnie Downs (No. 95)—stated in Black's Flora as probably to be found in our Far North-East.

(29) [*Kochia brevifolia,* R. Br., Mount Lyndhurst.]
(30) [*K. pyramidata,* Benth., Farina.]
(31) *K. tomentosa,* (Moq.) F. v. M., var. *appressa,* Benth., on claypans, 18 inches high, Minnie Downs (No. 125).
(32) *Salsola kali,* L., Rolly-poly, in sandhills, 1 to 2 feet high, eaten by stock, Minnie Downs (No. 16).
(33) *S. kali,* var. *strobilifera,* Benth, Cordillo.
(34) *Enchylaena tomentosa,* R. Br., Ruby Saltbush, Cordillo; Currant Bush, grows anywhere, 1 to 4 feet high, berries eaten, Minnie Downs (Nos. 112 and 129); [Mount Lyndhurst].
(35) [*Arthrocnemum leiostachyum,* (Benth.) Paulsen, near Carraweena].
(36) *Pachycornia tenuis,* (Benth.) J. M. Black, Cordillo; [near Carraweena; Farina.]

AMARANTACEAE:—

(1) *Trichinium obovatum,* Gaud., Cordillo.
(2) *T. alopecuroideum,* Lindl., Cordillo; sandhills, 2 feet high, Minnie Downs (No. 55).
(3) *Amarantus Mitchellii,* Benth., Chick Weed, in sandy loam, 1 to 2 feet high, frogs are very fond of the seeds, Minnie Downs (No. 22).
(4) *A. Mitchellii,* var. *grandiflora,* J. M. Black, between Mount Lyndhurst and Murnpeowie ("may be a distinct species. Only known by one specimen in the Tate Herbarium, from Mount Parry, near Lake Torrens."—Black's Flora of S.A.).
(5) *A. macrocarpus,* Benth., Chick Weed, in sandy loam, 1 to 2 feet high, frogs are very fond of the seeds, Minnie Downs (No. 22)—a new record for the State.
(6) *Ptilotus latifolius,* R. Br., in sandhills, Cordillo.
(7) *Alternanthera* sp., in watercourses, Cordillo.

NYCTAGINACEAE:—

(1) [*Boerhavia diffusa,* L., Mount Lyndhurst, Lower Strzelecki.]
(2) *B. repanda,* Willd., Cordillo, Innamincka.

PHYTOLACCACEAE:—

(1) *Gyrostemon ramulosus,* Desf., collected at Arrabury, Q'land, on the sandhills one mile over the border, said to be found on Cordillo itself.

AIZOACEAE:—

(1) *Tetragonia expansa,* Murr., young plant, probably this, Cordillo.
(2) *Gunniopsis quadrifida,* (F. v. M.) Pax, in sand, 2 feet high, Minnie Downs (No. 51).
(3) *Trianthema decandra,* L., Cordillo and 25 miles south; in sandhills and in red and black loam, 6 to 8 inches high, Minnie Downs (Nos. 67, 96A).
(4) *T. crystallina,* Vahl., in sand, 5 or 6 inches high, Minnie Downs (No. 47); Cordillo and 25 miles south; [between Mount Lyndhurst and Murnpeowie].
(5) *T. pilosa,* F. v. M., 25 miles south of Cordillo.
(6) *Glinus lotoides,* Loefl., Cordillo; on flats, 4 inches high, Minnie Downs (No. 74); [Burnie Burnie near Innamincka].

PORTULACACEAE:—

(1) *Portulaca oleracea,* L., Purslane, Cordillo; between Cordillo and Innamincka; [Lower Strzelecki].

(2) *P. oleracea,* var. *grandiflora,* Benth., Pig Weed, root eaten by blacks after cooking, in the sandhills, 6 inches high, Minnie Downs (No. 63).

(3) *Calandrinia* sp., drying plants, very succulent, in sandhills, Cordillo.

CARYOPHYLLACEAE:—

(1) *Polycarpaea synandra,* F. v. M., on tablelands, 4 to 6 inches high, Minnie Downs (No. 143A).

(2) *P. corymbosa,* (L.) Lamk., in watercourse, Cordillo.

RANUNCULACEAE:—

(1) *Ranunculus pentandrus,* J. M. Black, a new species, flooded land, Minnie Downs.

CAPPARIDACEAE:—

(1) *Polanisia viscosa,* (L.) DC., near dry watercourses, Cordillo.

(2) *Capparis Mitchellii,* Lindl., Native Orange, in garden at Cordillo, also occurs wild.

CRUCIFERAE:—

(1) [*Blennodia trisecta,* (F. v. M.) Benth., Murnpeowie west; Mount Lyndhurst.]

(2) *B.*, near *curvipes,* F. v. M. (too young), between Cordillo and Innamincka.

(3) [*B. pterosperma,* J. M. Black, Carraweena.]

(4) *B. eremigena,* (F. v. M.) Benth., Innamincka—new record for the State.

(5) *Alyssum linifolium,* Steph., 25 miles south of Cordillo.

(6) [*Menkea sphaerocarpa,* F. v. M., near Carraweena.]

(7) *Lepidium* sp., in sandy loam, 8 inches to 1 foot, Minnie Downs (No. 22A)—perhaps a new species.

PITTOSPORACEAE:—

(1) *Pittosporum phillyreoides,* DC., Toorawatchy.

LEGUMINOSAE:—

(1) *Acacia Victoriae,* Benth., Prickly Acacia, Cordillo; [Tinga Tingana; Strzelecki Creek].

(2) *A. Murrayana,* F. v. M., the stems are yellowish, in the sandhills, Cordillo.

(3) *A. salicina,* Lindl., Native Willow, Broughton Willow, on flooded ground, 20 feet high, good wood for buggies, bark tans a bit, eaten by camels, Minnie Downs (No. 78); [along the creek, Murnpeowie].

(4) *A. ligulata,* A. Cunn., in sandhills, Cordillo; Pitchuri Willow, 12 feet high, Minnie Downs (No. 86); [Tinga]—the ash of the leaves is mixed by the natives with the narcotic pitchuri leaves. It has a strong taste resembling that of rotten eggs.

(5) *A. tetragonophylla,* F. v. M., Dead Finish, Cordillo; in any soil, 8 to 10 feet high, good for boomerangs and wohera sticks, also for whip handles, takes a splendid polish and looks well, eaten by camels, Minnie Downs (No. 99).

(6) *A. dictyophleba,* F. v. M., forming handsome shrubs in full flower (May) in the sandhills at Cordillo and Arrabury (Q'land); sandhills, 8 or 10 feet high, in flower in April, Minnie Downs (No. 84).

(7) *A. stenophylla,* A. Cunn., Toorawatchy waterhole; Bulgroo, in any soil, 10 feet high, used principally for hobble-pegs, Minnie Downs (No. 98).

(8) *A. Cambagei,* R. T. Baker, Gidya, Stinking Wattle, characterised by a strong smell, especially when in flower, which is very objectionable to many people. The smell is like that given out from the roots of various *Acacias,* and also of *Albizzia* when the roots are injured when digging. As the bacterial nodules on these roots give off this smell when crushed, these nodules are possibly its source. In this *Acacia* the whole plant appears to give off this smell. Near watercourses, Cordillo (flowering in May).

(9) *A. Oswaldii,* F. v. M., Cordillo; [near Carraweena].

(10) *A. brachystachya,* Benth., Umbrella Mulga, in sand, 16 to 20 feet high, good stock feed, Minnie Downs (No. 143); [Burnie Burnie near Innamincka].

(11) *A. cyperophylla,* F. v. M., Red Mulga. This characteristic mulga was first seen lining a creek some 20 miles north of Innamincka. From thence it occurs to Cordillo. The stems with their shreddy reddish fragments of bark present a striking appearance, as if due to tearing by the horns of cattle.

(12) *A. farnesiana,* Willd., Cordillo, on the flats; in black soil, 8 feet high, Minnie Downs (No. 148).

(13) *Neptunia monosperma,* F. v. M., Cordillo, recorded in Black with the statement that it probably occurred in this State.

(14) *Cassia pleurocarpa,* F. v. M., in sandhills, Cordillo and Arrabury (Q'land).

(15) *C. desolata,* F. v. M., Cordillo and between here and Innamincka.

(16) *C. desolata,* tending towards *C. eremophila,* A. Cunn., Cordillo.

(17) *C. Sturtii,* R. Br., Cordillo.

(18) *C. Sturtii,* var. *planipes,* J. M. Black, Cordillo, a new variety.

(19) *C. eremophila,* A. Cunn., Turpentine Bush, in sand, 10 feet high, Minnie Downs (No. 94).

(20) *C. artemesioides,* Gaudich., Cordillo; Arrabury (Q'land).

(21) *C. phyllodinea,* R. Br., Cordillo; in sand, 8 or 10 feet high, eaten by camels, Minnie Downs (No. 177).

(22) *Bauhinia Carronii,* F. v. M., Strzelecki Bean, from about 10 miles below Tinga Tingana on the Strzelecki up to Cordillo in creeks.

(23) *Crotalaria Cunninghamii,* R. Br., Bird Flower, in sand from Akalana Crossing on the Strzelecki to Cordillo and Arrabury (Q'land); Hack's Pea or Bird Flower, in sandhills, 4 to 5 feet high, a fair plant for making aboriginal string, Minnie Downs (No. 62).

(24) *C. dissitiflora,* Benth., in sand from Lakes Crossing to Cordillo; Kahlo, in sand, 6 feet high, used by the natives for making string, ranking amongst the best for this purpose, Minnie Downs (No. 147).

(25) *Lotus australis,* Andr., var. *parviflorus,* Benth., Poison Pea, sandy loam, 1 foot high, with the reputation of being poisonous, but L. R. knows of no instances of actual poisoning by it; [Carraweena and between here and Lakes Crossing].

(26) *Indigofera brevidens,* Benth., Arrabury (Q'land).

(27) *I. enneaphylla,* L., Cordillo, first record for the State.

(28) *Psoralea patens,* Lindl., Cordillo; [near Carraweena; Hawker].

(29) *Ps. cinerea,* Lindl., 25 miles south of Cordillo; Minnie Downs (No. 23).

(30) *Ps. eriantha,* Benth., Cordillo; in sand, 2 to 4 feet high, Minnie Downs (Nos. 30 and 60); [near Carraweena].

(31) *Tephrosia sphaerospora,* F. v. M., between Cordillo and Innamincka, first record for the State.

(32) *Sesbania aegyptiaca,* Poir., not eaten by stock, Minnie Downs (No. 71), first record for the State.

(33) *S. aculeata*, Poir., Yellow Pea, 4 to 6 feet high, grows at the bottom of dried-up waterholes, no good for feed, Minnie Downs (Nos. 25 and 72).

(34) *Clianthus speciosus*, (G. Don) Aschers. et Graebn. *(C. Dampieri*, A. Cunn.), Sturt Pea, said to occur on Cordillo.

(35) *Swainsona oligophylla*, F. v. M., in sand, 18 inches high, Minnie Downs (No. 45).

(36) *S. oroboides*, F. v. M., Cordillo; in sand, 6 inches to 1 foot high, Minnie Downs (Nos. 32, 35).

(37) [*S. microphylla*, A. Gray, near Carraweena.]

(38) *S. laxa*, R. Br., var. *rigida*, Benth., in sand, 3 to 5 feet high, Minnie Downs (Nos. 94A and 178); [Lakes Crossing], first record for the State.

(39) *Glycine sericea*, (F. v. M.) Benth., Cordillo.

(40) *Vigna lanceolata*, Benth., along watercourses, Cordillo; Yam, a creeper with branches 4 or 5 feet long, in sand, Minnie Downs (No. 185).

(41) *Aeschynomene indica*, L., along watercourse, Cordillo, Toorawatchy.

ZYGOPHYLLACEAE:—

(1) [*Nitraria Schoberi*, L., Nitre Bush, near Carraweena.]

(2) *Zygophyllum* sp., Cordillo.

(2) *Tribulus hystrix*, R. Br., Cordillo; Bull Head, creeping, in sand, Minnie Downs (No. 9A); [Lakes Crossing].

MELIACEAE:—

(1) *Owenia acidula*, F. v. M., in sandhills, Cordillo, first record for the State.

EUPHORBIACEAE:—

(1) *Phyllanthus rhytidospermus*, F. v. M., no male flowers collected, Cordillo and south thereof; in sand, 18 inches high, Minnie Downs (No. 126); [near Carraweena].

(2) *Ph. lacunarius*, F. v. M., in sandy soil, 1 foot high, Minnie Downs (No. 154); [Upper Strzelecki, Tinga, and near Carraweena].

(3) *Ph. Fuernrohrii*, F. v. M., on black soil flats and sandhills, 1 foot high, Minnie Downs (No. 102); [Tinga].

(4) *Adriana glabrata*, Gaudich., in sandhills, Cordillo.

(5) [*Euphorbia australis*, Boiss., Mount Lyndhurst.]

(6) *E. Drummondii*, Boiss., Cordillo; Buffalo Bush, Currawinya Clover, in sand and sandy loam, on stony downs or any soil, 3 to 12 inches high, kills sheep when they eat much of it when hungry, a sheep-buyer lost 400 or 500 sheep at Mina Mitta from eating it probably after a semi-starve, Minnie Downs (Nos. 36, 93, and 130).

(7) *E. Wheeleri*, Baill., on sandhills, Cordillo and 25 miles south; Sandhill Caustic, in sand, 18 inches or 2 feet high, the iguana is said to eat this plant or *E. eremophila* after he has had a fight with a snake, Minnie Downs (No. 82).

(8) *E. eremophila*, A. Cunn., on sandhill 20 miles south of Cordillo; Flooded-ground Caustic, in flooded country, 2 to 3 feet high, Minnie Downs (No. 83).

CALLITRICHEAE:—

(1) *Callitriche verna*, L., on damp bank of drying watercourse, Cordillo.

SAPINDACEAE:—

(1) *Atalaya hemiglauca*, F. v. M., Whitewood, on flats, Cordillo; on all sorts of soil, 16 feet high, good camel feed but poisonous to them in November when it is in flower, every year Afghans lose some animals from it, Minnie Downs (No. 91).

(2) *Heterodendron oleifolium,* Desf., Cordillo.
(3) *Dodonaea attenuata,* A. Cunn., in sand, Cordillo (probably this species); [Lakes Crossing].

MALVACEAE:—
(1) *Sida corrugata,* Lind., var. *trichopoda,* Benth., south of Cordillo; in sandy loam, 1 to 2 feet high, eaten by stock, Minnie Downs (No. 17).
(2) *S. corrugata,* var. *goniocarpa,* F. v. M., in sandy soil, 8 inches to 1 foot high, eaten by stock, Minnie Downs (No. 19).
(3) *S. virgata,* Hook., along watercourses, Cordillo.
(4) *S. rhombifolia,* L., Cordillo and between here and Innamincka.
(5) *S. intricata,* F. v. M., a form, Cordillo.
(6) *Abutilon leucopetalum,* F. v. M. (including *A. Mitchellii,* Benth.), all with yellow flowers, Cordillo; Innamincka; [Murnpeowie].
(7) *A. Fraseri,* Hook., var. *parviflorum,* Benth., Cordillo.
(8) *Lavatera plebeja,* Sims, Cordillo; Marsh Mallow, on flooded parts, 6 to 10 feet high, eaten by stock, Minnie Downs (No. 12).
(9) *Malvastrum spicatum,* A. Gray, Cordillo and 25 miles south; 1 foot to 18 inches high, the leaves follow the sun, Minnie Downs (No. 31).
(10) *Hibiscus trionum,* L., in sandy soil, 1 foot high, Minnie Downs (No. 103).

ELATINACEAE:—
(1) *Bergia ammanioides,* Roxb., Cordillo.

FRANKENIACEAE:—
(1) *Frankenia serpyllifolia,* Lindl., Cordillo; in sand and sandy loam, 6 to 18 inches high, Minnie Downs (Nos. 20 and 44); [Farina].

VIOLACEAE:—
(1) *Hybanthus Tatei,* F. v. M. (?), Cordillo.

THYMELEACEAE:—
(1) [*Pimelea microcephala,* R. Br., Tinga; between Mount Lyndhurst and Murnpeowie.]

LYTHRACEAE:—
(1) *Ammania multiflora,* Roxb., Cordillo; in sandy and flooded country, 12 inches high, Minnie Downs (No. 158).

MYRTACEAE:—
(1) [*Melaleuca glomerata,* F. v. M., in creek bed, Blanchewater Station.]
(2) *M. trichostachya,* Lindl., probably, in the bed of the Cooper at Innamincka.
(3) *Eucalyptus pyrophora,* Benth., Bloodwood, on flats, Cordillo to Arrabury, with large apple-like brachysclid galls, new record for the State.
(4) *E. terminalis,* F. v. M., Bloodwood, in sand and sandy flats, 20 feet high, makes good yard timber, Minnie Downs (No. 153).
(5) *E. microtheca,* F. v. M., Coolebah, Cordillo to Murnpeowie; in all sorts of soil, up to 30 to 40 feet, the chief wood, growing mostly on flooded flats and round waterholes, the aboriginals grind and eat the seed (which is very small), camels eat the leaves, and horses when starving will eat a few mouthfuls, good firewood and good wood for repairing drays, etc., Minnie Downs (No. 29); [Burnie; Murnpeowie].
(6) *E. rostrata,* Schlecht. Cordillo; Innamincka; [none between Innamincka and 7 miles below Tinga, but found from here to the end of the Strzelecki; Blanchewater Creek; Murnpeowie].
(7) [*E.* sp., Box., 18 miles west of Murnpeowie, in creek bed.]

HALORRHAGIDACEAE:—

(1) *Halorrhagis* (?) sp., Cordillo.
(2) *Myriophyllum verrucosum*, Lind., in waterhole, Cordillo.
(3) *M. Muelleri*, Sond., in a waterhole, Cordillo.

GENTIANACEAE:—

(1) *Limnanthemum crenatum*, F. v. M., in mud near waterhole, Cordillo.

ASCLEPIADACEAE:—

(1) *Sarcostemma australe*, R. Br., Tableland Caustic Bush, cattle eat a little of it, it makes the mouth very black, on stony downs and sandy flats, 4 to 5 feet high, Minnie Downs (No. 81); [cropped by sheep, near Blanchewater Station; Murnpeowie west].

(2) *Cynanchum floribundum*, R. Br., Pear, in sandhills, Cordillo; Weela, in sand, 3 feet high, eaten by the blacks, used for string, stock eat it a little, Minnie Downs (Nos. 76 and 138); [fruit edible, rather astringent, with plenty of moisture, used for quenching thirst, Tinga].

CONVOLVULACEAE:—

(1) *Ipomaea Muelleri*, Benth., Creeper, on flooded flats, 5 or 6 feet long, cattle like it and horses eat it, Minnie Downs, April (No. 79).

(2) *I.* sp., near *I. sepiaria*, Koen., Cordillo, Toorawatchy waterhole.

(3) *I. plebeja*, R. Br., Creeper, floats on the water, on black flats, cattle very fond of it, Minnie Downs (No. 110).

(4) *I. heterophylla*, R. Br., Creeper, in sandy loam, Minnie Downs (No. 137).

(5) *Convolvulus erubescens*, Sims, Cordillo; [Carraweena; Mount Lyndhurst].

BORRAGINACEAE:—

(1) *Trichodesma zeylanicum*, R. Br., Cattle Bush, in sandhills, 3 to 4 feet high. L. R. lost a young bull camel in hobbles in October and did not find him till January, when he still had the hobbles on. The nearest water from where he was lost and found was 30 odd miles away. When found, he was in a patch of this bush and had not shifted 100 yards away from it. L. R. is certain that he had no water during the four months and was getting this bush only to quench his thirst. Minnie Downs (No. 59); in sandhills, Cordillo and 25 miles south thereof.

VERBENACEAE:—

(1) *Verbena officinalis*, L., south of Cordillo; [Burnie Burnie near Innamincka].

(2) *Newcastlia cephalantha*, F. v. M., in sandhills, Cordillo.

LABIATAE:—

(1) *Mentha australis*, R. Br., in watercourse, Cordillo, Toorawatchy.

(2) *Teucrium racemosum*, R. Br., Cordillo and south thereof; in sandy loam, 1 to 2 feet high. Minnie Downs (No. 18).

(3) *T. racemosum*, var. *tripartitum*, F. v. M., in sandy loam, about 12 inches high, Minnie Downs (No. 33).

SOLANACEAE:—

(1) *Solanum orbiculatum*, Dun., on flats, 2 feet high, camels will eat a fair quantity, stock take an occasional mouthful, Minnie Downs (No. 73).

(2) [*S. oligacanthum*, F. v. M., binding the sand in large sand mounds, near Lakes Crossing.]

(3) *S. esuriale,* Lindl., Cordillo; on sandy loam and claypans, 10 or 12 inches high, berries eaten by the aborigines, Minnie Downs (No. 50); [Murnpeowie; Hawker].

(4) [*S. lacunarium,* F. v. M., Farina.]

(5) *S. ellipticum,* R. Br., in sandhills, Cordillo.

(6) *Datura Leichhardtii,* F. v. M., in flooded ground, 1 foot high, Minnie Downs (No. 162); [Murnpeowie west].

(7) *Nicotiana suaveolens,* Lehm., Native Tobacco, Cordillo; in sandhills, 2 feet high, will kill cattle or sheep if eaten on an empty stomach, cattle when being driven through it will eat a little, Minnie Downs (No. 66).

SCROPHULARIACEAE :—

(1) *Mimulus gracilis,* R. Br., on sandy loam and flooded country, 6 to 18 inches high, eaten by stock, Minnie Downs (Nos. 168 and 180).

(2) *M. repens,* R. Br., in salt holes, sometimes right on the edge of the water, 6 inches high, Minnie Downs (No. 173).

(3) *Morgania glabra,* R. Br., Cordillo; in sandy loam, 1 foot to 18 inches high, eaten by stock, Minnie Downs (No. 21).

(4) *M. floribunda,* Benth. (*M. glabra,* var. *floribunda,* Maid. et Betche), Cordillo and 25 miles south thereof; bottoms of waterholes chiefly, 18 inches to 2 feet high, "for years I never saw it except round the edge of large waterholes and nothing ate it. In the last few years it has spread all over the flooded flats and stock eat it the same as other herbage" (L. R.). Minnie Downs (No. 8); [horses are said to get fond of this plant for a while, but then will not eat, and if forced to eat it go blind, Lakes Crossing and near Carraweena.]

(5) *Glossostigma spathulatum,* Arn., on damp bank of drying watercourse, Cordillo.

PEDALIACEAE :—

(1) *Josephinia Eugeniae,* F. v. M., in sandhills, 8 inches high, sometimes eaten by stock, Minnie Downs (No. 65).

ACANTHACEAE:—

(1) *Justicia procumbens,* L., near the edge of watercourses, Cordillo; in sandy loam, 4 to 8 inches, Minnie Downs (No. 420).

MYOPORACEAE :—

(1) *Eremophila (Pholidia) Dalyana,* F. v. M., in leaf only (leaves up to 5 cm. long), amongst rocks, Innamincka Station.

(2) *E. longifolia,* F. v. M., Cordillo; in sand, 12 feet high, Minnie Downs (No. 123).

(3) *E. Freelingii,* F. v. M., Cordillo.

(4) *E. bignoniflora,* F. v. M., Cordillo west and Arrabury (Q'land).

(5) *E. Macdonnellii,* F. v. M., Wakimba, in sandhills, 12 inches high, Minnie Downs (No. 57).

(6) *E. maculata,* F. v. M., on a flat a few miles south of Cordillo; [Murnpeowie].

(7) *E.* sp., on dry ground adjacent to watercourse, Cordillo.

(8) [*E. glabra,* (R. Br.) Ostenf., between Mount Lyndhurst and Murnpeowie.]

(9) [*E.* sp., Lakes Crossing].

RUBIACEAE :—

(1) *Oldenlandia tillaeacea,* F. v. M., in sandy loam, 5 or 6 inches, Minnie Downs (No. 14).

(2) *Dentella repens,* Frost, Dry Moss, creeper growing in a patch about a foot in circumference, Minnie Downs, No. 188; forming patches of dense green carpet in the dry bed of the Strzelecki between Innamincka and Tinga and at Tinga, said to be poisonous to goats.

CUCURBITACEAE:—

(1) *Cucumis trigonus,* Roxb., waterhole 25 miles south of Cordillo; Ulcardo Melons, creeper up to 8 feet long, on flooded ground, relished as food by the aborigines, allowed to drop off the vine before being eaten and then rubbed to get a fluffy substance off which makes the mouth sore, Minnie Downs (No. 122).

(2) *Melothria maderaspatana,* Cogn., along creek beds, Cordillo.

(3) *M. micrantha,* (F. v. M.) Cogn., creeper, Minnie Downs.

CAMPANULACEAE:—

(1) *Wahlenbergia gracilis,* DC., Cordillo; [Carraweena to Lakes Crossing].

GOODENIACEAE:—

(1) *Leschenaultia divaricata,* F. v. M., growing in colonies in sandy soil, Cordillo; in sand, 12 inches high, Minnie Downs (No. 48); [Upper Strzelecki].

(2) *Scaevola spinescens,* R. Br., Cordillo.

(3) *S. depauperata,* R. Br., sandhills near Cordillo, forming intricately branched small undershrubs—this and *L. divaricata* growing in loose sand have very similar appearances.

(4) [*S. collaris,* F. v. M., near Lakes Crossing.]

(5) *S. ovalifolia,* R. Br., Cordillo.

(6) [*Goodenia cycloptera,* R. Br., Carraweena to Lakes Crossing.]

(7) [*G. glauca,* F. v. M. (*typica* ?, a stunted form perhaps). Lakes Crossing.]

(8) *G. glauca,* F. v. M., var. *sericea,* in creek bed, Cordillo; Cowslip, in flooded country, 6 inches high, Minnie Downs (Nos. 61 and 164).

(9) *G. glauca,* var. *subintegra,* F. v. M., Minnie Downs (No. 24).

(10) [*G. heteromera,* F. v. M., probably, Lakes Crossing.]

COMPOSITAE:—

(1) *Minuria integerrima,* Benth., Cordillo; in swamps, 18 inches high, eaten by stock, Minnie Downs (No. 54).

(2) *M. denticulata,* Benth., in a washout, Cordillo; [between Carraweena and Lakes Crossing].

(3) [*M. rigida,* J. M. Black, Farina.]

(4) *Calotis multicaulis,* (Turcz.) J. M. Black, Daisy, on flooded flats and stony downs, stock feed, Minnie Downs (No. 10).

(5) *C. hispidula,* F. v. M. (Bogan Flea or Bindyi), in any country, 4 to 6 inches high, Minnie Downs.

(6) *C. erinacea,* Steetz., Cordillo, Arrabury (Q'land).

(7) *Brachycome ciliaris,* Less., Daisy, on tablelands, 6 inches high, Minnie Downs (No. 139).

(8) *Senecio Gregorii,* F. v. M., Cordillo; in sand, 12 inches high, Minnie Downs (No. 165); [near Carraweena and between here and Lakes Crossing].

(9) *S. lautus,* Sol., Mustard, flooded country, 18 inches high, not eaten at all even by starving animals, Minnie Downs (No. 152A).

(10) *S. Cunninghamii,* DC., Lakes Crossing.

(11) *Centipeda Cunninghamii,* F. v. M., in watercourses at Cordillo, Toorawatchy waterhole; in sand, 4 or 5 inches high, Minnie Downs (No. 34).

(12) *Rutidosis helichrysoides*, DC., near watercourse, Cordillo; flooded country Yellow-top, in flooded country, 1 foot high, liked very much by cattle, though after a day or two if there is nothing else they get tired of it, Minnie Downs (No. 144).
(13) *Pluchea rubelliflora*, (F. v. M.) J. M. Black (*P. cyrea*, F. v. M.), south of Cordillo.
(14) *Pterigeron adscendens*, Benth., Cordillo.
(15) [*Ixiolaena leptolepis*, Benth., Nilpena, Farina.]
(16) *Gnaphalium luteo-album*, L., probably (very young), in watercourse, Cordillo; in sandy loam, 6 inches high, Minnie Downs (No. 11).
(17) *G. indutum*, Hook., probably (very young), in watercourse, Cordillo; [Burnie Burnie near Innamincka].
(18) [*Helipterum floribundum*, DC., Murnpeowie.]
(19) *H. moschatum*, Benth., in sand, 18 inches high, Minnie Downs (No. 184); [between Carraweena and Lakes Crossing; Murnpeowie].
(20) [*Helichrysum podolepideum*, F. v. M., near Lakes Crossing.]
(21) *H. ambiguum*, Turcz., in sandhills, Cordillo ("but our varied specimens under this name will probably require revision."—J. M. B.).
(22) *H. apiculatum*, DC., in sandhills, Cordillo; [near Carraweena].
(23) *Myriocephalus Stuartii*, F. v. M., 25 miles south of Cordillo; Billy or Bachelor Button, in sand, 8 inches high, good stock feed, Minnie Downs (No. 149); [near Carraweena].
(24) *Angianthus (Siloxerus) pusillus*, Benth., in sandhills, Cordillo.
(25) *Calocephalus platycephalus*, Benth., Yellow-top, on flooded flats, 6 inches to 1 foot, good cattle feed but after a couple of days they get tired of it, Minnie Downs (No. 9); [Lakes Crossing].
(26) *Pterocaulon sphacelatus*, Benth. et Hook., Cordillo; between Cordillo and Innamincka.
(27) *Sonchus oleraceus*, L., introduced, Cordillo.
(28) [*Centaurea melitensis*, L., introduced, Mount Lyndhurst Station.]

ABORIGINAL MARKINGS ON ROCKS NEAR BURRA (KOORINGA).

By J. P. H. Biddle.
(Communicated by A. G. Edquist.)

[Read August 13, 1925.]

Plate X.

Approximately five miles due east of Burra (Kooringa), in what is known locally as "Deep Creek," Mr. Frank Spencer, of Kooringa, and myself, discovered a large number of marks on the faces of various rocks, and the very crudeness of the designs led us to believe that they represented some form of aboriginal art.

Deep Creek is one of the small streams that drain the eastern slopes of that range of bald hills which runs north and south parallel to and on the eastern side of the Main North Road from Black Springs to Mount Bryan. It issues from these hills at a point near the foot of the high peak known as "Sugar-loaf" which lies in a north-easterly direction from Kooringa and about three miles from that town. From this point it flows in a southerly direction for a couple of miles across what is known as Baldina Plain, keeping almost parallel to the range and within half a mile of it, and then it takes a bend to the east and breaks through the system of low ranges which form the eastern boundary of this plain, which separates it from the Murray Plains. Some five or six miles farther on, it is joined by another small stream from the south-west, but soon peters out on reaching the level country.

At the spot where the creek first enters those low ranges, it has cut out a small gorge, and it is on the various exposed rock-faces in the gorge that the native art is noticeable.

The exact spot may be reached by following the Main Eastern Road from Burra for about three miles, turning to the south along the World's End Road for a quarter of a mile, and taking the first turn again to the east, along what is known as Mann's Road, until the first water reserve is reached. It is in the creek where it passes through this reserve, and also in the property that adjoins it on the western side, that the marks may be seen.

The rocks in the bed and banks of the creek at this point are very striking in that they are exposed in large, flat, rectangular surfaces. They are clay-slates resembling in appearance and formation the slates at Mitcham. Two sets of joint planes are very noticeable, one almost vertical, and the other approximately horizontal, with a dip of 7° to the east.

The exposed surfaces upon which the markings were made have been preserved by a skin of oxide of iron, and the rock-face, containing the bulk of the marks, is a huge platform, roughly rectangular in shape, and measuring 36 feet by 24 feet.

The markings occur in at least four different places along the creek within a total length of 300 yards. The first and second groups (from west to east) occur on approximately horizontal faces, the third on perpendicular faces, and the fourth on a surface which slopes to the east at an angle of about 30° to the horizontal.

The marks are all well preserved, but by far the most striking group is the second, which occurs on a large stage of solid rock standing about 18 inches above the present level of the creek bed, measuring some 36 feet by 24 feet, and rectangular in shape.

This large stage is practically covered with designs, though some portions have disappeared owing to erosion, the platform being subject to scouring in flood time. The third occurrence is on perpendicular faces on the south side of the creek, some 50 yards down stream. Here, again, some are well preserved while others have crumbled.

The fourth occurrence, about 100 yards farther down stream, is on a sloping rock on the north side of the creek, and the lower portion of its face was buried under several feet of silt. Upon removing this earth it was discovered that the buried portions of the surface had also received attention by the natives, for it was liberally covered with designs. Here, on the unearthed face, were found, among others, two of the "broad-arrow" designs, which were very distinct and the only examples of that type noticed.

The form of the designs themselves I shall not attempt to describe, beyond stating that the majority resemble circles and elliptical figures, some containing smaller internal designs, while there are various other forms of which the photographs will give a clearer idea than any description.

The designs appear to have been punched into the rock with some sharp-pointed instrument, for each line is composed of a series of small holes or indentations. Some are two millimetres in diameter at the top and average a depth of one millimetre. It is remarkable that these intagliated designs escaped observation for so many years, for operations were in full swing at the Burra Mines in 1845.

On making a search for stone implements, etc., that might have been used by the natives, a camp site was discovered some three-quarters of a mile along the creek to the eastward.

It is on the southern bank and covers an area of about half an acre. The level here is about 8 inches lower than that of the surrounding ground and is practically destitute of grass, as if kept wind-swept since the time when the occupation by blacks prevented the growth of herbage. Many chippings of chert, a mineral which is geologically foreign to this locality, were found on this patch, as well as a number of finished implements, anvils and pieces of stone showing fine secondary work.

DESCRIPTION OF PLATE X.

Aboriginal markings on rocks near Burra (Kooringa).

DETAILED NOTES ON THE ABORIGINAL INTAGLIOS NEAR BURRA.

By T. D. Campbell, D.D.Sc.

[Read August 13, 1925.]

Plates XI. and XII.

The following notes are intended as a supplement to the paper on "Native Rock Carvings at Burra," given by J. P. H. Biddle, to whom the credit of their discovery is due.

It is not proposed to give here any repetition of the account of the discovery, the situation, the nature of the rocks and their vicinity, but to place on record a brief description of the actual native work, together with a few general notes on the subject.

The published accounts of the occurrence of native rock intaglios in South Australia seem to commence with a brief note recorded in the Transactions of this Society in 1902 (1). Basedow has recorded his many finds in the Flinders Range (2). Recently Hale and Tindale have reported their discovery of fresh instances of this form of native art, and have also made a brief but interesting review of the subject (3).

The occurrence under present review has several points of interest.

It seems to be the southernmost instance of this type of native intaglios discovered in this State at the present time;[1] and, as such, it is interesting from the viewpoint of the distribution of various types of native art.

The matter of the antiquity of these particular carvings is one which can, of course, only be speculative; the difficulty of making any sort of chronological calculation is too great to permit of dogmatic estimations. As has been pointed out in the foregoing paper, careful enquiry from living persons shows that the natives have not been known to inhabit this particular district for at least eighty years. Thus it is possible to say definitely that the most recent of the carvings cannot be much less than a hundred years old. Beyond this we have two indefinite but significant features bearing on their age. Firstly, in the case of one slanting intagliated rock-face, we noticed the designs were buried beneath the creek bed deposit, and this was removed to a depth of half a metre or more, exposing further designs. This removed deposit consisted chiefly of creek bed gravel. Even allowing for the vigorous flooding activities of such a creek, a fairly considerable period would be necessary to permit of gravel being deposited to that depth over the designs carved on a rock-face situated at the side of the creek channel. Also, a few fresh chips intentionally made on the rock-faces for comparison purposes revealed that even the obviously freshest and youngest of the aboriginal indentations were well coated with that dark rust-coloured patina which is considered by some as geological evidence of marked antiquity. This condition was even more marked on other of the designs, where, in

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(1) A few vague newspaper references have been made to the occurrence of carvings in rock shelters on the Murray River, but no definite account was given therein. Hale and Tindale also mention having seen native markings on rocks on River Murray, but of quite a different type from these intaglios.

addition to a dense patina, the chipped depressions have become much eroded and smoothed by the effects of long weathering.

Another point of interest is the occurrence of the large, almost horizontal, intagliated rock-faces, right in the creek channel. In other examples the intaglios generally appear to have been worked on vertical or slanting rock surfaces at the sides of creek beds or ravines. Basedow, however, also records an example of a horizontal, intagliated rock-face occurring at Yunta.

The various worked designs at the Burra site undoubtedly represent efforts which must have been performed at different intervals over a long period of time. Some of the figures are unquestionably older than others, as is seen by the differences in weathering and patination of the chippings, and also the instances of younger intaglios have been worked over obviously much older designs.

It is unnecessary to make any remarks here on the probable methods employed by the natives in executing this type of work, as Basedow has treated this aspect of the subject very well both in his initial account (2) of rock carvings and in his more recent work of the Australian native (4).

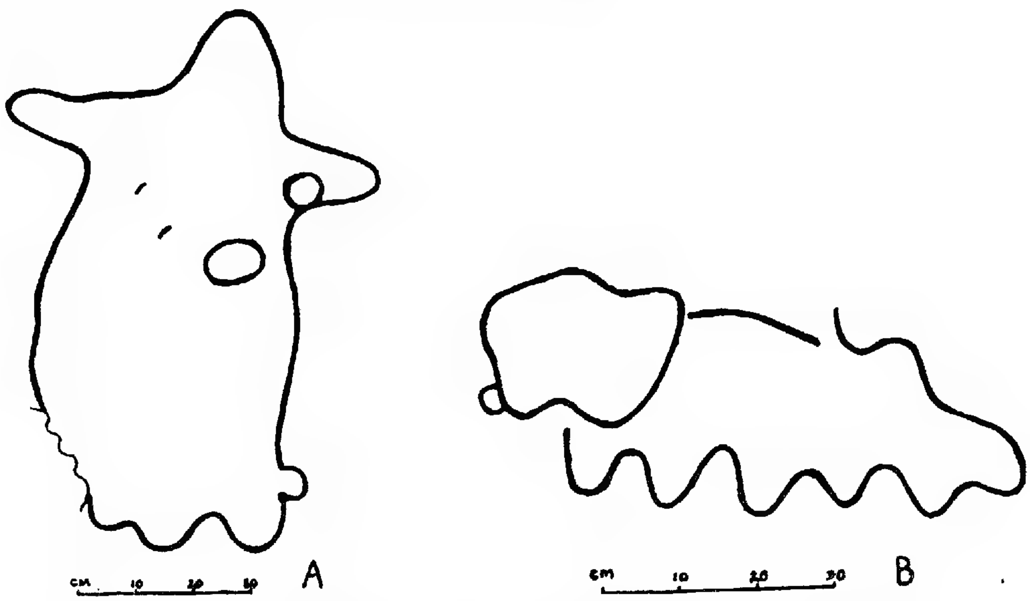

Fig. 1.

Reduced outlines of two figures occurring in Group 2. The small associated circles probably bear no relation to larger design. Wavy line indicates fracture of the rock-face.

The following are brief descriptive notes on the actual designs:—

No. 1 rock-face was a horizontal slab in the creek channel. Its surface was about a metre square and contained only a single figure, somewhat oval in outline and about 30 centimetres in diameter.

No. 2 group of figures occurred on the large horizontal slab which measured about ten metres by seven. Over a considerable area, chiefly the central portion of the slab, were many figures, most of which—with the exception of a few almost indiscernible ones—were chalked in for the purposes of photography and are shown in the illustration accompanying Mr. Biddle's paper (pl. x.). Many of the intaglios were sharply chipped and well preserved, but not a few had been apparently affected either by the vigorous scouring action of the creek in flood times or by the erosion of the material separating the individual punctations. In these cases, instead of the lines being formed by a series of chipped-out depressions, they give an appearance such as might be obtained by an irregular gouging process. Some idea of this effect can be obtained from pl. xi., fig. 1, which shows some of the intaglios of this group before they were chalked. The designs here for the most part consist of circular and elliptical figures, singly, interlaced, or one or more contained within another larger figure. Some of them are barred so as to divide the figure into two or more segments. These circular figures are generally referred to as "corroboree circles." Two of the most interesting figures of this group are depicted in outline in text fig. 1, the scale providing a close approximation to their natural size. They are just indefinite enough to permit of only a guess being made as to what they probably represent. "A" may depict some short-legged creature like a wombat, or could well represent the outline of the skin of some such stumpy-bodied animal. "B" might depict a rough approximation to a profile outline of a similar type of animal. The small circles associated in this tracing probably bear no direct relation to the form outline. On the lower right side of this group (see Biddle's pl. x.) will be seen portion of a figure which may have been similar to that in text fig. 1A, but a large part is missing owing to the breaking up of the rock slab. On both the extreme right and left sides of the main chalked-in batch were also a few faint scattered and fragmentary figures, chiefly of the circular pattern.

No. 3 group occurred chiefly on a vertical rock-face which measured about three metres in height and four in length. At the base of this face was also a

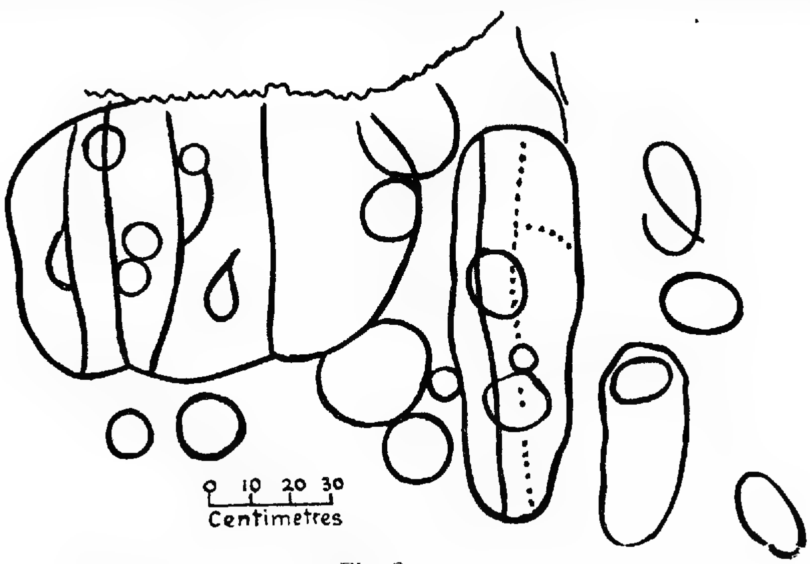

Fig. 2.
Traced outlines of some of the carvings shown in pl. xii., fig. 1.

disintegrating horizontal platform which extended about seven metres outwards into the creek channel. The figures on the vertical face were mostly well preserved and skilfully executed circle designs, the circles apparently having no particular grouping or relation to one another (pl. xi., fig. 2). The outlines consisted of a band of very sharply-defined pits, each about five millimetres in diameter and three to five millimetres deep. The nature of the chipped lines in this case presents an appearance different from the more grooved effect of many of those on the large No. 2 slab. The figures on the associated horizontal platform were fairly numerous, of circular and elliptical form, but very much eroded and fragmentary. They were exposed by removing ten to twenty centimetres of soil.

No. 4 group consisted of two slanting (about 45°) faces of rocks, about two metres apart, situated on the side of the creek bed. There was obviously a marked difference in age between the oldest and youngest intaglios of this group. This was evidenced by the much worn and almost obliterated appearance of the former compared with the relative freshness of the latter. With the exception of the few individual figures referred to in Group 2, the designs in this instance were the most complex of all. The outlines were not such that a ready suggestion could be made as to representing any familiar object or animal, but the figures presented what seemed more intentional grouping than the somewhat haphazard display elsewhere executed. Fig. 2 shows the outlines of the figures forming the upper portion of the group intagliated on the northern of these two associated rock-faces (see pl. xii., fig. 1). The outlines have been reproduced from tracings secured, and the scale provides a close approximation as to their natural size. The two striking designs are the large oval-shaped outlines, one placed horizontally and the other vertically. Both are barred and contain circular figures, while the vertical design has intermittent punctations, somewhat similar to what is sometimes said to represent a human track. Again, on the southern of these two faces (see pl. xii., fig. 2) are fragmentary remains of what also appear to be large oval figures with closely associated circles and lines. At the lower part of the same rock-face occurs the only instance found in this locality of markings representing bird footprints. One probably represents the foot of an emu, the other may be a similar but incompleted figure, the two marks forming it being too nearly the same in length to permit of their representing a kangaroo footprint.

No. 5 consisted of a single, large, somewhat leaf-shaped figure, intagliated on the horizontal face of a boulder situated several metres above Group 4, on the creek bank.

The chief points of interest concerning this occurrence of rock intaglios at Burra may be summarized thus:—

It provides the southernmost example of this type of native rock intaglios so far recorded for this State.

The probability of many of the intagliated figures being of quite appreciable antiquity.

The obvious age differences in some of the designs indicate that the work was executed at different periods over a long interval of time.

The figures, with a few exceptions, consist of the so-called "corroboree circles" and elliptical figures, and appear to have little relationship to, or grouping with one another.

The art displayed does not appear to be quite so advanced as many of the occurrences recorded from the Flinders Range, there being a paucity of representations of various animals, reptiles, footprints, and other familiar objects.

I am indebted to Professor Wood Jones for the photographs reproduced in pl. xi., fig. 2, and pl. xii., and to Mr. A. G. Edquist for that shown in pl. xi., fig. 1.

My thanks are also due to Mr. J. P. H. Biddle and Mr. Edquist for the opportunity of being associated in the work of examining this occurrence.

Tracings of the figures were made on brown paper of most of those forming Group 2, as shown in Biddle's pl. x., and also portion of Group 4; and these, with the kind permission of Professor Wood Jones, have been retraced on to the walls of the University Anatomy School Museum, thus forming a preserved record should the actual intaglios on the site itself become deteriorated or damaged.

References.

(1) Trans. Roy. Soc. S. Austr., xxvi., 1902, p. 326.

(2) Basedow, H.: Journ. Roy. Anthrop. Inst., xliv., 1914, p. 195.

(3) Hale and Tindale: Records S. Austr. Mus., iii., No. 1, 1925, p. 52.

(4) Basedow, H.: "The Australian Aboriginal," 1925 (Preece).

DESCRIPTION OF PLATES XI. AND XII.

Plate XI.

Fig. 1. Portion of large intagliated rock-face belonging to Group 2.

Fig. 2. Group 3; vertical face with most of the figures chalked in.

Plate XII.

Fig. 1. Northern slab of Group 4. Figures chalked in. Photograph taken looking somewhat side on and from above. Creek bed and removed débris showing on upper left side.

Fig. 2. Southern slab of Group 4. Photograph taken in same direction as indicated by fig. 1.

REVIEW OF AUSTRALIAN ISOPODS OF THE CYMOTHOID GROUP. PART I.

By Herbert M. Hale, Zoologist (Crustacea), South Australian Museum.

[Read August 13, 1925.]

Isopoda-Flabellifera.

The Cymothoid families of the tribe Flabellifera form a connected group, embracing species which range from symmetrical, active forms, feeding upon fishes and other marine animals or acting as scavengers, to others specialized for a parasitic mode of life. The truly parasitic species are found in the Aegidae and Cymothoidae; most of the representatives of the two last-named families, at least in the adult stages, feed upon fishes.

The members of the group have the uropods lateral, each with a free, more or less lamelliform, exo- and endopod, and the pleon, as a rule, is composed of six distinct segments. This last condition does not obtain in the Australian genus *Ouroseuktes*, M. Edw., which has all six segments coalesced, nor in the American *Colopisthus*, Rich., which has but two distinct segments, the first five being fused into one short segment. Haswell states that in his genus *Codonophilus* the uropods are uniramous. An examination of the type of *Codonophilus* shows, however, that it is a very juvenile example of *Meinertia imbricata*, and that the uropods are normal, each having two lamelliform branches.

I desire to express my thanks to the Director of the Australian Museum, Sydney, for the opportunity of examining the specimens preserved in that institution (including the types of the species described by the late Prof. W. A. Haswell and by Mr. T. Whitelegge), and to the Curator of the Western Australian Museum for the loan of specimens from Western Australia. I am also indebted to various other collectors who have obtained specimens from South Australian waters. The collections housed in the Australian, South Australian, and Western Australian Museums include good series of specimens from the eastern, southern, and western coasts of Australia, but material from the northern waters is not plentiful. The families represented in Australian seas may be separated as follows:—

a. Palp of maxillipeds free, the last two articles setose, not furnished with hooks.

- *b.* Distal part of mandibles usually stout, conspicuous. Inner lobe of first maxillae expanded at apex and furnished with three or four spines; outer lobe wide and capped with many strong spines. Second maxillae with three free, very setose lobes.
  - *c.* Molar part of mandibles large. Last four pairs of peraeopods ambulatory, with normal dactylus and claw, the merus, carpus, and propodus of fourth and fifth pairs not greatly expanded .. *Eurydicidae*
  - *cc.* Molar part of mandibles small. Last four pairs of legs natatory, with dactylus rudimentary or absent; in the fourth and fifth pairs the merus, carpus, and propodus are greatly expanded and flattened, each being about twice as wide as long .. .. .. *Phoratopodidae* (nov.)
- *bb.* Distal part of mandibles narrow, partly or quite concealed by upper and lower lips. Inner lobe of first maxillae without apical spines; outer lobe narrow, tapering from middle of length to apex, which is armed with a few spines (sometimes with some small and inconspicuous spines also), or with many tiny hooked spines. Second maxilla not having three distinct lobes, and usually with apex simple *Corallanidae*

aa. Palp of maxillipeds embracing cone formed by distal parts of mouth organs, the inner upper margin and apex never setose, at least the apex furnished with outwardly curved hooks in the males and non-ovigerous females.

d. Both pairs of antennae with well-defined peduncle and flagellum. Maxillipeds with palp five-jointed or two-jointed, the last joint in the latter case rather short, obtuse .. .. *Aegidae*

dd. Antennae reduced, without clear distinction between peduncle and flagellum. Palp of maxillipeds always two-jointed, the last joint rather long and narrow, subacute .. .. *Cymothoidae*

The above is adapted in part from Hansen's key.(1) The first four families are herein dealt with; in the descriptions the seven free segments of the peraeon are referred to as the first to seventh peraeon segments, and the appendages of these somites as peraeopods. The localities given under "Loc." are those from which specimens now described were taken, and "Hab." indicates the general distribution of a species.

Family EURYDICIDAE.(2)

The antennae are usually unequal in length. The mandibles are usually wide throughout, their cutting edges more or less tridentate and meeting behind the large labrum; the movable lacinia is large, with many spines, and the molar process is large and triangular. The outer lobe of the first maxillae is wide and capped with many spines; the inner lobe bears three spines, usually plumose. Maxillipeds with palp free, wide and very setose. The last four pairs of peraeopods are ambulatory, and the others are, as a rule, prehensile.

Key to Australian Genera.

a. Front of cephalon not produced in an anteriorly dilated process; sides of fifth pleon segment usually more or less covered by lateral parts of preceding segment; outer margin of exopod of uropods furnished with hairs.

b. Cutting edge of mandibles long .. .. *Cirolana*

bb. Cutting edge of mandibles short .. .. *Neocirolana* (nov.)

aa. Front of cephalon produced in a prominent and anteriorly dilated process; sides of fifth pleon segment free, not covered by preceding segment; outer margin of exopod of uropods naked .. .. .. *Excirolana*

Cirolana, Leach.

Cirolana, Leach, Dict. Sci. Nat., xii., 1818, p. 347; Sars, Crust. of Norway, ii., 1899, p. 69; Stebb., Herdman's Ceylon Pearl Fish. Suppl. Rep., xxiii., 1905, p. 11 (syn.).

The *Cirolanae* are very agile in the water, and some of them, for a short period at least, display considerable activity on land also. They are eminently carnivorous and, at times, are encountered literally in swarms; fishes captured in nets are sometimes rendered useless through their depredations. Persons wishing to obtain vertebrate skeletons, and not desiring to undertake the unpleasant task of maceration, take advantage of the scavenging habits of the "sea lice," and submerge their specimens, in the flesh, at a place where these Isopods are abundant; the bones are rapidly and very cleanly denuded of all flesh.

Schioedte(3) remarks that the Order Isopoda "occupies one of the highest steps to which the class of Crustacea upon the whole attains in the scale of development of the articulate type," and that the "Cirolanae represent, no doubt, the highest development of the Crustacean type amongst Isopoda."

Seven species and one variety have been previously recorded from our waters and seven species are now added to the list.

(1) See Stebbing, Hist. of Crust., 1898, pp. 340, 341.

(2) Stebbing, Herdman's Ceylon Pearl Fish. Suppl. Rep., xxiii., 1905, p. 10.

(3) Schioedte, Ann. Mag. Nat. Hist. (4), i., 1868, pp. 2 and 9.

Key to Australian Species.

a. Flagellum of second antennae not reaching to hinder margin of fifth peraeon segment.
b. Apex of telson broadly rounded or subtruncate.
c. Endopod of uropods with a prominent nick in outer margin .. *pumicea*
cc. Endopod of uropods with outer margin entire.
d. Exopod of uropods only about half as long as endopod .. *hermitensis*
dd. Exopod of uropods very little shorter than endopod .. .. *arcuata*
bb. Apex of telson narrowly rounded or subacute.
e. Second antennae much longer than first antennae.
f. End of peduncle of first antennae not reaching beyond middle of fourth peduncular article of second antennae.
g. Frontal lamina sublinear.
h. Basos of seventh peraeopods expanded, twice as long as greatest width.
i. Form stout; posterior angles of coxal plates of third and fourth peraeon segments acute .. .. .. *corpulenta*
ii. Form narrower; posterior angles of coxal plates of third and fourth peraeon segments rounded .. .. .. *tenuistylis*
hh. Basos of seventh peraeopods greatly expanded, only one and one-half times as long as greatest width .. .. *woodjonesi*
gg. Frontal lamina broad.
j. Peraeon and pleon ornamented with rows of tubercles .. *pustulosa*
jj. Peraeon and pleon without tubercles .. .. .. *cranchii*, var. *australiense*
ff. End of peduncle of first antennae reaching to or beyond end of fourth peduncular article of second antennae.
k. Flagellum of second antennae composed of twenty-five articles .. .. *lata*
kk. Flagellum of second antennae composed of thirteen to fifteen articles.
l. Eyes subquadrate .. .. *lata*, var. *integra*
ll. Eyes elongate .. .. *laevis*
ee. Second antennae scarcely or not longer than first antennae .. *lineata*
aa. Flagellum of second antennae reaching back beyond hinder margin of fifth peraeon segment.
m. Flagellum of first antennae not extending beyond end of peduncle of second antennae; coxal plates with oblique furrows.
n. Frontal lamina broad; flagellum of second antennae not reaching to hinder margin of sixth peraeon segment .. .. .. *schioedtei*
nn. Frontal lamina sublinear; flagellum of second antennae reaching to middle of length of pleon .. .. *victa*
mm. Flagellum of first antennae extending for more than half its length beyond end of peduncle of second antennae; coxal plates without oblique furrows .. .. *concinna*

The length of the flagellum of the second antennae is unknown in *C. pumicea;* if, when perfect specimens are obtained, this species should prove to belong to section *aa*, it is readily separated from *C. vieta, C. schioedtei,* and *C. concinna* by the shape of the telson and frontal lamina, the character of the peraeopods, the shape of the uropods, etc.

The position of *C. tenuistylis* in the key is also somewhat tentative, for the second antennae are damaged in the type specimens; I have placed it near *C. woodjonesi,* as it is evidently allied to that species. *C. concinna* and *C. vieta* also have the frontal lamina narrow, but otherwise cannot be confused with *C. tenuistylis.*

C. lata, C. lata, var. *integra,* and *C. laevis* are apparently allied forms; I have not seen the two last-named and, working with the descriptions alone, find it difficult to satisfactorily separate them.

Cirolana pumicea, n. sp.

♀. Form narrow, with sides subparallel, three and three-fourths longer than greatest width. Dorsal surface with evenly spaced, small, but very distinct punctures, intermixed with which are some coarse punctures. Cephalon twice as wide as medial length; a strong, transverse, bisinuate ridge between the front angles of eyes defines the anterior margin, as seen in dorsal view; surface rugose. Eyes prominent, tumid, situate antero-laterally. Peduncle of first pair of antennae not as long as first three articles of second antennae together; articles of peduncle short, subequal in length; flagellum a little longer than peduncle, composed of seventeen articles and extending slightly beyond end of fourth article of peduncle of second antennae. First two articles of second antennae very short, together as long as the fourth article, which is shorter than the third; fifth article the most slender, a little longer than third article; flagellum missing. Frontal lamina complex; a horizontal basal part is subtriangular in shape, not adpressed, the anterior part projecting forwards and visible in dorsal view between bases of first antennae; from the dorsal face of the basal part a narrow piece extends perpendicularly upwards between the bases of the second antennae; this linear process is a little dilated anteriorly, narrowest at middle of length, and is again dilated

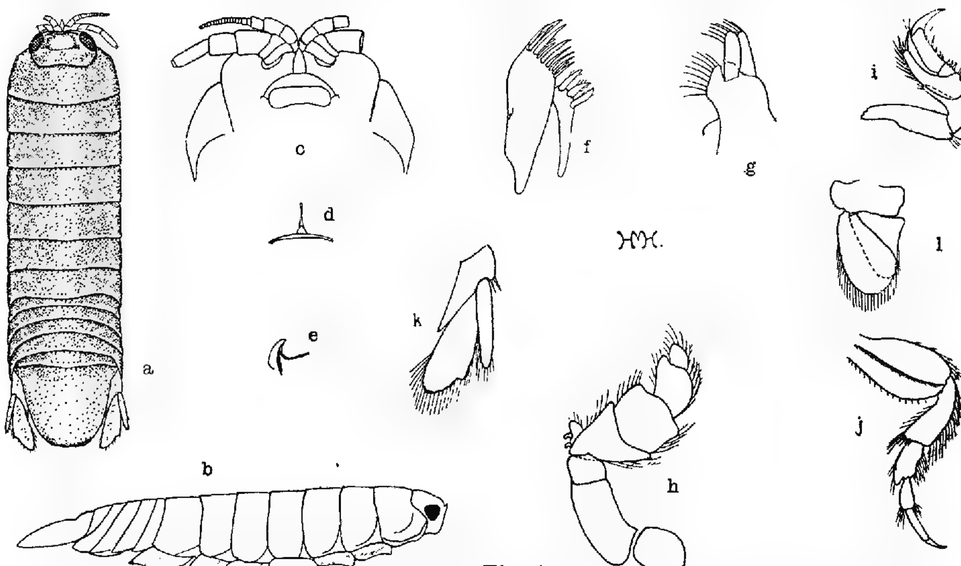

Fig. 1.

Cirolana pumicea, type female; a and b, dorsal and lateral views (3 diams.); c, antennae, frontal lamina, clypeus and labrum in ventral view (7 diams.); d, anterior view of clypeus and frontal lamina, showing perpendicular process (7 diams.); e, lateral view of frontal lamina (7 diams.); f, first maxilla (14½ diams.); g, second maxilla (14½ diams.); h, maxilliped (14½ diams.); i and j, first and seventh peraeopods (5 diams.); k, uropod (7 diams.); l, first pleopod (7 diams.).

towards the junction with the basal part. Clypeus wide and short, crescentic, much shorter than labrum. Second article of palp of mandibles twice as long as third. Outer lobe of first maxillae capped with twelve spines, two or three of the outermost seven being denticulate; inner lobe with three stout, plumose spines. Maxillipeds moderately stout, the basipodite about one-half as long as the five-jointed palp. First peraeon segment embracing base of cephalon, longer than any of the other segments, which are subequal in length. Coxal plates each with a very indistinct, oblique furrow in addition to the submarginal furrow; plates of second to fourth segments rounded behind, not extending beyond hinder margins of their segments; those of fifth and sixth segments subacutely rounded posteriorly, reaching a little beyond level of hinder margins of their segments; last pair extending slightly beyond level of postero-lateral angles of first pleon segment, and with posterior angle acute. Pleon not at all narrower than peraeon, with all segments visible, the first a little shorter than the others, which are subequal in length; postero-lateral parts of fourth segment covering lateral portions of fifth segment; telsonic segment less than one-third wider than long; basal part tumid; lateral margins convexly rounded, evenly converging to the widely subtruncate and crenulate apical margin. Uropods extending to level of apex of pleon; protopod with two spines on outer margin near articulation of exopod, and with inner process not reaching to middle of length of endopod; exopod narrow, a little more than three-fourths as long as, and much less than half as wide as endopod, which is crenulately rounded posteriorly and has a prominent nick in the outer margin. Peraeopods stout; the outer distal part of the merus of the first three pairs is greatly produced, extending nearly to level of distal end of propodus, and with outer margin and apex armed with strong setae; outer distal part of ischium of these limbs similarly but less markedly produced; last four pairs furnished with spines, setae and plumose hairs, the basos of each with a longitudinal, median ridge; basos of fourth and fifth pairs expanded, that of sixth and seventh pairs much more expanded; basos of seventh pair greatly expanded, the length only twice the greatest width; merus of seventh pair nearly one-third longer than carpus and about three-fourths as long as ischium. Inner ramus of first pair of pleopods not much more than three-fourths of length of, and about same width as, outer ramus.

Colour.—Anterior ridge of cephalon, hinder margins of cephalon, peraeon segments, first to fifth pleon segments, and posterior four-fifths of telsonic segment, whitish; the remainder of the dorsal surface is thickly covered with black dots and thus appears of a greyish-black colour.

Length, 18 mm.

Loc.—New South Wales (Austr. Mus. Coll.). Type, female, in Australian Museum, Reg. No. G 5319.

Four mutilated specimens are before me. The posterior margin of the telson is not at all distinctly truncate in the type, and in two of the paratypes it is rounded.

The peraeopods of *C. pumicea* slightly resemble those of *C. japonensis*, Rich.,[4] but the process of the merus of the first three pairs is much more marked and the cephalon and pleon are totally different.

CIROLANA HERMITENSIS, Boone.

Cirolana hermitensis, Boone, Proc. U.S. Nat. Mus., liv., 1918, p. 592, pl. xci., fig. 2.

The form is widely subovate, about twice as long as wide. According to Boone's figure the hind margin of the cephalon is trilobate. The flagellum of the first antennae reaches to just beyond the end of the peduncle of the second antennae, the flagellum of which reaches to the posterior margin of the third peraeon segment. The second to seventh peraeon segments are subequal in length. The greater part of the first pleon segment is concealed beneath the last peraeon segment; the telsonic segment has "the apex roundly truncate, crenulated, and ornamented with a row of spines." The uropods reach a little beyond the apex of the telson and the exopod is "oval and about half as long as" endopod.

Colour.—"The specimen is heavily banded crosswise with light brown stripes, with an equal light creamy area between them on the head, thorax, and first five abdominal segments; the sixth segment and uropoda are similarly marked but have the bands longitudinally placed."

Length, 9 mm.; width, 4·9 mm.

Hab.—Western Australia: Home Lagoon, Hermite Island, Montebello Islands.

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(4) Rich., Proc. U.S. Nat. Mus., xxvii., 1904, p. 35, figs. 3-5.

I have not seen this species, and the above details are culled from Boone's description. *C. hermitensis* differs exceedingly from the other three species of the genus *(C. concinna, C. lineata,* and *C. schioedtei)* herein recorded from Western Australian waters.

Cirolana arcuata, n. sp.

♀. Form narrowly oval, three times longer than greatest width. Surface with very fine punctures. Cephalon about two and one-half times wider than medial length; anterior margin rounded, with a small, median, downbent, subtriangular process, not separating first pair of antennae and not visible in dorsal view. Eyes moderately large. Peduncle of first pair of antennae as long as first three articles of peduncle of second antennae; second article slightly shorter than third and a little longer than first article; flagellum extending beyond end of peduncle of second antennae, composed of fifteen to seventeen articles. Second antennae reaching to level of hinder margin of third peraeon segment; first two articles of peduncle short, together about as long as third article; fourth longer than third and about three-fourths the length of fifth article; flagellum half as

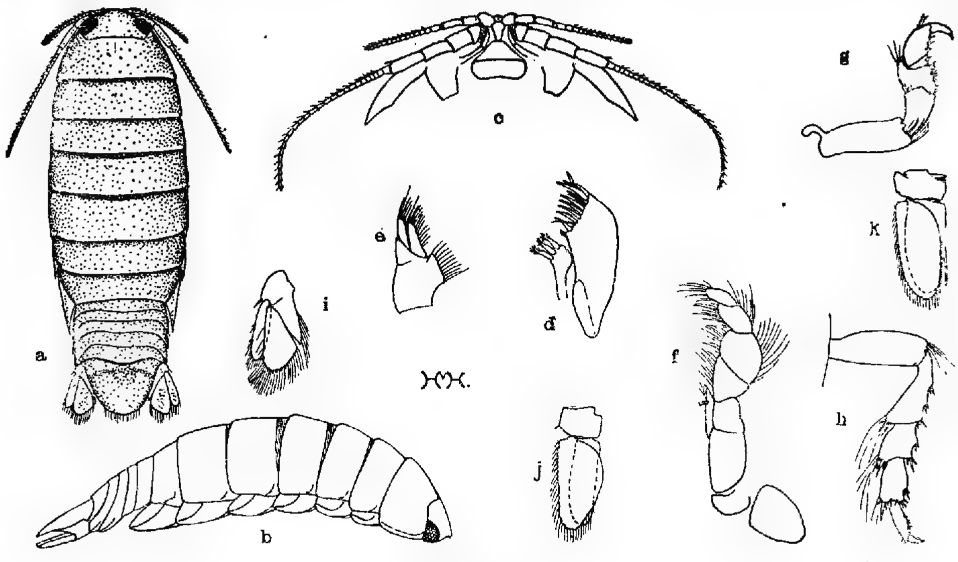

Fig. 2.

Cirolana arcuata, type female; a and b, dorsal and lateral views (4 diams.); c, antennae, frontal lamina, clypeus and labrum (6 diams.); d, first maxilla (22 diams.); e, second maxilla (22 diams.); f, maxilliped (22 diams.); g and h, first and fifth peraeopods (7 diams.); i, uropod (7 diams.); j and k, first and second pleopods of male (7 diams.).

long again as peduncle, composed of twenty-three to twenty-six articles and a terminal style. Frontal lamina pentagonal, longer than wide, widest at about first fourth of length and with postero-lateral margins converging posteriorly. Clypeus rather long, its medial length subequal to that of labrum and with anterior part not adpressed but projecting outwards and forwards. Mandibles normal, the first and third articles of palp of equal length, each much more than half as long as second article. Outer lobe of first maxillae capped with eleven strong spines and one thinner spine; the three innermost spines are denticulate; inner lobe with three stout plumose spines. Maxillipeds narrow, elongate, the basipodite less than one-half the length of the five-jointed palp, the basal article of which is nearly as long as the second. First peraeon segment embracing base of cephalon, longer than any of the others; second, third, and fourth segments subequal in length, each a little shorter than fifth or sixth; seventh segment the shortest. Coxal plates each with a curved, oblique furrow in additional to the submarginal furrow; those of second and third segments rounded behind, not reaching beyond hinder margins of their segments; those of fourth segment extending very slightly beyond hinder margin of their segment, and with rounded posterior angles; last three pairs extending successively further beyond the hinder margins of the segments and with posterior angles subacute; those of seventh segment reaching to level of hinder margin of second pleon segment. All segments of pleon completely visible, the fifth a little longer than any of the others (which are subequal in length) and with lateral parts partly covered by postero-lateral portions of fourth segment; telsonic segment nearly half as wide again as medial length; lateral margins roundly converging to the rounded and crenulate posterior margin. Uropods extending slightly past apex of pleon; protopod with a spine on outer margin near articulation of exopod and with inner process wide and produced to well beyond middle of length of endopod; exopod narrowly suboval, rounded posteriorly, furnished with hairs and a few short spines on outer and apical margins; endopod more than twice as wide as, and a little longer than, exopod, rounded posteriorly, and with postero-lateral and apical margins furnished with long hairs and short spines. Peraeopods stout, armed with spines and moderately dense, long hairs; last four pairs armed with strong spines on inner and apical margins of ischium, merus, and carpus, and with a few short spines on inner margin of propodus; basos of seventh pair expanded, two and one-third times longer than wide; merus equal in length to carpus and more than one-half length of ischium. Outer ramus of first pair of pleopods nearly twice as wide as, and very slightly longer than, inner ramus.

Colour, in alcohol.—Yellow, dotted with prominent black chromatophores on dorsal surface of cephalon, peraeon, first to fifth segments of pleon and basal part of telsonic segment.

Length, 12·5 mm.

♂. A somewhat damaged example of this sex does not notably differ from the female. The flagellum of the second antennae consists of a lesser number of articles—twenty and a terminal style. The male appendage of the second pair of pleopods does not reach quite to the end of the inner ramus.

Length, 12 mm.

Loc.—New South Wales: Little Sirius Cove, Port Jackson (Austr. Mus. Coll.). Type, female, and allotype, male, in Australian Museum, Reg. Nos. P8200 and P8201.

Several specimens were taken in company with *Sphaeroma quoyana.* This species somewhat resembles *C. hermitensis,* but has the form more slender, the second to fifth peraeon segments not subequal in length, the first segment of the pleon not almost wholly concealed, the exopod of the uropods relatively longer and the hinder margin of the cephalon not at all trilobate.

Cirolana corpulenta, n. sp.

♀. Form widely suboval, less than two and one-fourth times longer than greatest width. Surface with rather fine sparse punctures arranged in transverse series and intermixed with a few large punctures. Cephalon twice as wide as medial length; anterior margin distinctly bisinuate, with a median subtriangular process, not completely separating the basal articles of the first antennae. Eyes moderately large, situate laterally. First antennae short, the end of flagellum not reaching to end of peduncle of second antennae; peduncle as long as first three articles of second antennae, the first article widest, extending in front at a right angle to remaining part of antennae; second article a little shorter than first, and scarcely more than one-half as long as third, the posterior distal part of which is produced into a lobe; flagellum a little shorter than peduncle, composed of eleven articles. Second antennae reaching almost to hinder margin of second peraeon segment; first two articles of peduncle short, together about as long as third article, the first longer than second; third article longer than fourth and scarcely as long as fifth; flagellum about one-fourth longer than peduncle, composed of eighteen articles and a terminal style. Frontal lamina linear, a little dilated anteriorly. Clypeus not much more than one-half as long as labrum. Mandibles normal, the first article of palp more than half as long as second and longer than third article. Outer lobe of first maxillae capped with seven stout simple spines of various lengths, one thin spine and one very short spine; inner lobe with three stout, plumose spines. Maxillipeds moderately slender, the basipodite a little more than one-third as long as the five-jointed palp. First peraeon segment embracing base of cephalon, distinctly longer than any of the others; second and seventh segments subequal in length, shorter than third, fourth, fifth, or sixth segments, which are subequal in length. Coxal plates each with an obliquely curved, shallow furrow, in addition to the submarginal furrow; plates

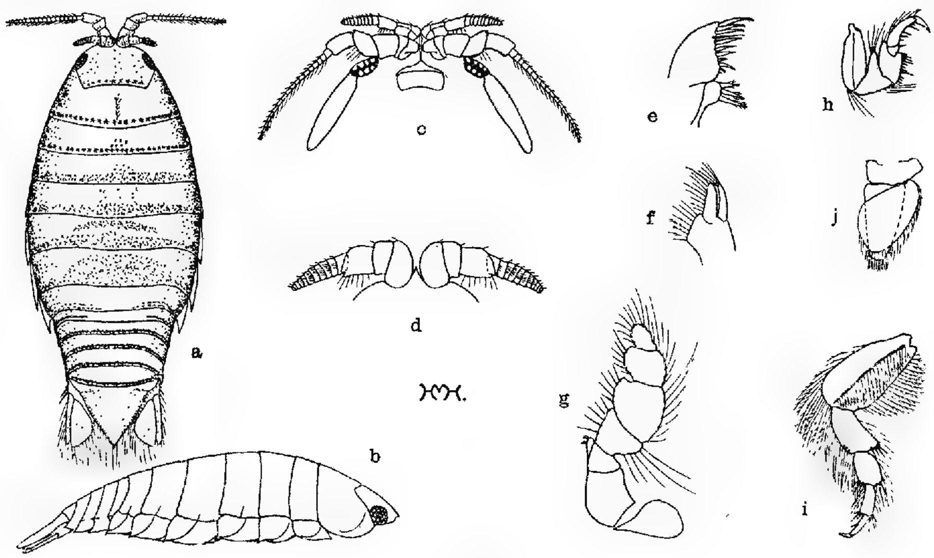

Fig. 3.

Cirolana corpulenta, type female; a and b, dorsal and lateral views (4¼ diams.); c, antennae, frontal lamina, clypeus and labrum (8 diams.); d, first antennae (13 diams.); e, first maxilla (14½ diams.); f, second maxilla (14½ diams.); g, maxilliped (14½ diams.); h and i, first and seventh peraeopods (5 diams.); j, first pleopod (5 diams.).

of second to sixth segments subrectangular in shape, the first three pairs not or scarcely extending beyond hinder margins of their segments, and those of fifth and sixth segments extending but little past the level of hinder margins; plates of second segment obtusely rounded posteriorly and with lower anterior angle acute, those of third to sixth segments with a small acute point at posterior angles; plates of seventh segment extending back to level of postero-lateral angles of first pleon segment, and with acute posterior angles. All segments of pleon visible, the first the shortest; fifth segment slightly longer than fourth, which is a very little longer than third; telsonic segment about one-half as wide again as long; lateral margins slightly sinuate, converging to the acute apex; postero-lateral margins crenulate, furnished with short spines and plumose hairs. Uropods reaching to level of apex of pleon; protopod with three setae on outer margin and with inner process reaching to middle of length of endopod, which is two and one-half times wider, and a little longer, than exopod; endopod acutely rounded posteriorly, with outer margin almost straight, slightly sinuate, and with postero-lateral edges furnished with plumose setae and a few short spines; exopod narrowly rounded at apex; margins furnished with plumose hairs and a few short spines near distal end. Peraeopods stout; outer distal part of ischium and merus a little produced in first pair, and in second pair much produced; the outer apex of the merus of the second peraeopods extends past level of anterior margin of carpus, and the outer apex of the ischium reaches to middle of length of carpus; outer apex of merus of third pair a little forwardly produced, and outer part of ischium considerably expanded laterally and a little forwards, the outer apex reaching beyond apex of merus; last four pairs with long, mostly plumose, hairs, and with the basos expanded; basos of seventh pair only twice as long as wide, and with both lateral margins and median ridge furnished with long plumose hairs; merus of seventh pair about same length as carpus and more than half as long as ischium. Outer ramus of first pair of pleopods much wider and distinctly shorter than inner ramus.

Colour during life—White, with transverse series of black chromatophores near hinder margins of cephalon, peraeon segments, first to fifth pleon segments, and along lateral margins of peraeon; the chromatophores near the hinder margins of cephalon and first two peraeon segments, and along the lateral margins of peraeon, are larger than the others.

Length, 12 mm.

Loc.—South Australia: Port Willunga, on meat near shore (type loc., H. M. Hale), Brighton, from *Heterodontus phillipi* (H. Collyer). Type, female, in South Austr. Mus., Reg. No. C275.

A single specimen was obtained amongst a large number of specimens of *C. woodjonesi* taken from the body cavity of the Port Jackson shark. A small series, mostly of immature specimens, was obtained at Port Willunga in company with *C. woodjonesi* and *C. cranchii*, var. *australiense*. During life the three species can be very readily separated by the colour alone; *C. woodjonesi* is white without pigmentation, *C. cranchii*, var. *australiense*, is closely dotted with small black chromatophores, and *C. corpulenta* is characteristically marked with transverse bars of black chromatophores.

C. corpulenta approaches *Eurydice* in the structure of the first antennae, but in other respects is a typical *Cirolana*, for the peduncle of the second antennae is five-jointed, the inner plate of the basipodite of the maxillipeds is furnished with two hooks, the protopod of the uropods is well produced, and the peduncle of the first pair of pleopods is much wider than long.

The number of articles in the flagella of the antennae is a little variable, and in some specimens there are but eight articles in the flagellum of the first pair.

Cirolana tenuistylis, Miers.

Cirolana tenuistylis, Miers, Zool. "Alert," 1884, p. 303, pl. xxxiii., fig. B.

This species belongs to the group of *Cirolanae* having the frontal lamina elongate, at least three times longer than wide, the first antennae short and stout, the basos of the posterior peraeopods expanded, and the coxal plates each with a distinct, oblique furrow in addition to the usual submarginal furrow. The eyes are "subquadrate or somewhat rounded, with very large ocelli."

Length, 15 mm.

Hab.—North Queensland: Prince of Wales Channel.

C. tenuistylis is somewhat close to *C. woodjonesi*, but Dr. W. T. Calman has very kindly compared specimens of the last-named species with Miers' syntypes, and informs me that the basos of the seventh peraeopods is less markedly expanded in *C. tenuistylis,* while the furrows of the coxal plates are considerably different. These furrows are not indicated in Miers' figure, and I am indebted to Dr. Calman for the accompanying sketches of one of the syntypes in the British Museum collection.

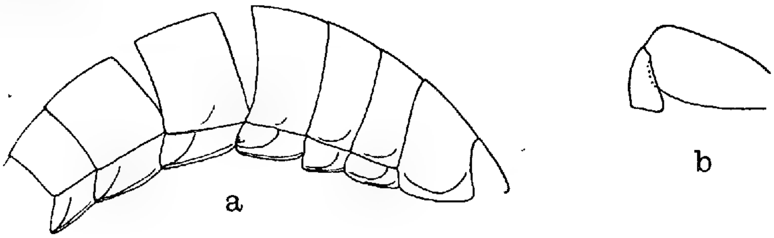

Fig. 4.
Cirolana tenuistylis, syntype; a, lateral view of peracon; b, basos and ischium of seventh peraeopod.

Cirolana woodjonesi, Hale.

Cirolana woodjonesi, Hale, Trans. Roy. Soc. S. Austr., xlviii., 1924, p. 71, pl. v., and text fig. 2.

♂. Form narrowly obovate, about three times longer than greatest width. Surface finely and sparsely punctate, the punctures arranged in transverse series. Cephalon twice as wide as medial length; anterior margin slightly bisinuate with

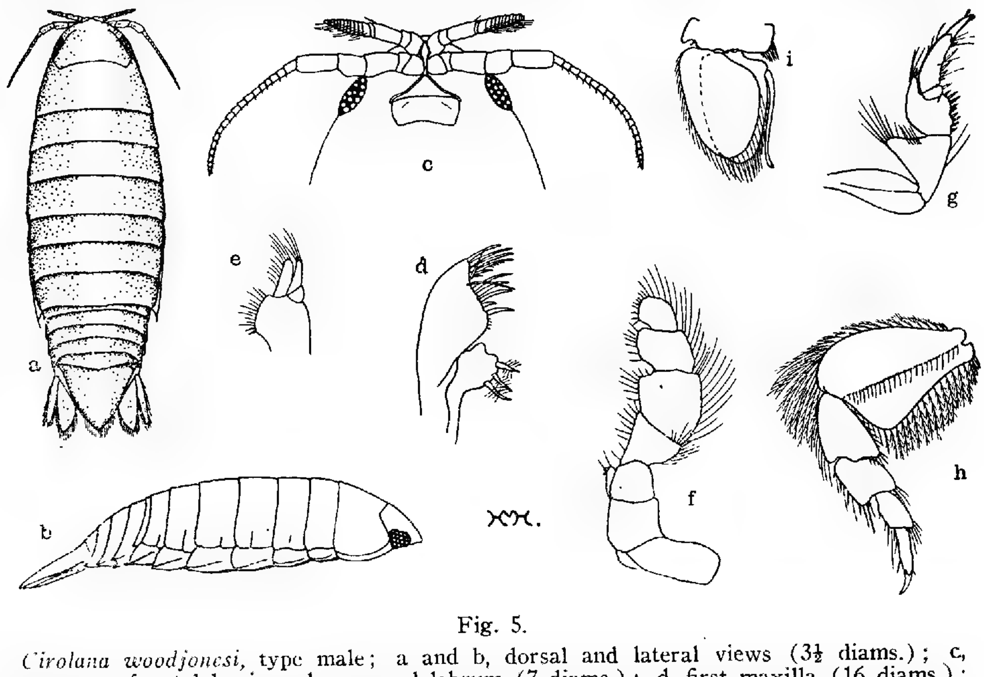

Fig. 5.
Cirolana woodjonesi, type male; a and b, dorsal and lateral views (3½ diams.); c, antennae, frontal lamina, clypeus and labrum (7 diams.); d, first maxilla (16 diams.); e, second maxilla (16 diams.); f, maxilliped (16 diams.); g and h, first and seventh peraeopods (8 diams.); i, second pleopod (8 diams.).

a small, median, subtriangular process, which does not separate the first pair of antennae. Eyes moderately large, with the inner margins straight; subquadrate in lateral view. First antennae short, reaching almost to middle of last peduncular article of second antennae; first article of peduncle much longer than second, and third article as long as first two articles together; flagellum composed of thirteen articles, the second longer than the others, which are very short. Second antennae reaching to posterior margin of first peracon segment; first article of peduncle twice as long as second; third as long as first two together, a little longer than the fourth and slightly shorter than the fifth article; flagellum composed of eighteen articles and a terminal style. Frontal lamina linear, at least four times longer than greatest width, widened at anterior third and slightly dilated at posterior end. Clypeus wider and shorter than labrum. Mandibles normal; first article of palp two-thirds as long as second, and about one-fourth longer than third article. Outer lobe of first maxillae capped with eleven spines (two of the outermost of which are denticulate) and two thinner spines; inner lobe with three stout, plumose spines. Maxillipeds rather slender, the basipodite less than one-third as long as the five-jointed palp. First peraeon segment embracing base of cephalon, subequal in length to cephalon, and much longer than any of the other segments, which are more or less subequal in length. Coxal plates each with a distinct. oblique furrow in addition to the usual submarginal furrow; first three pairs of plates subquadrate and obtusely rounded posteriorly; first and second pairs scarcely reaching to level of posterior margins of their segments and third pair extending very slightly beyond level of posterior margin of fourth segment; plates of fifth to seventh segments subacute posteriorly and reaching beyond level of hinder margins of their segments. All segments of pleon visible in dorsal view, the first partly concealed beneath last peraeon segment; second to fifth segments subequal in length, the lateral parts of the fifth covered by the postero-lateral portions of the preceding segment; telsonic segment distinctly wider than its medial length; lateral margins a little convex and converging to the roundly angular apex; postero-lateral margins with hairs and short spines. Uropods reaching slightly beyond level of apex of pleon; protopod with two or three spines at outer posterior angle and with inner process reaching to beyond middle of length of endopod; exopod lanceolate, shorter than and but half as wide as endopod, the margins furnished with plumose hairs and the apex with two spines; endopod subacute posteriorly, the margins provided with plumose hairs and a few spines. Peraeopods stout, all more or less expanded and flattened; outer distal part of merus of first three pairs forwardly produced; the propodus of the first pair bears three spines (the distal of which is serrate), the carpus one spine, and the merus ten or eleven spines, on the inner edge; propodus of second and third pairs with one spine, carpus with six, and merus with nine to twelve spines; ambulatory peraeopods armed with many spines and long plumose hairs; basos of seventh pair greatly expanded, two-thirds as wide as long, the median, inferior ridge set with shorter hairs than the lateral margins; merus as wide as long, a little longer than carpus and more than one-half as long as ischium. Outer ramus of first pair of pleopods a little shorter than, and nearly half as wide again as, inner branch; male appendage of second pair moderately stout, not much longer than rami and bent inwards at tip.

Colour during life—White.

Length, 14 mm.

♀. Form slightly wider than in male.

Length (largest specimen), 24 mm.

Hab.—South Australia: Gulf St. Vincent (type loc.) and south coast (S. Austr. Mus. Coll.). Tasmania: 100 fms. (C. Hedley); off Cape Portland, 5-10 fms., "fish baits on lines at night" (Dr. E. J. Paradice). Victoria: Port Phillip (Austr. Mus. Coll.). New South Wales: "From porpoise" (Austr. Mus. Coll.).

C. woodjonesi is common in the shallow waters around the South Australian coast. During life some specimens are diffused with rose red, but the usual colour is white; examples have been taken from sharks and from a porpoise, and numbers have been secured on fish baits.

The antennae are a little variable in length and in the number of articles of which they are composed; the first pair may extend only to the end of the fourth peduncular article of the second antennae, and the latter may reach to the level of the posterior margin of the second peraeon segment. As many as twenty-eight articles are sometimes present in the flagellum of the second antennae. In some specimens the first pleon segment is entirely concealed in dorsal view, in others only a small postero-lateral portion on each side is visible. The relative width of the basos of the seventh peraeopods varies a little, but is always equal to more than half the length of the joint. As with other species of the genus, the number of spines margining the telson and uropods proves variable when a large series is examined.

I have referred to this species a small male dredged in 100 fathoms off Tasmania; in this example the male appendage of the second pleopods is apically rounded and is not inbent.

Cirolana pustulosa, n. sp.

Form rather narrowly suboval, about two and three-fourths times longer than greatest width. Surface very finely punctate. Cephalon scarcely twice as wide

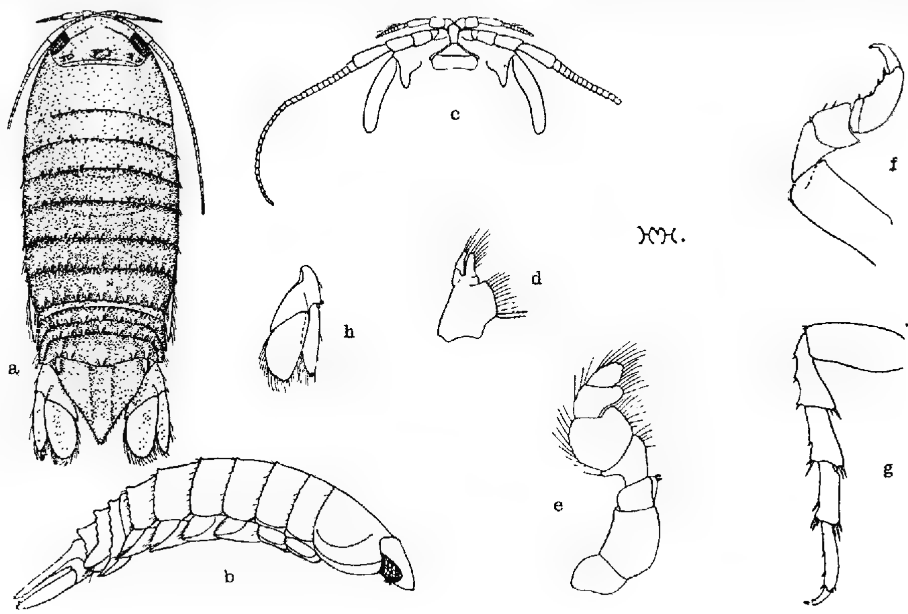

Fig. 6.

Cirolana pustulosa, type; a and b, dorsal and lateral views (8 diams.); c, antennae, frontal lamina, clypeus and labrum (10 diams.); d, second maxilla (29 diams.); e, maxilliped (29 diams.); f and g, first and seventh peraeopods ($14\frac{1}{2}$ diams.); h, uropod (7 diams.).

as medial length; anterior margin incrassate, somewhat conically rounded in outline and with a tiny, median, subtriangular process, which does not separate the first antennae; dorsum with a curved, medianly interrupted furrow, extending along inner margins of eyes and subparallel to antero-lateral margins, and with another furrow submarginal to posterior edge of cephalon; an irregular tubercle at middle of basal part and two smaller and less distinct tubercles near postero-lateral angles. Eyes moderately large, situate laterally. First antennae reaching slightly beyond fourth article of peduncle of second antennae; first article stouter than second and subequal to it in length; third narrower than, and about three-fourths as long again as second article; flagellum composed of ten articles and a tiny terminal style; the first article is very short and the second is longer than any of the others. Second antennae reaching to level of posterior margin of fourth peraeon segment; first two articles of peduncle short, the first longer than the second; fourth article half as long again as third and about five-sixths as long as the fifth article; flagellum composed of thirty articles and a terminal style. Frontal lamina twice as long as greatest width, dilated anteriorly; margin of anterior part convex, and posterior margin concave. Clypeus scarcely as long as labrum. Outer lobe of first maxillae capped with strong spines, some of which are denticulate; inner lobe with three strong, plumose spines. Maxillipeds rather stout, the basipodite less than half as long as the five-jointed palp. First peraeon segment embracing base of cephalon and much longer than any of the others; second and seventh segments shorter than the third to sixth, which are subequal in length; posterior margins of all segments with sparse hairs; the last four have a submarginal row of conical, backwardly-directed tubercles, and on the third segment is a row of similar but very indistinct tubercles; on the first and second segments are faint and barely discernible indications of tubercles. Coxal plates each with a distinct, oblique furrow in addition to the submarginal furrow; plates of second and third segments obtusely rounded behind, not extending beyond posterior margins of their segments; remaining pairs subacute, reaching well beyond the level of the posterior margins of their segments, the last pair extending to beyond hinder margin of second pleon segment. Whole of first pleon segment, and anterior part of second segment, concealed beneath last peraeon segment; third and fourth segments subequal in length, much shorter than the fifth; postero-lateral angles of third segment acute, those of fourth rounded, lobular; lateral parts of fifth segment partly covered by postero-lateral portions of preceding segment; a submarginal row of nine subconical tubercles on third and fourth segments and with five tubercles (the median of which is largest) on fifth segment; telsonic segment wider than long; lateral margins sinuately converging to the narrowly rounded apex; dorsum with a prominent, elongate tubercle near each antero-lateral angle and with a longitudinal carina on each side of median line. Inner process of protopod of uropods not reaching to middle of length of endopod, which extends past level of apex of pleon, is rounded posteriorly, and has the outer margin almost straight; exopod not quite half as wide as and shorter than endopod, reaching to level of apex of pleon, and with the extreme apex emarginate, with a short spine set in the incision; apical and inner posterior margins of endo- and exopod, and apex of telson, with short spines intermixed with the fringe of hairs. Peraeopods rather slender; basos of seventh pair not greatly expanded; ischium, merus, carpus, and propodus with spines on distal margins and a few on inner margins; merus equal in length to carpus and about four-fifths as long as ischium.

Colour bleached.

Length, 7 mm.

Loc.—Queensland: Cooktown (A. G. Maitland). Type in Austr. Mus., Reg. No. P8202.

A single mutilated example, previously preserved in a dry state; the pleopods are destroyed. In some features this species resembles *C. cranchii*, but may be separated by the narrower frontal lamina and by the ornamentation of the dorsum. It is allied to *C. sculpta*, M. Edw., and to *C. willeyi*, *C. pleonastica*, and *C. sulcaticauda* of Stebbing, but the sculpturing of the pleon is different.

CIROLANA CRANCHII, Leach, var. AUSTRALIENSE, NOV.

♂. Form suboval, more than three times longer than greatest width. Surface with fine punctures intermixed with a few larger punctures. Cephalon twice as wide as medial length; anterior margin rounded, with a small, median, subtriangular process, arching downwards and backwards, completely separating the first pair of antennae, and meeting the apex of the frontal lamina. Eyes moderately large, situate laterally. First antennae reaching slightly beyond end of peduncle of second antennae; first and second articles of peduncle subequal in length; third article more slender and more than one-third longer than either of first two articles; flagellum composed of fifteen articles and a small terminal style. Second antennae reaching to level of posterior margin of third peraeon segment; first and third articles of peduncle subequal in length, each longer than the second; fourth article twice as long as third and about four-fifths as long as fifth article; flagellum composed of thirty-four articles and a terminal style. Frontal lamina pentagonal, a little longer than greatest width. Clypeus wider

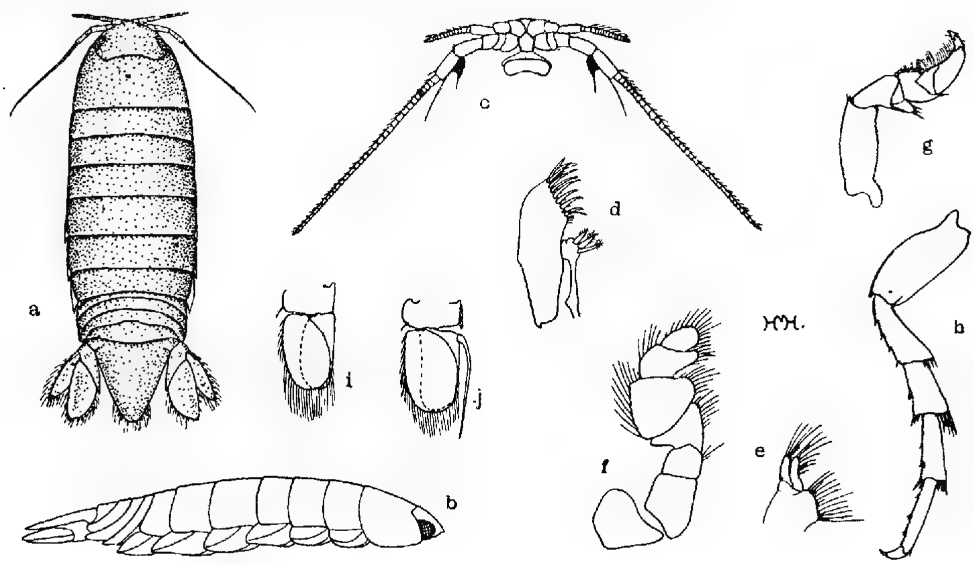

Fig. 7.

Cirolana cranchii, var. *australiense*, type male; a and b, dorsal and lateral views (4 diams.); c, antennae, frontal lamina, clypeus and labrum (9 diams.); d, first maxilla (9½ diams.); e, second maxilla (9½ diams.); f, maxilliped (9½ diams.); g and h, first and seventh peraeopods (8 diams.); i and j, first and second pleopods (5½ diams.).

and shorter than labrum. Mandible with tridentate cutting edge, movable lacinia and molar process well developed; first article of palp one-half as long as second. Outer lobe of first maxillae capped with eleven stout spines and one long seta (also some short setae near inner distal angle of lobe), the three or four innermost spines denticulate; inner lobe with three stout, plumose spines. Maxillipeds moderately stout, the basipodite not much more than one-third as long as the five-jointed palp. First peraeon segment embracing base of cephalon, much longer than any of the others. Coxal plates each with an oblique furrow in addition to the submarginal furrow; those of second and third segments obtusely rounded posteriorly, not reaching beyond hinder margins of their segments; remaining plates subacute posteriorly, extending beyond hinder margins of their segments, those of last segment reaching slightly beyond postero-lateral angle of first pleon segment. Pleon not abruptly much narrower than peraeon; first segment almost wholly concealed beneath last peraeon segment, only a small postero-lateral portion being visible; anterior median part of second segment covered by last peraeon segment; third and fourth segments subequal in length; medial length of fifth segment equal to that of third and fourth together; lateral parts of fifth segment covered by postero-lateral parts of preceding segment; telsonic segment longer than wide; lateral margins almost straight, a little convex, converging to the rather narrowly rounded apex, which is furnished with eight short spines and short hairs. Inner process of protopod of uropods reaching to middle of length of endopod, which extends a little past level of apex of pleon and is twice as wide as exopod; apices of both exo- and endopod sub-bifid; outer margin of endopod with three, and inner with seven spines, and plumose hairs; outer margin of exopod with nine, and inner with three spines, and plumose hairs. Peraeopods rather slender; ischium of first pair with three or four setae on outer distal margin, the merus with six blunt spines on inner margin and with outer distal apex capped with several setae; merus, carpus, and propodus of first peraeopods with a dense fringe of hairs; ischium of second and third pairs with one spine and three setae on outer distal margin, merus with seven to nine spines on inner margin and with one spine and several setae on outer apex; carpus with several short spines at inner apex; last four pairs of peraeopods furnished with spines on inner and distal margins of ischium, merus, carpus, and propodus; basos of seventh pair more than twice as long as greatest width; ischium longer than carpus, which is longer than merus. Outer ramus of first pair of pleopods more than one and one-half times wider, and scarcely shorter, than inner ramus; male appendage of second pleopods more than one-fourth longer than inner ramus.

Colour.—Whitish, with dorsum closely dotted with tiny black chromatophores.

Length, 13 mm.

♀. The form is slightly wider than in the male.

Length, 12 mm.

Loc.—South Australia: Port Willunga, in rock pools and near shore (type loc.), and Gulf St. Vincent, dredged in 6-8 fms., etc. (H. M. Hale); Hallett's Cove, from a sponge (W. H. Baker). New South Wales: Near Tuggerah Lakes, in rock pools (A. A. Livingstone and H. O. Fletcher); off Bateman's Bay, 80 fms., in crevice of conglomerate (Capt. J. Fordar); east of Ulladulla, 74 fms., in conglomerate boulder (C. W. Mulvey); Port Jackson (F. A. McNeill); Port Stephens (Austr. Mus. Coll.). Victoria: Port Phillip (Gabriel). Type, male, and allotype, female, in S. Austr. Mus., Reg. No. C304-305.

This form is by no means rare in South Australia. A series of about 300 specimens was selected from a multitude recently obtained by lowering a piece of meat into the water near shore at Port Willunga, on a moonlight night. Immediately the meat was submerged swarms of *Cirolanae* crowded to it; two other species, *C. corpulenta* and *C. woodjonesi*, accompanied *C. cranchii*, var. *australiense*, but the last-named was in greatest number, so that a series was obtained in a few minutes. The following variation obtains in these specimens:—Some young examples are relatively wider in form, being not much more than two and one-half times longer than wide; in specimens 5 mm. or so in length most of the first pleon segment is concealed. The number of articles and the length of the flagellum is variable in both pairs of antennae; in some cases the flagellum of the second antennae reaches slightly beyond the posterior margin of the fourth peraeon segment; in an example 5 mm. in length the flagellum of the first antennae is composed of nine articles and that of the second of nineteen. The number of spines on the apical margin of the telson is not constant and varies from six to fourteen. The fringe of hair on the inner margin of the first peraeopods is not always developed. A young specimen from the marsupium of a female 8 mm. in length is approximately 2 mm. in length, and has the apices of the branches of the uropods scarcely sub-bifid; the telsonic segment is much as in the adult, but the apical spines are blunt.

In large specimens of *C. cranchii* the distal half of the lateral margins of the telson is a little concave,[5] and the apical part is narrower than in the Australian examples. In other respects the latter agree closely with the descriptions of *C. cranchii,* but as the difference in the shape of the telson is apparently constant they are provisionally given a varietal name. I am indebted to Dr. K. H. Barnard for a small specimen of *C. cranchii (C. vicinia,* Barn.)[6] from South Africa; in this the postero-lateral margins of the telson are not concave, but the apical part of the telson is very narrowly rounded.

Cirolana lata, Haswell.

Cirolana lata, Hasw., Proc. Linn. Soc. N.S. Wales, vi., 1881, p. 192, pl. iv., fig. 1, and Cat. Austr. Crust., 1882, p. 286.

♀. Form somewhat widely obovate, two and one-third times longer than greatest width. Surface punctate. Cephalon three times as wide as medial length; anterior margin rounded, medianly very slightly excavated, and with a

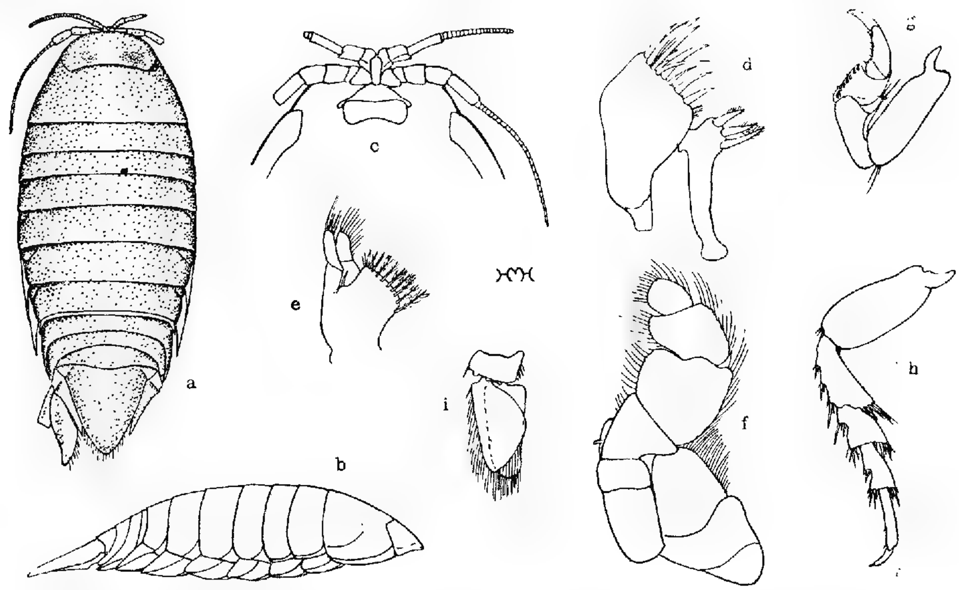

Fig. 8.

Cirolana lata, type female; a, dorsal view (3 diams.); b, lateral view (3 diams.); c, antennae, frontal lamina, clypeus and labrum ([illegible] diams.); d and e, first and second maxillae (14½ diams.); f, maxilliped (14½ diams.); g and h, first and fifth peraeopods (5½ diams.); i, first pleopod (5 diams.).

small, downbent, subtriangular median process, not visible in dorsal view and not separating bases of first antennae. No external trace of eye facets or pigment. Peduncle of first pair of antennae as long as first four articles of peduncle of second antennae; first article a little wider and shorter than second, which is wider than, and more than half as long as third; flagellum as long as peduncle, composed of twenty articles, the first very short. First article of peduncle of second antennae much longer than second, and shorter than third; fourth longer than third but only about two-thirds as long as fifth article; flagellum a little less

(5) Hansen, Journ. Linn. Soc., xxix., 1905, p. 351.

(6) Barn., Ann. S. Afr. Mus., x., 1914, p. 351*a*, pl. xxxb.

than half as long again as peduncle, reaching back well beyond hinder margin of first peraeon segment and composed of twenty-five articles. Frontal lamina more than twice as long as wide; lateral margins straight and slightly converging posteriorly; anterior margin convex and hinder margin concave; anterior end slightly projecting, visible in dorsal view. Medial length of clypeus subequal to that of labrum. Movable lacinia, molar part, and tridentate cutting edge of mandibles well developed. Outer lobe of first maxillae capped with ten strong, simple spines of varying lengths, and one thinner spine; one of the three outermost spines longer and much stouter than any of the others; inner lobe with three stout, plumose spines. Maxillipeds moderately wide, with basipodite less than one-third as long as palp. First peraeon segment embracing base of cephalon, twice as long as second segment, which is about as long as the seventh; fourth to sixth segments subequal in length, each a little longer than second; third segment slightly shorter than any of the others. Coxal plates each with a distinct furrow in addition to the submarginal furrow; first two pairs obtusely rounded posteriorly, not extending beyond hinder margins of their segments; those of fourth to seventh segments subacute posteriorly, successively extending further beyond hinder margins of their segments; the coxal plates of the sixth segment reach almost to the level of the hinder margin of the seventh segment, and the last pair reach to nearly the first fourth of the length of the pleon. First segment of pleon entirely concealed beneath last peraeon segment, and only a short portion of the second segment visible; postero-lateral angles of second segment subacute, a little backwardly produced; third, fourth, and fifth segments subequal in length; the postero-lateral angles of the third segment are greatly produced backwards and extend slightly beyond the produced and narrowly rounded postero-lateral angles of the fourth segment; lateral portions of fifth segment covered by postero-lateral parts of fourth segment; telsonic segment wider than medial length, which is equal to the second to fifth pleon segments and the last peraeon segment together; lateral margins convex, regularly converging to the acutely rounded apex. Protopod of uropods produced to almost two-thirds of length of endopod, which extends past apex of pleon; endopod narrowed on posterior fourth and narrowly subtruncate apically; armed with two short spines and some hairs, and with the inner margin convex, the outer margin sinuate. Peraeopods stout, the inner margin of the merus of first three pairs with a row of short stout spines; last four pairs armed with many strong spines on inner and apical margins of ischium, merus, and carpus. Outer ramus of first pair of pleopods wider and a little shorter than inner ramus.

Colour, after long preservation in alcohol—White.

Length, 16·5 mm.

Loc.—New South Wales: Off Broughton Islands, near Port Stephens.

The type (which, as the accompanying figure shows, has been damaged since Haswell described it) appears to be the only known example of this species. The uropods are now imperfect, but Haswell remarks that the exopod is "much narrower than . . . but of about equal length" to the endopod. Eyes are apparently absent. The exoskeleton is smoother and thinner for a small portion of the antero-lateral parts of the upper and underside of the cephalon, and by transmitted light a dark internal mass can be seen on each side of the basal part.

Cirolana lata, var. integra, Miers.

Cirolana lata, var. *integra*, Miers, Zool. "Alert," 1884, p. 304.

Miers' description of this form is rather brief; the variety resembles *C. lata* in having the frontal lamina moderately broad, the form broadly ovoid, the first peraeon segment long, and the pleon short, but differs in having "the eyes . . . black and subquadrate, the median rostral point prominent and prolonged between the bases of the antennules to or nearly to the apex of the interannular plate," and the flagellum of the second antennae "13-15 jointed." Miers refers "three small specimens . . . with much hesitation to this species."

Hab.—North Queensland: Albany Island.

I have not seen this or the following species.

CIROLANA LAEVIS, Studer.

Cirolana laevis, Studer, Abh. Kon. Akad., Berlin, 1884, p. 21, pl. ii., fig. 8.

This species is also broadly suboval in form. The flagellum of the second antennae consists of fourteen articles and the eyes are elongate. The uropoda reach beyond the apex of the pleon; both rami are lanceolate and the exopod is narrower than the endopod. The shape of the frontal lamina is not mentioned, but the form of the antennae, as figured by Studer, separates *C. laevis* from *C. lata.* Without examining specimens it is difficult to determine the differences between this species and *C. lata,* var. *integra.*

Length, 10 mm.; width, 5 mm.

Hab.—"Ostlich von Queensland aus 90 Faden Tiefe."

CIROLANA LINEATA, Potts.

Cirolana lineata, Potts, Carnegie Inst. of Wash., Papers from Dept. of Mar. Biol., viii., 1915, p. 89, pl. i., fig. 4, and text fig. 6.

♀. Ovigerous. Body very convex. Form broadly ovate, about two and one-third times longer than greatest width. Surface with tiny and almost obsolete punctures. Cephalon about one and one-half times as wide as medial length; surface with some irregular foveae, and a tumidity on each side of anterior part;

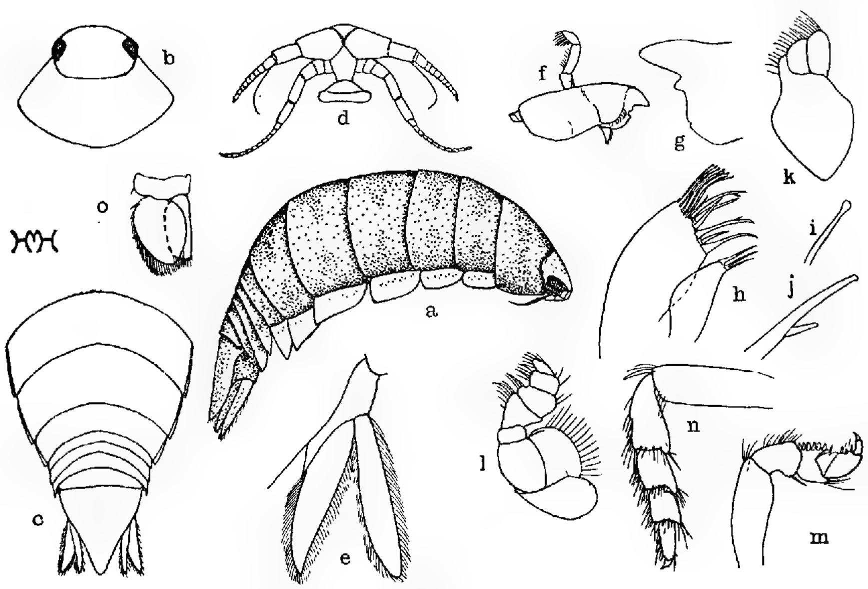

Fig. 9.

Cirolana lineata, female; a, lateral view (5 diams.); b, dorsal view of cephalon and first peraeon segment (5 diams.); c, dorsal view of pleon and hinder part of peraeon (5 diams.); d, antennae, frontal lamina, clypeus and labrum (10 diams.); e, uropod (12 diams.); f, mandible (16 diams.); g, cutting edge of mandible (32 diams.); h, first maxilla (32 diams.); i, tip of an outer, and j, tip of an inner, spine of outer lobe of first maxilla (188 diams.); k, second maxilla (32 diams.); l, maxilliped (16 diams.); m and n, first and seventh peraeopods (8 diams.); o, first pleopod (6 diams.).

anterior margin rounded, with a subtriangular, median process, scarcely visible in dorsal view but arching downwards and backwards, not completely separating the first pair of antennae and not quite meeting the apex of the frontal lamina. Eyes rather small, situate laterally. Antennae short. First pair reaching to hinder margin of cephalon and a little beyond end of peduncle of second antennae; peduncle two-jointed, the first article wider than, and one-half as long again as, second article; flagellum nearly as long as peduncle, composed of eleven articles, the first very short, and the second longer than any of the others. Second antennae not quite reaching to posterior margin of first peraeon segment; first three articles of peduncle short; fourth a little longer than fifth, which is slightly longer than the third; flagellum shorter than peduncle and not much longer than flagellum of first antennae, composed of ten articles and a tiny, terminal style. Frontal lamina large, pentagonal in shape, about one and one-half times longer than greatest width; with anterior apex acute, and lateral and postero-lateral angles obtuse. Clypeus and labrum rather short, subequal in length. Molar part of mandibles moderately well developed; first article of palp about four-fifths as long as second, and a little longer than third article. Outer lobe of first maxillae capped with thirteen spines of various lengths, many of them with a lateral branch and all with the apices blunt; inner lobe of one side with three, and of other with two, very acuminate simple spines. Basipodite of maxillipeds less than twice as long as wide, almost as long as the first three articles of the five-jointed palp; inner plate subtriangular, with the apex narrowly rounded and reaching nearly to level of anterior margin of second article of palp, and with outer margin furnished with plumose hairs and inner margin with five spines. First peraeon segment embracing base of cephalon; a little longer than fourth to sixth segments; second and third segments about two-thirds as long as first; seventh segment much the shortest, less than half as long as the first. Coxal plates smooth, without oblique furrows; those of second and third segments rounded posteriorly, not extending to level of hinder margins of their segments; those of fourth segment subacute posteriorly, reaching to level of hinder margin of segment; remaining coxal plates with acute posterior angles, extending downwards and backwards beyond hinder margins of segments. Pleon rather short and scarcely more than one-half as wide as peraeon; first segment wholly concealed beneath last peraeon segment; second to fourth segments subequal in length, with posterior angles subacute; third segment the widest, its postero-lateral angles extending outwards and downwards beyond the level of the others; fifth segment a little longer than any of the others with sides, but not posterior angles, covered by lateral parts of fourth segment; telsonic segment scarcely wider than medial length, with sides a little sinuate and converging to the acutely rounded apex, which is armed with tiny spines; lateral parts downbent, forming a sheath into which the uropods fold. Uropods extending to apex of telson, with both rami narrow; inner process of protopod not reaching to middle of length of endopod; endopod very little wider than exopod with apex acute; apex of exopod narrowly rounded; margins of both endo- and exopod furnished with rather short hairs and short spines. First pair of peraeopods with a spine at outer distal angle of ischium, six strong, short spines on inner margin of merus, one on the carpus and three on the propodus; in the second and third pairs the distal margins of the ischium and merus are armed with some stout spines intermixed with stout setae, the merus has nine spines on the inner margin, the carpus two or three at inner distal angle, and the propodus has three smaller spines on inner margin; inner and distal margins of ischium, merus, carpus, and propodus of last four pairs armed with spines intermixed with strong setae; merus of seventh pair longer than carpus and more than half as long as ischium; basos not much expanded, more than three times longer than wide. Outer ramus of first pair of pleopods longer than, and slightly more than twice as wide as, inner ramus.

Colour in alcohol.—Cephalon and telsonic segment densely mottled with dark purplish-brown. Peraeon segments and second to fifth pleon segments whitish, marked with dark mottled-brown along lateral margins and at middle of segments.

Length, 12 mm.

Loc.—Western Australia: Cottesloe (W. Austr. Mus. Coll). Queensland: Albany Passage (Austr. Mus. Coll.).

Hab.—Northern Queensland and Western Australia.

Only the female described above was collected from Cottesloe; a young example taken from the brood pouch is 2·35 mm. in length, and has the colouration much as in the adult, but differs in having the eyes relatively larger, the flagellum of the first antennae composed of six articles and that of the second of seven.

Four slightly smaller females in the Australian Museum Collection were taken in Albany Passage, and are labelled "Commensals of *Comatulae*." These are evidently some of the specimens referred to by Haswell,[7] who, after describing *Synalpheus comatularum*, remarks: "Other commensals of these Comatulids were *Galathea deflexifrons*, and an undescribed species of Cymothoid, the latter usually ensconcing itself in the alimentary canal of its host, in which it remained buried with the exception of the anterior third of its body." These specimens (the colour of which is bleached) have the body even more convex transversely, and more arched longitudinally, than in the female from Cottesloe; also, in one or two specimens the lateral parts of the telson are not quite so much downbent (so that the telson in dorsal view appears less narrowed posteriorly), and the apex of the median process of the cephalon meets the apex of the frontal lamina, thus completely separating the first antennae.

Potts' specimens are much smaller than those now examined; he had both sexes, and gives the following measurements: male, length, 4·7 mm., and width, 1·5 mm.; female, length, 6 mm., and width, 2·5 mm. The male appendage of the second pair of pleopods is described as "slender, much longer than inner ramus of second uropod [pleopod], apex rounded." Potts remarks that the species "Occurs on crinoids, generally *Comanthus annulatum*, in Torres Straits. . . . While the isopod may make busy excursions on to the surface of *Comanthus*, it is often to be seen diving into the gut of the host, where it apparently spends a large part of its time. It does not feed, so far as I know, on the tissues of the crinoid itself, but only on the food it finds in the stomach."

The species is not typical of *Cirolana*, and, in view of the several new Eurydicid genera which have been erected in recent years, it is possible that a separate genus will be proposed to receive it. The mouth parts differ a little from those of *Cirolana*. The molar part of the mandibles is furnished with a row of setae, but the anterior margin of this process is only feebly serrate; the inner plate of the basipodite of the maxillipeds is different and the three spines on the inner lobe of the first maxillae are not plumose as in *Cirolana*, but are thin and simple, as in *Hansenolana*.[8] In his description of the type species of the last-named genus[9] Stebbing remarks that the narrow second joint of the peduncle of the first antennae "is followed by what appears to be an extremely short third peduncular joint." The condition, as shown in his figure, is similar to that obtaining in *C. lineata*, and in the new genus proposed below, in which this small article is treated as belonging to the flagellum; it certainly appears that in these species the normal first and second articles of the peduncle of this pair of antennae have been fused together to form a single article. A short article is present at the

(7) Hasw., Proc. Linn. Soc. N.S. Wales, vi., 1882, p. 762.

(8) Stebb., Herdman's Ceylon Pearl Fish. Suppl., xxiii., 1905, p. 15.

(9) Stebb., Willey's Zool. Res., 1902, p. 635.

base of the flagellum of the first antennae of some *Cirolanae* in which the three articles of the peduncle proper are quite distinct. Potts evidently treats the peduncle as three-jointed, for he says, "first joint . . . large, second a little smaller, and third much smaller."

CIROLANA SCHIOEDTEI, Miers.

Cirolana schioedtei, Miers, Zool. "Alert," 1884, p. 302, pl. xxxiii., fig. A; Nierstrasz, Zool. Meded., iv., 1918, p. 103, figs. —

♂. Form narrow, three and one-half times longer than greatest width, with sides subparallel. Surface with very small punctures. Cephalon more than twice as wide as medial length; anterior margin slightly concave, with a small median, downbent, subtriangular process, not meeting apex of frontal lamina and not completely separating first antennae. Eyes moderately large, elongate, situate on antero-lateral portions of head and with only a narrow part of each

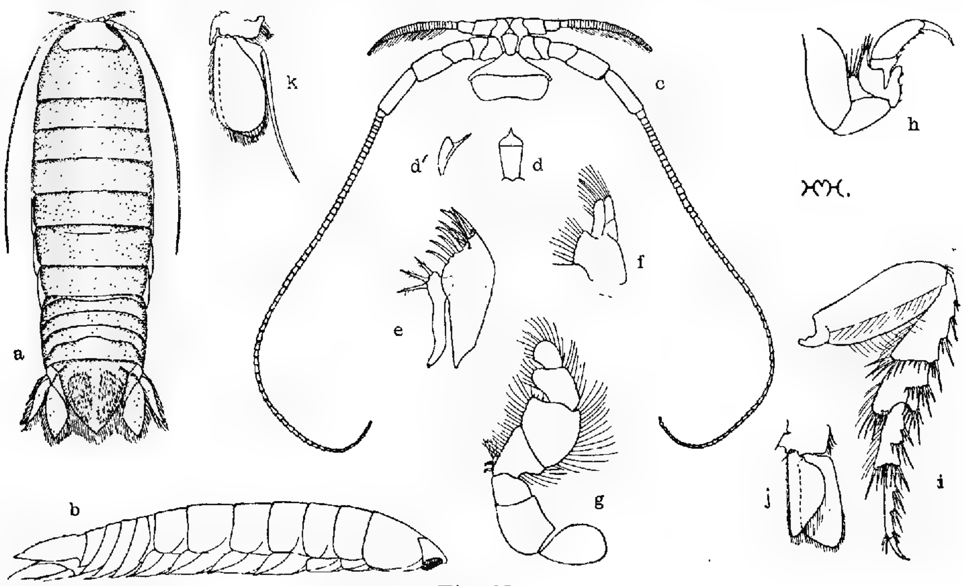

Fig. 10.

Cirolana schioedtei, male; a and b, dorsal and lateral views ($1\frac{1}{3}$ diams.); c, antennae, frontal lamina, clypeus and labrum (4 diams.); d, anterior, and d[1], lateral, views of frontal lamina (5 diams.); e and f, first and second maxillae ($7\frac{1}{2}$ diams.); g, maxilliped ($7\frac{1}{2}$ diams.); h and i, first and seventh peraeopods (4 diams.); j and k, first and second pleopods (3 diams.).

visible in dorsal view. First antennae not quite reaching to end of peduncle of second antennae; articles of peduncle subequal in length; flagellum nearly twice as long as peduncle, composed of forty-four articles, the first longer than any of the others, which are extremely short. Second antennae reaching back distinctly beyond level of hinder margin of fifth peraeon segment; first two articles of peduncle short, the first a little longer than second; third not quite as long as first two together and almost as long as fourth article, which is a little shorter than the fifth; flagellum very long, composed of sixty-five articles and a terminal style. Frontal lamina more than twice as long as greatest width; postero-lateral margins converging, and antero-lateral margins sinuately converging to the acute apex; in lateral view the ventral profile is convex for the posterior two-thirds, then abruptly and obliquely truncated; from the truncated surface arises the acuminate anterior part, the ventral surface of which is concave in lateral view. Clypeus wide, about as long as labrum, with apex emarginate. Mandibles normal; first article of palp slightly longer than third, and more than one-half as long as second article. Outer lobe of first maxillae capped with eleven strong simple spines and one thinner spine; inner lobe with three stout plumose spines. Maxillipeds moderately stout, the basipodite not much more than one-third as long as the five-jointed palp. First peraeon segment embracing base of cephalon, much longer than any of the others, which are subequal in length. Coxal plates each with a distinct, oblique furrow in addition to the usual submarginal furrow; those of second and third segments with obtuse posterior angles and not extending past level of hinder margins of their segments; remaining coxal plates with acute posterior angles, reaching well beyond hinder margins of their segments, the last pair extending to middle of length of postero-lateral margins of second pleon segment. Pleon not much narrower than peraeon; postero-lateral angles of first to fifth segments acute and not covered by preceding segments; all but a short posterior part of the fifth segment covered by last peraeon segment; first segment narrower and third wider than any of the others; fifth a little longer than second, third, or fourth; telsonic segment wider than medial length; lateral margins convexly converging to the acute apex; postero-lateral margins crenulate and furnished with a dense fringe of hairs; dorsum obscurely medianly carinate, for the greater part densely set with short hairs, leaving bare the basal area, a narrow median portion, and a narrow marginal part. Uropods reaching a little beyond level of apex of pleon; inner process of protopod extending to middle of length of endopod; exopod one-half as wide as, and shorter than, endopod, the outer margin sinuately curved and the inner margin slightly convex; both exo- and endopod with acute apices and with margins set with a dense fringe of hairs, intermixed with which are short spines. Peraeopods stout; outer distal part of ischium of first three pairs expanded, and outer distal part of merus produced to or a little beyond level of anterior margin of carpus, the outer margin and apex of produced part armed with spine-like setae; inner margin of merus in first pair with a few short spinules, and in second and third pairs with a series of spines; ischium, merus, carpus, and propodus of last four pairs armed with many strong spines; ischium folding back into a hollow in the outer posterior surface of basos, the anterior edge of the hollow, and also the margins of the basos, furnished with hairs; basos of seventh pair expanded, less than three times as long as greatest width; merus of this pair almost as long as carpus and more than one-half as long as ischium. Outer ramus of first pair of pleopods shorter than, and scarcely as wide as inner ramus; male appendage of second pair one-third as long again as outer ramus.

Length, 38 mm.

♀. The adult female is smaller in size and is relatively wider in form than the adult male, while the two patches of hair on the telson are less developed or absent.

The first segment of the pleon of an ovigerous female is almost wholly concealed beneath the last peraeon segment, and the postero-lateral angles are covered. The ova (in an early stage) are orange in colour, broadly cucumiform in shape, and about 2·4 mm. long by 1·65 mm. wide.

Length, 30 mm.

Colour in alcohol.—Pale brown or yellowish-white.

Loc.—Northern Territory (Prof. A. Watson). Western Australia: Broome (E. J. Stuart).

Hab.—Northern and North-west Australia.

A score of specimens of this large species are before me; as mentioned above, in this series the females have not the hair-tracts of the telson so well developed as in the male, or the patches are absent altogether. This difference between the sexes may not always obtain, however, for Miers remarks that "There are in the British Museum Collection several specimens collected in Torres Straits. . . . All of them appear to be of the male sex. The terminal segment (only) is slightly pubescent above."

The flagellum of the second antennae is slightly variable in length and occasionally does not quite reach the level of the hinder margin of the fifth peraeon segment; the number of the articles of which it is composed vary, in the adult, between forty-nine and sixty-six. In the youngest example available (10 mm. in length) the second antennae reach to the middle of the length of the sixth peraeon segment, and the flagellum consists of forty-four articles and a terminal style; the seventh peraeopods, including the coxal plate, of this young example are not yet developed, but the first pleon segment is partly concealed beneath the last peraeon segment.

Cirolana vieta, n. sp.

♀. Form rather elongate, obscurely suboval, about two and three-fourths times longer than greatest width. Dorsum of cephalon, peraeon, and middle portions of first to fifth pleon segments not punctate but marked with numerous

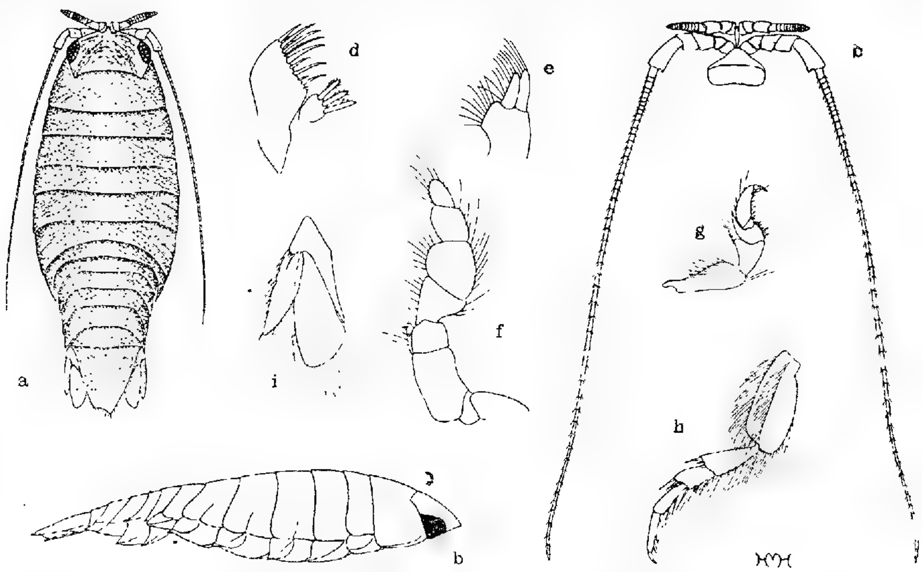

Fig. 11.

Cirolana vieta, type female; a and b, dorsal and lateral views (4 diams.); c, antennae, frontal lamina, clypeus and labrum (7 diams.); d and e, first and second maxillae ($14\frac{1}{2}$ diams.); f, maxilliped ($14\frac{1}{2}$ diams.); g and h, first and seventh peraeopods (5 diams.); i, uropod, ventral view (7 diams.).

transverse and oblique furrows, giving the surface a wrinkled appearance. Cephalon about one and three-fourths times wider than medial length; anterior margin distinctly bisinuate, with a small, median subtriangular process, partly separating basal articles of first antennae. Eyes moderately large, situate laterally. First antennae short, the tip of flagellum not reaching to end of peduncle of second antennae; peduncle not as long as first three articles of second antennae; first article a little shorter than second, extending in front at a right angle to rest of antenna; third article scarcely longer than second, with the posterior distal part produced and furnished with a short spine and two or three short setae;

flagellum composed of fourteen articles. Second antennae with very long flagellum which reaches back to level of postero-lateral angles of fourth pleon segment; first two articles of peduncle short; third about one-half longer than second, one-third longer than fourth and two-thirds as long as fifth article; flagellum composed of forty-nine to fifty articles and a terminal style. Frontal lamina very elongate, almost linear, a little dilated anteriorly; anterior end not adpressed, directed forwards, and visible in dorsal view between the bases of the antennae. Clypeus as long as labrum; mid-line of frontal lamina and clypeus obscurely carinate. Mandibles normal, the first article of palp more than one-half as long as second and longer than third article. Outer lobe of first maxillae capped with twelve spines of varying size, three of the outermost being denticulate; inner lobe with three stout, plumose spines. Maxillipeds rather slender, the basipodite one-half as long as the first four articles of the five-jointed palp. First peraeon segment embracing base of cephalon, longer than any of the others; second, sixth, and seventh segments shorter than third, fourth, or fifth segments, which are subequal in length; seventh segment much the shortest. Coxal plates each with a subobliquely curved furrow in addition to the submarginal furrow and various oblique wrinkles; plates of second to fifth segments subrectangular, not or scarcely passing hinder margins of their segments; those of sixth segment subrectangular, extending beyond posterior margin of their segment, and those of seventh segment subtriangular, posteriorly subacute, and reaching to level of hinder margin of first pleon segment; the coxal plates of the second segment are rounded posteriorly and the posterior angles of those of the third to sixth segments are produced into a small, acute point. Pleon much narrower than peraeon; all segments visible, the first shorter than the second to fifth, which are subequal in length; the posterior margins of the first two segments are tri-sinuate, the concave dorsal portion of these margins meeting the concave infero-lateral margins at an acute angle; lateral parts of fifth segment covered by postero-lateral parts of fourth segment; telsonic segment at least as long as basal width, the lateral margins slightly sinuate, and converging to the apex, which is asymmetric and abnormal. Uropods not reaching to end of pleon; protopod with two or three marginal spines on inferior side near articulation of exopod, and with inner process on one side reaching to two-thirds of length, and on other side not reaching to half of length of endopod; exopod lanceolate, more than three-fourths as long, and but half as wide, as endopod, the margins furnished with short spines and plumose hairs; outer margin of endopod almost straight, posterior margin obliquely rounded; margins with plumose hairs. Peraeopods moderately stout; outer distal part of merus of first pair produced to level of inner apex of carpus, the apex of produced part with a strong, short spine and some setae; basos of seventh pair considerably expanded, two and one-fourth times longer than greatest width; merus four-fifths as long as carpus and more than half as long as ischium. Outer ramus of first pair of pleopods shorter than and nearly twice as wide as inner ramus.

Colour completely bleached after long preservation in alcohol.

Length, 13 mm.

Loc.—South Australia: Encounter Bay (Dr. Robt. Pulleine). Type, female, in S. Austr. Mus., Reg. No. C278.

Only a single, slightly abnormal specimen was taken. As in *C. corpulenta* the first antennae approach the condition found in *Eurydice*, but other structural details of *C. vieta* are typical of the genus *Cirolana*. The very long flagellum of the second antennae and the wrinkled appearance of the dorsal surface separate this from all other Australian species.

Cirolana concinna, n. sp.

♀. Form widely suboval, two and one-third times longer than greatest width. Surface with transverse series of punctures submarginal to posterior edges of cephalon, and of peraeon and pleon segments; remainder of dorsum sparsely punctate. Cephalon about twice as wide as medial length; anterior margin bisinuate and with a small, median, subtriangular process, not separating bases of first antennae. Eyes moderately large, situate laterally. First antennae long, reaching back nearly to hinder margin of third peraeon segment; peduncle extending to about one-half of length of fourth article of second antennae; first article short, about two-thirds as long as second; third scarcely longer than first article; flagellum three times as long as peduncle, composed of eighteen articles and a terminal style. Second antennae long, extending back to posterior margin of sixth peraeon segment; first two articles of peduncle short, the second shorter than the first; third article as long as first two together and a little shorter than

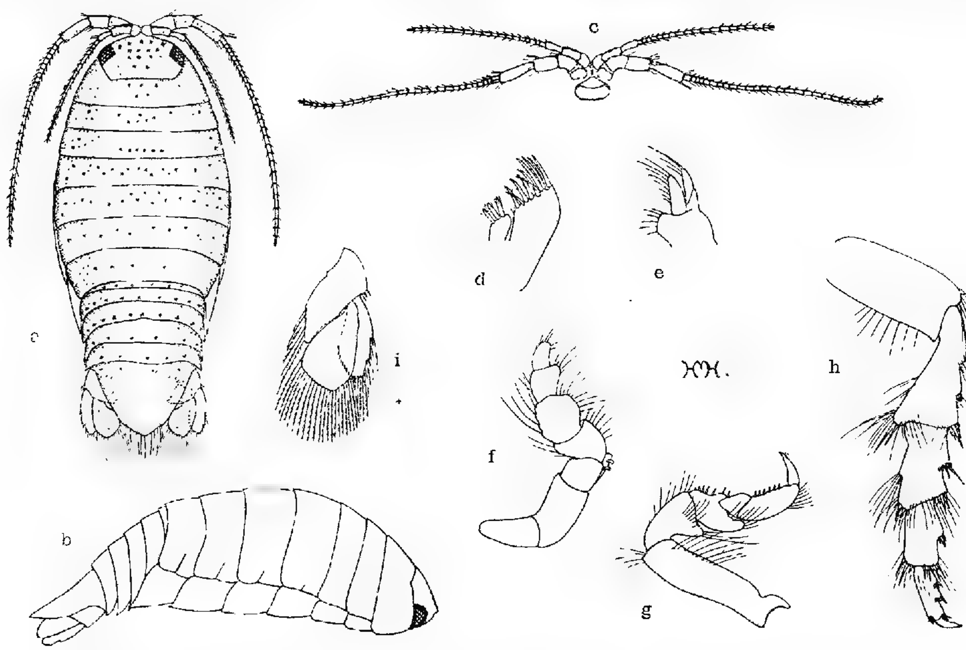

Fig. 12.

Cirolana concinna, type female; a and b, dorsal and lateral views (6½ diams.); c antennae, frontal lamina, clypeus and labrum (6½ diams.); d and e, first and second maxillae (29 diams.); f, maxilliped (29 diams.); g and h, first and seventh peraeopods (14½ diams.); i, uropod (14½ diams.).

fourth, which is more than one-half as long as fifth article; flagellum two and one-half times longer than peduncle, composed of twenty-seven articles and a terminal style. Frontal lamina linear, slightly dilated anteriorly and posteriorly. Clypeus scarcely as long as labrum, projecting outwards and forwards. Outer lobe of first maxillae capped with thirteen spines of various sizes, many of them being denticulate; inner lobe with three stout, plumose spines. Maxillipeds moderately slender, the basipodite less than half as long as the five-jointed palp. First peraeon segment embracing cephalon to level of middle of eyes; not very long, its medial length greater than that of second, third, or seventh segments, but less than that of fourth, fifth, or sixth segments, which are subequal in length. Coxal plates with sparse punctures but without oblique furrows; first two pairs subrectangular, not extending past the hinder margins of their segments; last four pairs with subacute or acute posterior angles, extending beyond the posterior margins of their segments, the last pair reaching almost to postero-lateral angles of third pleon segment. Greater part of first segment of pleon concealed beneath last peraeon segment, leaving visible only a short portion; postero-lateral angles of second to fifth segments acute and free, those of the fifth segment not covered by lateral parts of preceding segment; telsonic segment about one-half as wide again as medial length; lateral margins slightly sinuate, converging to the widely rounded and slightly crenulate posterior margin, which is furnished with long plumose hairs; this crenulate hinder portion of the edge forms a very obtuse angle with the lateral margin on each side. Uropods extending to level of apex of pleon; protopod with three setae on outer margin and with inner process very broad, extending to beyond middle of length of endopod, and with plumose hairs on posterior part of inner margin; exopod shorter than, and about two-thirds as wide as, endopod, the outer margin with two nicks, from each of which emanates a short spine; apex of endopod broadly, obliquely, and roundly truncate; postero-lateral and apical margins of both exo- and endopod furnished with long plumose hairs, intermixed with which are a few short inconspicuous spines. Peraeopods moderately slender, furnished with many long hairs and spines; outer distal part of merus of first pair a little forwardly produced; basos of seventh pair expanded, about two and one-half times longer than greatest width; the inner and apical margins of the ischium, merus, carpus, and propodus of the seventh peraeopods are set with clusters of strong spines, some of which are acute and others bluntly rounded apically; merus longer than carpus and about two-thirds as long as ischium. Outer ramus of first pair of pleopods longer and wider than inner branch.

Colour in alcohol.—White, marked with sparse black chromatophores arranged in transverse series, as shown in the accompanying figure.

Length, 8 mm.

Loc.—Western Australia: Cottesloe (type loc., W. Austr. Mus. Coll.). New South Wales: Broughton Islands, off Port Stephens (Austr. Mus. Coll.). Type, female, in W. Austr. Mus., Reg. No. 10789.

The number of articles in the flagella of the antennae is somewhat variable, and in immature specimens the first segment of the pleon is not at all concealed. According to Boone's figure of *C. hermitensis*, the first peraeon segment of that species is not much longer medianly than the other segments, as in *C. concinna;* the last-named species differs, however, in having very different antennae and in not having the frontal lamina "conspicuous with the anterior margin triangulate."

Neocirolana, n. gen.

Cephalon partly immersed in first peraeon segment. Eyes set widely apart. First antennae short, with the peduncle composed of two articles. Peduncle of second antennae consisting of five articles. Mandibles considerably narrowed towards the cutting edge, which is short and more or less distinctly tri- or quadridentate; palp three-jointed, the second article not very long; movable lacinia and molar part well developed, the first with stout and rather short spines and the last with triangular processes on anterior margin. Apex of outer lobe of first maxillae capped with many spines and that of inner lobe with three plumose spines. Maxillipeds with five-jointed palp; basipodite wide and not very elongate, the inner plate with two coupling spines. Frontal lamina distinct. Dactyli of all peraeopods bi-ungulate, there being a small claw on inner margin of dactylus near the base of the larger terminal claw. Pleon short, the lateral parts of fifth segment concealed by postero-lateral portions of preceding segment. Male appendage of second pleopods attached at base of inner ramus. Inner process of uropods well produced.

This genus is close to *Cirolana*, but differs in the narrower cutting part of the mandibles, in the bi-ungulate dactyli of the legs, etc.

Hansenolana[(10)] and *Conilorpheus*[(11)] of Stebbing differ in having the male appendage attached far from the base of the inner ramus of the second pleopods. *Pontogelos* of Stebbing[(12)] has the second joint of the mandibular palp very long, and the flagellum of the first antennae of "extraordinary length." *Pontogeloides* of Barnard[(13)] has but two articles in the palp of the mandibles, and *Gnatholana* of the same author[(14)] has no distinct frontal lamina.

The peraeopods of the type species of *Conilorpheus (C. herdmani)* are also apparently bi-ungulate, having "on the inner margin a small tooth or spine at the base of the short curved nail."

Neocirolana obesa, n. sp.

♂. Form oval, two and one-half times longer than greatest width. Surface with sparse and not very distinct punctures. Cephalon twice as wide as medial length; anterior margin somewhat conically rounded in outline and with a small, median, subtriangular process, not visible in dorsal view, arching downwards and backwards and meeting frontal lamina, thus completely separating the first pair of antennae. Eyes not very large, situate postero-laterally and widely separated.

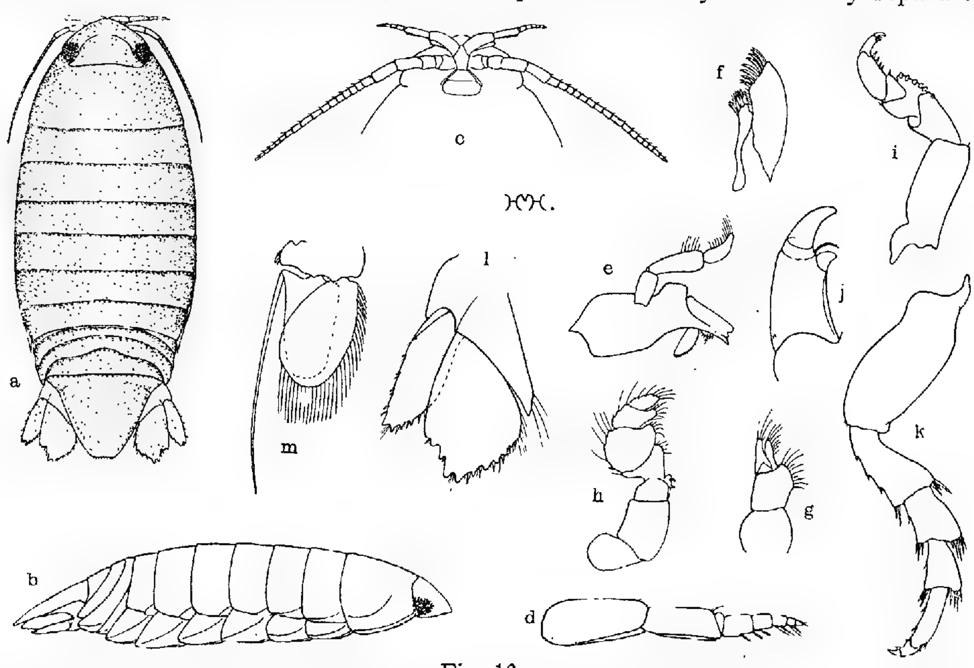

Fig. 13.

Neocirolana obesa, type male; a and b, dorsal and lateral views (6½ diams.); c, antennae, frontal lamina, clypeus and labrum (8 diams.); d, first antenna (30 diams.); e, mandible (30 diams.); f and g, first and second maxillae (30 diams.); h, maxilliped (30 diams.); i and k, first and seventh peraeopods (15 diams.); j, dactylus of first peraeopod (75 diams.); l, uropod (15 diams.); m, second pleopod (15 diams.).

(10) Stebb., Willey's Zool. Res., 1902, p. 634.

(11) Stebb., Herdman's Ceylon Pearl Fish., Suppl. Rep., xxiii., 1905, p. 13.

(12) Stebb., Trans. Linn. Soc., xiv., 1910, p. 97.

(13) Barn., Ann. S. Afr. Mus., x., 1914, p. 325*a*.

(14) Barn., *loc. cit.*, xvii., 1920, p. 352.

First antennae reaching almost to end of peduncle of second antennae; first article of two-jointed peduncle wider, and distinctly longer, than second; flagellum short, not as long as first article of peduncle, and composed of five articles and a terminal style; the first article is very short. Second antennae reaching well beyond hinder margin of first peraeon segment; second article of peduncle shorter than either first or third; fourth article almost as long as fifth and nearly as long as first three articles together; flagellum composed of sixteen articles and a terminal style. Frontal lamina nearly twice as long as wide, subpentagonal in shape. Clypeus shorter than labrum. Palp of mandibles stout, the first article almost as long as third, and more than half as long as second. Outer lobe of first maxillae capped with ten spines (all but two of which are denticulate) and one thinner spine, and with one simple, and several plumose, setae on distal part of interior margin; inner lobe with three plumose setae. Maxillipeds moderately wide, the basipodite about one-fourth longer than wide, and more than half as long as the five-jointed palp. First peraeon segment embracing base of cephalon, much longer than any of the others; second to sixth segments subequal in length, each longer than the seventh. Coxal plates each with a well-marked oblique furrow in addition to the submarginal furrow; plates of second and third segments obtusely rounded behind, not extending beyond posterior margins of their segments; remaining plates reaching a little beyond level of posterior angles of their respective segments. Whole of first pleon segment, and greater part of second, concealed beneath last peraeon segment; second segment wider, and fifth longer, than first, third, or fourth segments; telsonic segment wider than long, with the lateral margins slightly convex and converging to the truncate apex, which is crenulate and furnished with tiny spines. Inner process of protopod of uropods large, extending beyond middle of length of endopod; margins of rami with but sparse hairs; exopod barely half as wide as, and shorter than, endopod, with a row of small spines along outer margin (which is almost straight), with the apex sub-bifid, and with three serrations in the inner margin, each incision set with a spine; endopod with outer margin slightly and evenly convex for anterior two-thirds, thence incised, the incision further divided into two or three smaller serrations; intero-posterior margin serrate and apex sub-bifid; a spine emanates from most of the smaller marginal incisions. Peraeopods rather slender, the dactylus of each bi-ungulate; ischium of first pair with one blunt spine on inner margin near distal end, and merus with five blunt spines on inner margin; carpus with one, and propodus with four, acute spines on inner margin; ischium of second and third pairs with one or two strong, acute spines on outer apex and three blunt spines near distal end of inner margin; merus with two acute spines at outer apex and six blunt spines on inner margin, carpus with one or two, and propodus with three, spines on inner margin; last four pairs of peraeopods with many spines on distal margins of ischium, merus, carpus, and propodus, and a few on inner margins of these joints; basos of seventh pair more than twice as long as wide; merus longer than carpus and shorter than ischium. Outer branch of first pair of pleopods slightly longer than, and less than twice as wide as, inner ramus; male appendage of second pair long, acute, twice as long as the inner ramus.

Colour in alcohol.—Yellowish-white.

Length, 9 mm.

♀. Ovigerous. Form wider than in male, two and one-fourth times longer than greatest width. Head shorter, less conically rounded in front, more than twice as wide as medial length. Flagellum of first antennae composed of seven articles and a terminal style, that of second of twenty articles and a terminal style. Apex of telson rounded and scarcely subtruncate.

Length, 8·7 mm.

Loc.—New South Wales: Port Stephens and ? Port Jackson (Austr. Mus. Coll.). Type, male, and allotype, female, in Austr. Mus., Reg. Nos. P8203 and P8204.

Two separate series were taken from Port Stephens; the type specimens were secured in Nelson's Bay, in Port Stephens, in company with Sphaeromids, and with the others was a specimen of *Cirolana cranchii,* var. *australiense.* The tube of a *Spirorbis* is firmly attached to the left uropod of one of the examples thought to have been obtained at Port Jackson.

In a young example removed from the marsupium of the allotype, the apex of the telson is obtusely angular, while the rami of the uropods are not conspicuously serrate as in the adult, and are apically subtruncate and not sub-bifid; the second antennal flagellum of this specimen consists of but nine articles and a terminal style.

The length of the antennae, and the number of articles in their flagella, varies somewhat in the adult; the second antennae may reach only to level of posterior margin of the first peraeon segment, or extend to slightly beyond hinder margin of second segment. In a male 8 mm. in length the flagellum of the first antennae is seven-jointed, and that of the second is twenty-jointed. In a few examples only a small postero-lateral portion of the second pleon segment is visible, and in one male there are but two spines on the apex of the inner lobe of the first maxilla of one side.

This species resembles the much smaller *Cirolana excisa,* Rich.,[15] but differs in having the flagellum of the second antennae shorter and composed of fewer articles, the first peraeon segment longer, and the telson more narrowed posteriorly. In *C. excisa* the peduncle of the first antennae is three-jointed.

EXCIROLANA, Richardson.

Excirolana, Rich., Proc. U.S. Nat. Mus., xliii., 1913, p. 201.

The following characters are given in Richardson's diagnosis of this distinct genus. The middle of the front of the cephalon is produced in a prominent and anteriorly dilated process, which separates the antennae. The sides of the fifth pleon segment are not covered by the lateral parts of the fourth segment. The uropods and apical part of the telson are provided with long plumose hairs, but the outer margin of the exopod of the former is always naked. The pleopods have both rami long and slender. Mouth parts as in *Cirolana.*

EXCIROLANA ORIENTALIS, Dana.

Cirolana orientalis, Dana, U.S. Expl. Exped., Crust., xiv., 1853, p. 773, pl. li., fig. 7; Hansen, K.D. Vid. Selsk. Skr. (6), iii., 1890, p. 353, pl. iv., fig. 4; Stebb., Willey's Zool. Res., 1902, p. 633; Rich., Wash. Bur. of Fish., Doc. No. 736, 1910, p. 4.

Excirolana orientalis, Rich., Proc. U.S. Nat. Mus., xliii., 1913, p. 201.

♀. Form oval, two and one half times longer than greatest width. Surface finely and rather sparsely punctate. Cephalon much wider than medial length including frontal process, which is apically truncate. Eyes dorso-lateral, widely separated. First antennae reaching to hinder margin of first peraeon segment; third article of peduncle shorter than first or second, which are subequal in length; flagellum composed of sixteen articles, the first very short. Second antennae reaching almost to hind margin of fourth peraeon segment; last article of peduncle about one-third longer than penultimate; flagellum composed of twenty-two articles. Frontal lamina large, in form of an inverted triangle, with apex beneath extreme anterior apex of clypeus. Outer lobe of first maxillae capped with ten

(15) Rich., Wash. Bur. of Fish. Doc. No. 736, 1910, p. 6, fig. 4.

spines, most of which are denticulate; inner lobe with three plumose spines. Basipodite of maxillipeds as long as first three articles of palp together. First, fifth, and sixth peraeon segments subequal in length, a little longer than any of the other segments, which are subequal in length. Coxal plates each with a well-marked oblique furrow; plates of second and third segments subquadrate, not reaching beyond posterior angles of their segments; remaining plates subtriangular, reaching beyond hinder angles of their respective segments, those of seventh segment extending to middle of length of lateral margin of fourth pleon segment. Greater part of first pleon segment concealed beneath last peraeon segment; second segment a little longer than third, which is slightly longer than fourth; fifth distinctly longer than fourth segment; telsonic segment subtriangular, with sides rounded; dorsum with a pair of large foveae near base; apex with two short spines. Uropods reaching beyond apex of pleon, protopod with a spine at middle of outer margin and two marginal spines on ventral side near outer posterior angle; inner process reaching to about level of middle of length of endopod, with plumose hairs on inner margin; endopod shorter than, and more than half as wide again as, exopod, with outer edge emarginate; intero-posterior margins of endopod and inner margin of exopod provided with a row of short,

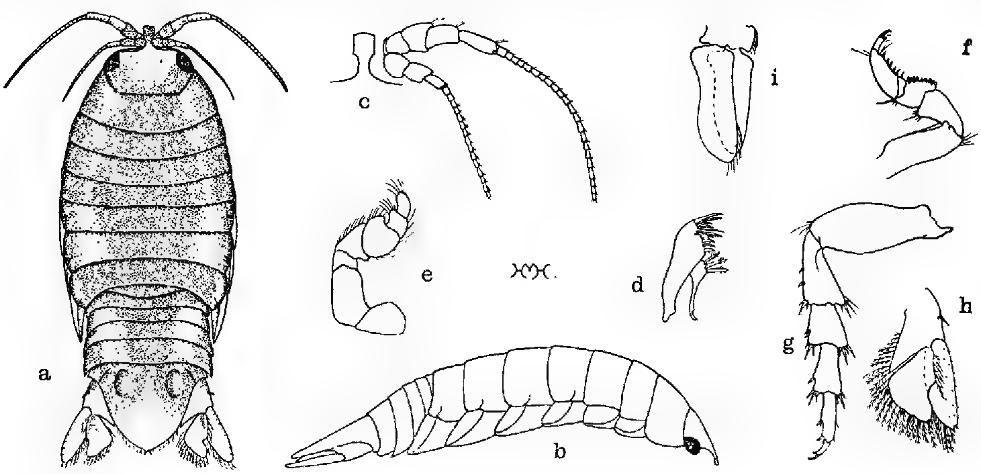

Fig. 14.

Excirolana orientalis, female; a and b, dorsal and lateral views (5 diams.); c, dorsal view of frontal process of cephalon and antennae (9½ diams.); d, first maxilla (14 diams.); e, maxilliped (14 diams.); f and g, first and seventh peraeopods (9½ diams.); h, uropod (9½ diams.); i, second pleopod (9½ diams.).

stout spines in addition to the plumose hairs; exopod suboval, narrowly truncate apically, dotted with tiny spinules towards and on outer margin. Dactyli of peraeopods bi-ungulate; first peraeopods with six blunt and three acute spines on inner margin of merus, one acute spine on inner margin of carpus and five on that of propodus; basos of seventh peraeopods not greatly expanded; ischium three-fourths as long again as merus, which is subequal in length to carpus.

Colour in alcohol.—Dorsum yellowish, with a broad median brown marking and a narrower lateral brown stripe; anterior part of head and posterior part of telson yellowish.

Length, 11 mm.

Loc.—Queensland: Bowen, Port Denison (E. H. Rainford).

Hab.—Nicobar Islands, Malay Archipelago, New Guinea, Isle of Pines, and North-eastern Australia.

The female described above, and three immature examples, were taken with a hand-net from a patch of weed in 3 feet of water at low tide. Richardson says that the species is "Very ravenous, attacking small fishes, first devouring eyes, then gills, then working into body cavity—all of this is done inside of ten minutes."

The salient features of *E. orientalis* are the two conspicuous pits on the dorsum of the telson, and the emargination of the outer edge of the endopod of the uropods.

Phoratopodidae, n. fam.

Both pairs of antennae with the peduncle large and expanded, and with the flagellum short; first antennae not shorter than second. Mandibles with the distal part conspicuous, the cutting edges moderately wide, trifid, or quadridentate, meeting behind the large labrum; movable lacinia large, attaining greater development in mandible of left side than in that of right; molar process tiny. Outer lobe of first maxillae wide, capped with many spines; inner lobe with four plumose spines. Second maxillae of moderate size, the three plates very setose. Maxillipeds with the palp free, five-jointed, broad and setose; basipodite not elongate, the inner plate with two coupling spines. Peraeon semicylindrical in form. Coxal plates well defined on second to seventh segments, the first five pairs very large and the last abruptly smaller. First pair of peraeopods subchelate, and second and third pairs imperfectly subchelate; fourth, fifth, and sixth pairs with merus, carpus, and propodus greatly expanded and flattened; seventh peraeopods much less expanded; dactylus rudimentary or absent in fourth to seventh peraeopods. Pleon composed of six distinct segments. Pleopods well developed. Uropoda large, lateral, forming a caudal fan with the telsonic segment.

This family approaches the Eurydicidae in the form of the mouth parts, but the molar process is small. In other respects it is totally dissimilar, the great development of the coxal plates of the second to sixth peraeon segments, and the curious modification of the posterior peraeopods being very distinctive. The first pair of peraeopods are subchelate in the genotype of the Eurydicid genus *Hansenolana*, but there the other peraeopods are normal.

Phoratopus, n. gen.

The only genus of the family is represented by a single species.

Phoratopus remex, n. sp.

♀. Form suboval, with sides of peraeon subparallel, more than twice as long as wide. Surface almost smooth. Cephalon immersed in first peraeon segment, rather more than half as wide again as medianly long; anterior margin sinuate, with a median subtriangular process separating the bases of the first articles of the first antennae. Eyes apparently absent. First antennae not reaching to hinder margin of first peraeon segment, slightly longer than second pair; peduncle four-jointed, the margins of the articles furnished with long plumose hairs; first article greatly expanded, not much longer than wide, and about one-third longer and slightly wider than second; third article as long, but only half as wide, as second; fourth short, almost as wide, but only about one-fourth as long, as third article; flagellum composed of six articles and a small, rounded, terminal style, immersed in the sixth article, which is abruptly smaller than the others. Peduncle of second antennae five-jointed; first article short and inconspicuous; second greatly expanded, almost as long as wide, with plumose hairs on anterior margin; third article about three-fourths as wide as, and slightly longer than, second, with long hairs on distal half of anterior margin and near posterior distal angle; fourth article as wide, and half as long, as third, with long plumose hairs on posterior margin and distal part of anterior margin; fifth article nearly as long, but only half as wide, as second, with long plumose hairs on posterior margin and distal part of anterior margin; flagellum consisting of five articles and a very short, apically truncate, terminal style; a tuft of long hairs emanates from the antero-distal margin of each article and from apex of style. Clypeus rather short, strongly keeled. Labrum large and conspicuous, less than twice as wide as long. Mandibles with cutting edge tridentate or quadridentate; palp stout, the first article shorter than the third, which is a little more than half as long as second article; movable lacinia of left mandible highly chitinized and hard, with anterior margin tridentate (obscurely quadridentate); that of right mandible much thinner and less chitinized, with anterior margin feebly and

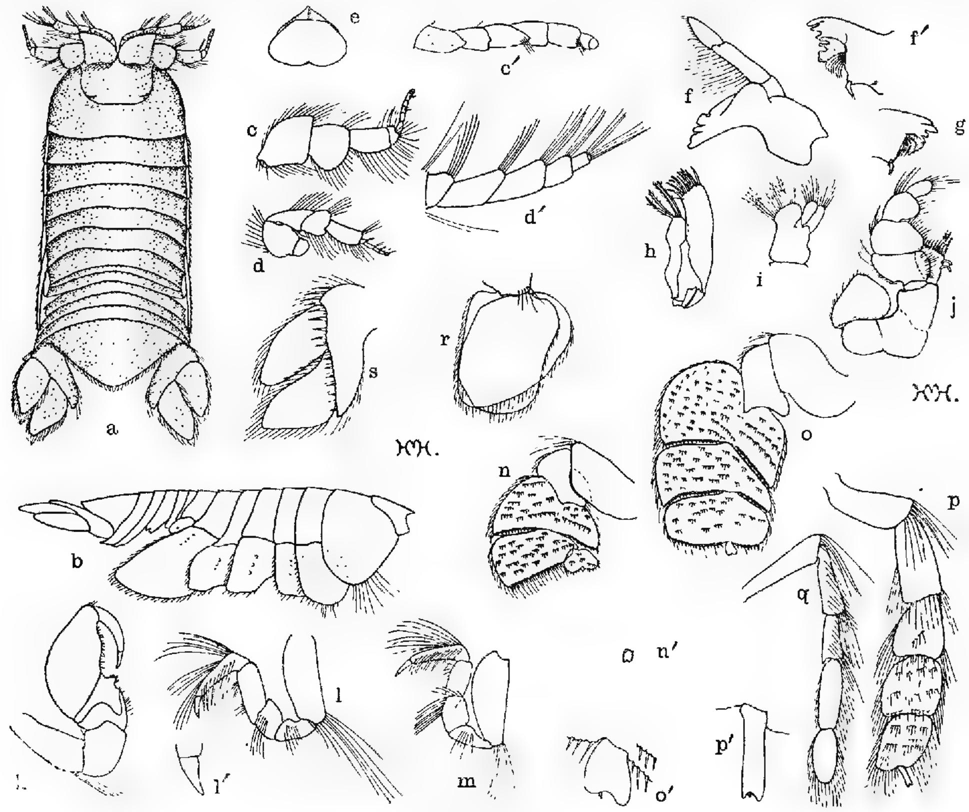

Fig. 15.

Phoratopus remex, type female; a and b, dorsal and lateral views (2 diams.); c and d, first and second antennae (4 diams.); c^1 and d^1, flagellum of first and second antennae (15 diams.); e, clypeus and labrum (4½ diams.); f, left mandible (6 diams.); f^1, ventral view of anterior part of left mandible (6 diams.); g, ventral view of anterior part of right mandible (6 diams.); h and i, first and second maxillae (8 diams.); j, maxilliped (8 diams.); k to q, first to seventh peraeopods (4 diams.); l^1, claw of second peraeopod (32 diams.); n^1, o^1, and p^1, dactylus of fourth, fifth and sixth peraeopods respectively (15 diams.); r, second pleopod (4 diams.); s, uropod (4 diams.).

irregularly serrate, both laciniae with strong spines; molar process rudimentary, apically bidentate. Outer lobe of first maxillae capped with eleven simple spines and one thinner spine; inner lobe with four long plumose spines. Maxillipeds with basipodite stout, the inner plate bearing two coupling hooks and having the truncate apex furnished with nine spines and some plumose hairs; first article of palp very short, second and third subequal in length, each much wider than long; fourth shorter and narrower than third, and fifth shorter and narrower than fourth. First peraeon segment longer than any of the others, which are more or less subequal in length. Coxal plates without submarginal or oblique furrows, smooth excepting for a few shallow grooves and pits, the first five pairs greatly enlarged; plates of second to fourth segments not or scarcely passing beyond posterior angles of their segments and those of fifth segment reaching beyond level of hinder margin of their segment; plates of sixth segment larger than any of the others, reaching back to level of posterior angles of fourth pleon segment; plates of seventh segment small and comparatively inconspicuous. First pleon segment slightly shorter and narrower than second, which is subequal in length to third to fifth segments; lateral parts of fourth and fifth segments produced, the sides of the fifth not covered by preceding segment; lateral parts of third segment broken; telsonic segment subtriangular, twice as wide as medianly long, the lateral margins furnished with short hairs. Protopod of uropods large, the outer margin with a few strong spines and long hairs, the outer posterior margin with some rather slender setae and spines dorsally and with stronger spines and setae ventrally; inner process well produced, reaching beyond level of apex of pleon, the distal part of the inner margin with long plumose hairs; rami of uropods broad, subequal in length, subacutely rounded apically, the inner side of endopod very obliquely truncate. First pair of peraeopods subchelate, the dactylus provided with a curved claw and folding back on to the bristle-set inner edge of the enlarged, suboval propodus; posterior distal angle of basos with a tuft of long hairs. Dactylus of second and third peraeopods much shorter than in first, but with distinct claw; joints of these peraeopods furnished with various tufts of hairs and propodus with conspicuous, hair-like sensory organs, each of which narrows abruptly towards its apex, which is rounded. Last four pairs of peraeopods more or less expanded and flattened. Merus, carpus, and propodus of fourth pair greatly expanded, each about twice as wide as long, with the margins provided with plumose hairs and some spines and with dorsum furnished with numerous groups of small adpressed spines; posterior margin of merus fitting over anterior margin of carpus, the dorso-posterior margin set with a row of short stout spines; propodus articulating near inner posterior angle of carpus, abruptly smaller than carpus; dactylus very small, obcordate, without claw. Merus, carpus, and propodus of fifth peraeopods of same character as in fourth pair, but the propodus is almost as large as the carpus; dactylus rudimentary, somewhat obcordate, with a minute claw. Sixth peraeopods much less expanded than fourth or fifth, but with longer marginal hairs and with the spines on the dorsum of merus, carpus, and propodus longer, sparser, and more slender; dactylus tiny, elongate, parallel-sided, the apex incised, and bearing a minute claw. Seventh peraeopods slender, much less expanded than sixth, with long marginal hairs; propodus oval and dactylus completely aborted. Pleopods with both rami membranaceous, the outer a little wider than inner.

Colour completely bleached.

Length, 20·5 mm.

Loc.—South Australia: Encounter Bay (Dr. R. H. Pulleine). Type in S. Austr. Mus., Reg. No. C302.

Only a single, non-ovigerous female was secured by Dr. Pulleine in 1886, in company with *Cirolana vieta.* The specimen is somewhat damaged, and after long preservation in methylated spirit has become soft and brittle.

Family CORALLANIDAE.

The distal half of the mandibles is narrow, directed inwards and hidden under the lips; the movable lacinia is small or vanishing and the molar process is often rudimentary, but may be well developed. The outer lobe of the first maxillae tapers towards the apex, which is armed with tiny spines, or with a few large spines, and, sometimes, a few small inconspicuous spines also. The apex of the second maxillae is not furnished with spines, but sometimes a few setae are present.

KEY TO AUSTRALIAN GENERA.

a. Outer lobe of first maxillae ending in two spines (or unciform teeth). Molar process of mandibles wanting .. .. *Alcirona*
aa. Apex of outer lobe of first maxillae without large spines, or with only one large spine. Molar process of mandibles developed.
b. Outer lobe of first maxillae ending in a sharp, curved unguis, at base of which are a few small hooked spines. Peduncles of first pair of antennae two-jointed .. .. *Argathona*
bb. Outer lobe of first maxillae furnished with tiny hooked spines at distal end, but without large claw. Peduncle of first pair of antennae three-jointed .. .. *Smicrostoma*

ALCIRONA, Hansen.

Alcirona, Hansen, K.D. Vid. Selsk. Skr. (6), v., 1893, pp. 285, 313, and 391; Stebb., Hist. Crust., 1893, p. 346; Rich., Bull. U.S. Nat. Mus., No. liv., 1905, p. 157.

ALCIRONA MULTIDIGITATA, Miers.

Cirolana multidigitata, Miers, Journ. Linn. Soc., Zool., xiii., 1878, p. 511, pl. xxiv., figs. 6 11.

Alcirona multidigitata, Stebb., Willey's Zool. Res., 1902, p. 637.

Stebbing *(ut supra)* says that the species "named *Aega multidigita* by Dana, and that named *Cirolana multidigitata* by Miers," should apparently be referred to *Alcirona.* I have seen no specimens of the species.

Hab.—Philippine Islands and Western Australia *(fide* Miers).

ARGATHONA, Stebbing.

Argathona, Stebb., Herdman's Ceylon Pearl Fish., Suppl. Rep., xxiii., 1905, p. 17, and Trans. Linn. Soc., xiv., 1910, p. 99, and Rec. Ind. Mus., vi., 1911, p. 179.

Brotherus, Budde-Lund, Voeltzkow's Reise in Ostafrika, ii., 1908, p. 306.

Stebbing erects a family for the reception of this genus and cites the following distinguishing characters:—"Mandibles with cutting edge bidentate or simple; molar represented by a feeble blade, not serrate. First maxillae with inner plate broadly truncate, outer strongly produced, ending in an unguis with a small curved spine at its base. Second maxillae very short, ending in a broadly rounded single lobe. Maxillipeds six-jointed, second joint not elongate, fourth and fifth joints fused together, seventh well developed, blunt. Male appendix of second pleopods affixed at the base of the ramus."

In 1910 Stebbing somewhat expands the limitations of the family to include a second species *(A. reidi)* in which the palp of the maxilliped is composed of five distinct articles. In the same year Richardson,[16] in dealing with some Isopods from the Philippine Islands, describes three new species of *Argathona.* Under one of these *(A. setosa)* she remarks:—"I have placed this species in Stebbing's genus *Argathona,* notwithstanding the slight difference in the form of the second maxilla, which, instead of ending in a curved, sharp unguis, seems to end bluntly. There is also an additional article to the maxillipeds, but this may have been overlooked in Stebbing's specimen." A year later Stebbing notes that *Brotherus,* of Budde-Lund, "is not distinguishable from *Argathona* . . . unless the fusion of the fourth and fifth joints of the maxillipeds of *Argathona normani* suffices to distinguish that type species generically from *Brotherus longi-*

(16) Rich., Wash. Bur. of Fish., Doc. No. 736, 1910, pp. 9-11.

cornis . . . and *Argathona reidi* . . . in which there is no such fusion." Budde-Lund places *Brotherus* in the family Alcironidae (Corallanidae).

The genera placed in the family Corallanidae differ considerably in the form of the mouth parts; in fact, similar relative differences to those separating the Argathonidae from the Corallanidae have been regarded as of only generic importance in the last-named family. Thus, it will be convenient to include *Argathona* in the Corallanidae, unless some of the genera at present placed in this family are to be accommodated with new families.

Argathona differs from *Lanocira* of Hansen in having one or more small hooked spines at the base of the terminal unguis of the first maxillae, and in having the apical article of the second maxillae broadly rounded instead of sublinear or elongate. Apparently all the species have the first and second articles of the peduncle of the first antennae fused together, as in *Exocorallana, Alcirona,* etc. The genus has not been hitherto noted in Australian waters.

Key to Australian Species.

a. Second antennae reaching back beyond hinder margins of penultimate peraeon segment. Articles of peduncle of first antennae subequal in length .. .. *similis*

aa. Second antennae reaching back scarcely beyond middle of length of peraeon. First article of peduncle of first antennae much longer than second .. .. *confine*

Argathona similis, Richardson.

Argathona similis, Rich., Wash. Bur. of Fish., Doc. No. 736, 1910, p. 11, fig. 10.

♀. Form suboval, about two and one-half times longer than greatest width. Dorsal surface distinctly punctate and with a few short setae near lateral margins of peraeon. Cephalon two and one-half times wider than medial length; anterior margin rounded, slightly conical, with a small, median, subtriangular process, downbent, but not separating the first pair of antennae. Eyes large, the interocular space about equal to the length of an eye. First antennae extending to beyond end of fourth peduncular article of second antennae; peduncle two-jointed, the first article scarcely longer than the second; flagellum composed of twenty articles and a terminal style, the first article being very short and the second longer than any of the others. Second antennae with long flagellum, which extends beyond level of apices of coxal plates of seventh peraeon segment; first three peduncular articles short, the second the shortest; fourth about three-fourths as long as fifth article; flagellum composed of fifty articles and a terminal style. Frontal lamina not very elongate, twice as long as greatest width, a little dilated anteriorly and with anterior margin subangularly rounded. Clypeus broadly Λ-shaped. Mandibles elongate; molar process feeble, transparent; first article of palp more than half as long as second, and longer than third article. Outer lobe of first maxillae terminating in a strong claw, at the inner side of the base of which is a small hooked spine; inner lobe apically subtruncate. Second maxillae short, ending in a broadly rounded lobe. Basipodite of maxillipeds as wide as long, a little shorter than first three articles of palp together; the division between the second and third articles of the five-jointed palp is very indistinct. First peraeon segment embracing base of cephalon; first, third, and fourth segments subequal in length, longer than second, fifth, and six segments, which are subequal in length; seventh segment a little shorter than sixth. All coxal plates prominent in dorsal view, each with a very distinct, obliquely-curved furrow in addition to the usual submarginal furrow; plates of second and third segments roundly subrectangular, not extending past level of posterior margins of segments; remaining plates subacute posteriorly, reaching beyond hinder margins of their segments. First pleon segment short, concealed beneath last peraeon segment; fifth longer than second, third, or fourth segments, which are subequal in length; postero-lateral angles of first three segments subacute, those of fourth concavely truncate; fifth segment narrower than, and with the rounded postero-lateral angles not wholly covered by, fourth segment; telsonic segment more than one-third wider than medial length, with lateral margins sinuately converging to the subacutely rounded apex; dorsal surface punctate, with indications of short stout hairs, and with an obsolete, longitudinal, median carina; basal part rather prominently tumid, the tumidity divided into three parts by a longitudinal furrow on each side of the mid-line; posterior half of lateral margins furnished with hairs, and apex with six short, stout spines also. Uropods extending beyond level of apex of pleon; inner process of protopod reaching to middle of length of endopod, which is rounded posteriorly, almost straight on outer edge, and is about same length but twice as wide as exopod; margins of both branches furnished with hairs, intermixed with which are short spines. Peraeopods moder-

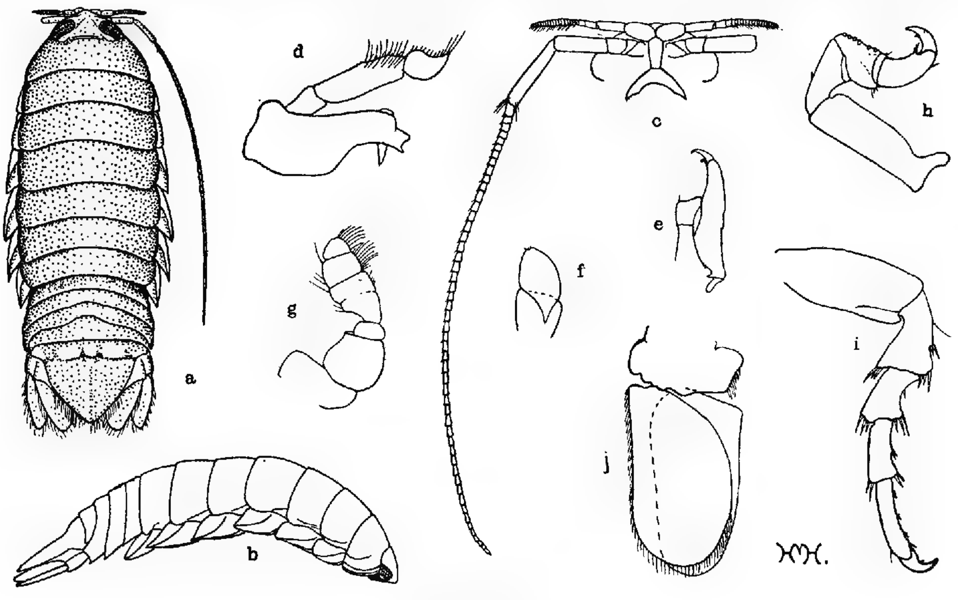

Fig. 16.

Argathona similis, female; a and b, dorsal and lateral views ($2\frac{1}{2}$ diams.); c, antennae, frontal lamina and clypeus (4 diams.); d, mandible (14 diams.); e and f, first and second maxillae (14 diams.); g, maxilliped (14 diams.); h and i, first and fourth peraeopods (7 diams.); j, first pleopod (7 diams.).

ately stout; dactyli bi-ungulate, the inner claw minute; merus of first pair with six short, stout spines on inner margin and three slender spines at outer distal angle, and carpus with one minute spine on inner edge; ambulatory peraeopods with strong spines on distal and inner margins of third to sixth joints; ischium, merus, and carpus of seventh peraeopods subequal in length. Rami of first pair of pleopods wide, the inner ramus slightly longer and narrower than outer branch.

Colour in alcohol.—Dark brown.

Length, 21 mm.

Loc.—South Australia: Glenelg (W. H. Baker). Western Australia: Garden Island (W. Austr. Mus. Coll.).

Hab.—Celebes (Richardson) and Australia.

The example described above was taken in June, 1907, from amongst weeds attached to a pile at Glenelg. It is somewhat mutilated, and the clothing of the telson is abraded; the telsonic segment is relatively wider than in the single male examined by Richardson.

Another female, 18·5 mm. in length (taken in Western Australian waters), is narrower in form, being three times longer than greatest width. The telsonic segment is in close agreement with that of the type, being narrower than in the larger female; excepting on the obsolete median carina, the telson is clothed with short adpressed hairs. The hinder margins of the second to fifth pleon segments, and of the posterior peraeon segments, are sparsely furnished with hairs. The second antennal flagella reach to level of apices of coxal plates of sixth peraeon segment, and each is composed of forty articles in addition to the tiny terminal style. The mouth parts are as in the larger example, excepting that no trace of suture is discernible between the second and third articles of the palp of the maxilliped, which thus consists of but six distinct articles. The six spines on the inner edge of the first peraeopods are exactly similar, two near the distal end being separated from four on the posterior half. The colour is dark purplish-brown, with the telson, uropods, and peraeopods pale brown.

Argathona confine, n. sp.

♀. Ovigerous. Form narrowly suboval, three and one-third times longer than greatest width. Dorsal surface punctate. Cephalon two and one-half times as wide as medial length, dorsally clothed with short upright hairs; anterior margin with a median, subtriangular process, partly separating the first pair of antennae, and almost meeting frontal lamina. Eyes set well apart. First antennae reaching to end of fourth peduncular article of second antennae; peduncle two-jointed, the first article nearly twice as long as second; flagellum about same length as peduncle, composed of ten articles and a terminal style; the first article is very short but is wider than any of the others, being almost as wide as the last peduncular article; second article longest. Second antennae reaching to middle of length of fourth peraeon segment; first three peduncular articles short, subequal in length, and together equal in length to fourth article, which is six-sevenths as long as fifth article; flagellum composed of twenty-eight articles and a terminal style. Frontal lamina pentagonal, the posterior margin somewhat incised. Clypeus broadly Λ-shaped. Mandibles elongate; molar process represented by a transparent feeble blade; first article of palp subequal in length to third, and scarcely more than one-half as long as second article. Outer lobe of first maxillae terminating in a strong claw, at the inner side of base of which are three hooked spines, one being almost half as long as the claw; inner lobe apically truncate. Second maxillae shorter than first pair, with apex simple. Palp of maxillipeds five-jointed on one side, abnormal and but three-jointed on the other. Dorsum of peraeon and of visible segments of pleon clothed with upstanding hairs, which are denser on hinder margins of segments, on whole of first peraeon segment and on telson. First peraeon segment not embracing base of cephalon; first, third, fourth, fifth, and sixth segments subequal in length, each longer than the second, which is a little longer than seventh segment. Coxal plates each with a distinct oblique or curved furrow in addition to the submarginal furrow; plates of second and third segments subrectangular, rounded behind, not extending beyond level of hinder margins of segments; remaining plates subacute posteriorly, reaching beyond hinder margins of their segments, the last pair extending to hinder margin of second pleon segment. First pleon segment smooth, almost wholly concealed beneath last peraeon segment; fifth segment longer but narrower than fourth, the postero-lateral parts of which partly cover lateral portions of fifth segment; telsonic segment more than one-third wider than medial length, with lateral margins sinuately converging to the narrowly rounded apex. Uropods reaching to slightly beyond apex of pleon; protopod with two spines near outer posterior angle and with inner process extending to about middle of length of endopod; exopod suboval in shape, shorter than and scarcely more than half as wide as endopod, which is also suboval in shape, obscurely, obliquely truncate posteriorly; margins of both branches furnished with plumose hairs and short spines. Peraeopods moderately stout, with dactyli bi-ungulate, there being a tiny claw at the base of the larger one; ischium of first peraeopods with two stout, short spines near the distal end of inner margin, merus with seven short spines on inner margin and one (more slender) at outer apex, carpus with one, and propodus with four, sharp spines on inner margin; ambulatory legs with strong spines on inner and distal margins of third to sixth joints; some of the spines on the distal margin of carpus are branched, the remainder are simple; basos of seventh pair not greatly expanded; merus as long as carpus and two-thirds as long as ischium. Outer ramus of first pair of pleopods a little wider and shorter than inner branch.

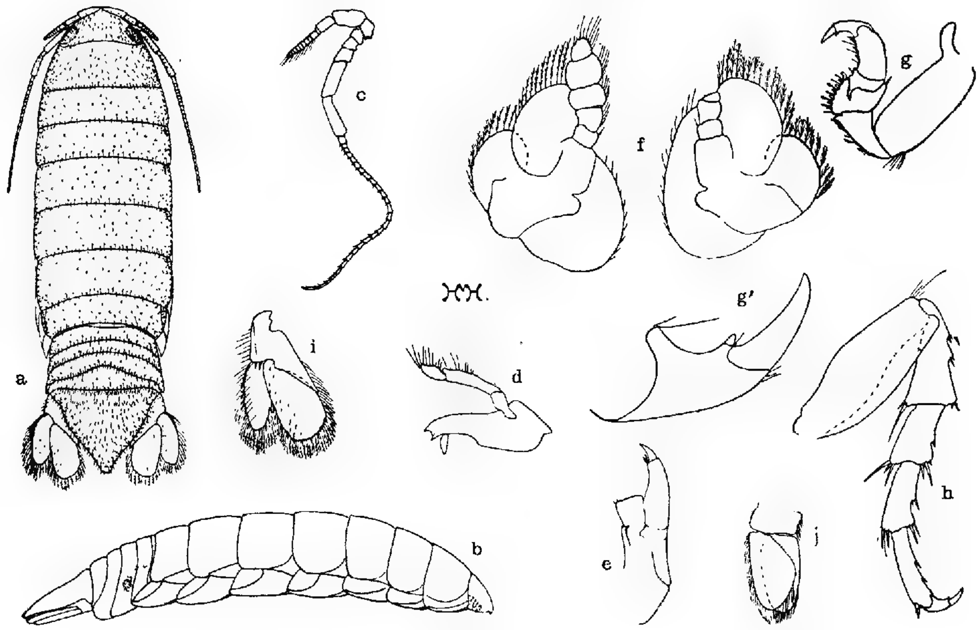

Fig. 17.

Argathona confine, type female; a and b, dorsal and lateral views (5 diams.); c, frontal lamina and antennae (7 diams.); d, mandible (14 diams.); e, first maxilla (29 diams.); f, maxillipeds (29 diams.); g and h, first and seventh peraeopods (14 diams.); g[1], dactylus of first peraeopod (73 diams.); i, uropod (7 diams.); j, first pleopod (7 diams.).

Colour in alcohol.—Pale yellow.

Length, 11·5 mm.

Loc.—Queensland: Albany Passage (Austr. Mus. Col.). Type, female, in Austr. Mus., Reg. No. 8205.

A single female, with the exoskeleton in a rather soft state, is before me; this specimen was taken in a *Comatula* in company with *Cirolana lineata*.

A. confine differs from *A. similis* in the smaller size, narrower form, less elongate frontal lamina, shorter second antennae, in the shape of the branches of the uropods, in not having the coxal plates so completely visible in dorsal view, etc. In some respects it is very close to the genotype *(A. normani)*, but differs in the much more elongate form, in the absence of tubercles on the peraeon and pleon, in having seven instead of only four spines on the inner edge of the merus of the first peraeopods, in the five-jointed palp of the maxillipeds, and in having the uropods of slightly different shape, with the inner process of the protopod less produced; as shown in Stebbing's figure, this process reaches to two-thirds of the length of the endopod in *A. normani.* When more specimens are available it is possible, however, that these differences may prove to be sexual. Stebbing examined apparently two males of *A. normani,* for at the end of his description he gives measurements of two examples.

The small Corallanid doubtfully referred to *Alcirona multidigitata* by Miers *(Cirolana multidigitata,* Miers) was also taken near Albany Island.(17)

Smicrostoma, n. gen.

Peduncle of first pair of antennae composed of three articles, that of second pair of five. Molar process of mandibles well developed. Outer plate of first maxillae slender, curved, and tapering, the inner side furnished with minute hooks at distal end; second maxillae elongate, much stouter than first pair, the apical article conical, closely beset with tiny downbent spinules. Maxillipeds rather elongate, with five-jointed palp, the third article of which is about as long as wide; inner plate of basipodite very elongate, as long as the palp and not furnished with hooks. Clypeus short and wide, ∧-shaped. Labrum small.

Type, *S. saxicola,* n. sp.

The very long inner plate of the basipodite of the maxillipeds distinguishes this from all other genera of the family. In some respects *Smicrostoma* approaches *Tridentella,* Richardson,(18) (species of which are known from North America and Japan), but the maxillae and maxillipeds are totally dissimilar.

Smicrostoma saxicola, n. sp.

♂. Form broadly oval, about two and one-third times longer than greatest width. Surface faintly punctate and granulate. Cephalon more than twice as wide as medial length, anteriorly produced forwards over and beyond the insertion of the antennae; antero-lateral margins slightly concave, converging to the rather narrowly rounded apex, which is slightly upturned; dorsal surface with a pair of prominent, well separated tubercles on basal part; on underside of cephalon a subtriangular process from anterior part is directed backwards between the basal joints of the first antennae and meets the anterior margin of the frontal lamina. Eyes moderately large, well separated, situate at the antero-lateral portions of head. Peduncle of first pair of antennae extending to end of fourth article of peduncle of second pair; first two articles of equal length, together a little longer than third article; flagellum short, as long as last two articles of peduncle together, reaching beyond end of peduncle of second antennae and composed of nine articles. First three articles of peduncle of second antennae together equal in length to fourth, which is slightly shorter than fifth; second article much shorter than first or third; flagellum longer than peduncle, extending to a little beyond hinder margin of second peraeon segment; composed of eighteen articles and a terminal style. Frontal lamina pentagonal, longer than greatest width, the postero-lateral margins longer than any of the others. Clypeus ∧-shaped. Labrum projecting outwards and slightly backwards. Palp of mandibles stout, the first article one-half as long as the second. First peraeon segment not quite twice as long as second to sixth segments, and twice as long as the seventh. Coxal plates each with an oblique furrow in addition to the submarginal furrow;

(17) Miers, Zool. "Alert," 1884, p. 301.

(18) Rich., Bull. U.S. Nat. Mus., liv., 1905, p. 161.

plates of second and third segments subrectangular, with obtusely rounded posterior angles, not extending past hinder margins of segments; last four pairs of coxal plates successively increasing in length backwards, and with posterior angles successively more subacute; the last pair reach past posterior angles of second pleon segment. Pleon ornamented with small and obscure tubercles, which are most distinct on telsonic segment; greater part of first segment concealed beneath last peraeon segment, leaving exposed part of middle of hinder margin and a small postero-lateral portion on each side; second, third, fourth, and fifth segments subequal in length, the fourth wider than any of the others, and laterally covering sides of fifth segment; telsonic segment broad, nearly half as wide again as medial length; lateral margins roundly converging to apex, which is slightly subtruncate and crenulate; with a low, median, longitudinal carina, on each side of which is a broader and much more prominent carina. Uropods reaching to end of pleon; protopod produced to beyond first third of length of endopod, which is longer than, and more than twice as wide as, exopod; endopod widest at posterior

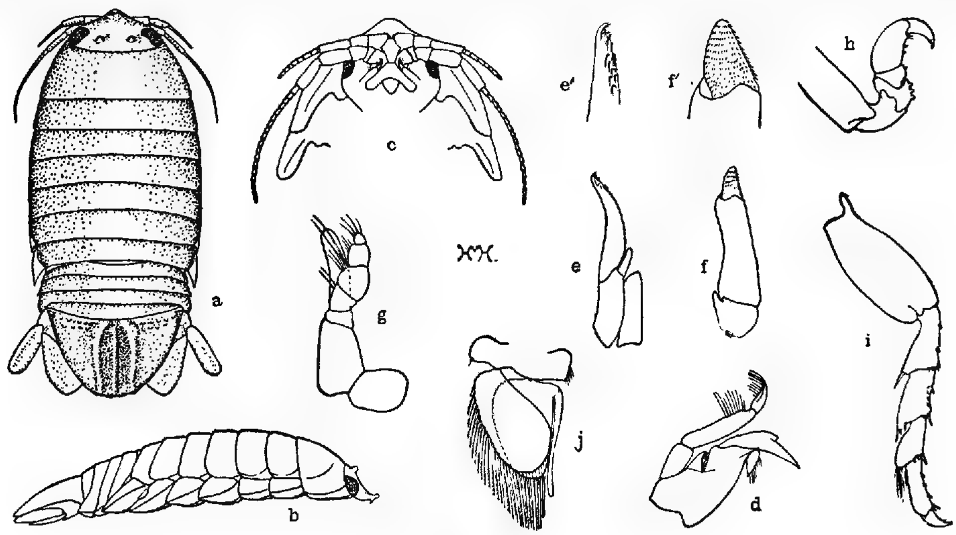

Fig. 18.

Smicrostoma saxicola, type male; a and b, dorsal and lateral views (7 diams.); c, antennae, frontal lamina, clypeus and labrum (9 diams.); d, mandible (29 diams.); e and f, first and second maxillae (29 diams.); e^1 and f^1, apices of maxillae (73 diams.); g, maxilliped (29 diams.); h and i, first and seventh peraeopods (14½ diams.); j, second pleopod (14½ diams.).

fourth, posteriorly subacute, and with margins crenulate; exopod elongate suboval, with posterior and postero-lateral margins crenulate. Peraeopods stout, none of them greatly expanded. Pleopods wide, the male appendage of second pair one-fifth longer than inner ramus.

Colour in alcohol.—Yellow, in parts faintly mottled with brown.

Length, 7·25 mm.

♀. Cephalon not forwardly produced, with antero-lateral margins convex; middle of anterior margin with a small subtriangular process, bent downwards and backwards to meet anterior margin of frontal lamina; surface without two prominent tubercles (although there are three small and very obscure elevations in line at the posterior part of cephalon). Flagellum of second antennae composed of nineteen articles, extending to middle of length of fourth peraeon segment. Almost whole of first segment of pleon concealed beneath last peraeon segment, only a very tiny postero-lateral portion being visible.

Length, 7·25 mm.

Loc.—New South Wales: East of Ulladulla, lat. 35° 20′ S., long. 150° 47′ E., 75 fms. (type loc., C. W. Mulvey); off Bateman's Bay, lat. 30° 47′ 30″ S., long. 150° 34′ E., 80 fms. (Capt. J. Fordar). Type, male, and allotype, female, in Austr. Mus., Reg. Nos. P8206 and P8207.

Several specimens were secured by Mr. Mulvey; they were found "burrowing in a conglomerate boulder taken by the trawler 'Goonambee,'" and from the same boulder Sphaeromids, *Cirolana cranchii*, var. *australiense,* and an Amphipod were collected. Capt. Fordar obtained two small specimens; they were taken in a "crevice of a piece of conglomerate" brought up in a trawl.

In one adult male the exopod of the uropods, although perfect in form, is scarcely more than one-half as long as the endopod. Younger examples than those described, 5 mm. or so in length, are relatively narrower in form, and a lesser portion of the first pleon segment is concealed.

The sexes may be distinguished at a glance, the cephalon of the male, with the two large interocular tubercles and produced anterior portion, presenting a very different appearance to that of the female.

Family AEGIDAE.

The Aegidae, in common with the other families herein considered, have the peduncle of both pairs of antennae distinct from the flagellum. The first maxillae are slender and styliform, and the apex of each is furnished with short spines. The second maxillae are broad, with two unequal apical lobes, armed with hooked spines. The palp of the maxillipeds embraces the cone formed by the anterior parts of the mouth organs, and in the male and non-ovigerous females is furnished with outwardly curved spines.

The oral parts together form a sucking tube; according to Hansen the modified maxillipeds are probably utilised to pull apart the skin of a fish, the mandibles are adapted to enable the Aegids to tear out a piece of flesh, and the style-like first maxillae are used to deepen and lacerate the wound so caused.

Key to Australian Genera.

a. Peraeon and pleon compact, not relaxed. Anterior margin of cephalon with a small, median process, separating more or less the basal articles of the first antennae. Flagellum of first antennae usually composed of numerous articles. Frontal lamina moderately large. Maxillipeds with five-jointed palp .. .. *Aega*

aa. Peraeon more depressed and pleon relaxed. Anterior margin of cephalon overhanging the basal articles of the first antennae, the flagellum of which is composed of only four to six articles. Frontal lamina small. Maxillipeds with two-jointed palp .. .. .. *Rocinela*

Aega, Leach.

Aega, Leach, Trans. Linn. Soc., xi., 1815, p. 369; Sch. and Mein., Naturh. Tidsskr., (3) xii., 1879, p. 334; Sars, Crust. of Norway, ii., 1899, p. 58; Barn., Ann. S. Afr. Mus., x., 1914, p. 361 (syn.).

Owing to the curve of the maxilliped in males and non-ovigerous females, it is not always possible to show all five segments of the palp in illustrations. In ovigerous females the maxilliped as a whole is lamellar; the palp has no hooks and the coxo-, basi-, and epipodite are greatly expanded. The anterior marsupial plates of females in this condition overlap the greater part of the oral organs, and it is said that they are then unable to feed and have never been found attached to a fish.

Ingested food solidifies in specimens preserved in alcohol and, removed in this condition, provides a cast of the inside of the capacious stomach (fig. 19). In Europe these dark-brown or black masses were at one time regarded by superstitious fishermen and others as "lucky stones" or "Peter's stones"; the stomach contents of *A. psora* are said to have been used in the preparation of a salve, hence the popular name "Salve-bug" was formerly applied to this species; further, medical men prescribed the substance as an antidote to sea-sickness and other ills.

Fig. 19.
Aega serripes, and food mass removed from stomach (1½ diams.).

Key to Australian Species.

a. Eyes of moderate size, distinctly separated one from the other.
  b. Form slender, much more than three times longer than greatest width. Telsonic segment terminating in an acute projection .. *angustata*
  bb. Form stouter, less than three times longer than greatest width. Telsonic segment obtusely rounded or truncate apically.
    c. Inferior margin of basos of last four pairs of peraeopods produced into a thin carina, excised to form three or four prominent dentations .. .. *serripes*
    cc. Inferior margin of basos of peraeopods not so produced .. *australis*
aa. Eyes very large, confluent, and occupying the greater part of dorsal surface of cephalon.
  d. Whole dorsal surface of cephalon, excepting a small V-shaped piece at middle of anterior margin, occupied by eyes .. .. .. *vigilans*
  dd. Dorsal surface of cephalon with a subtriangular portion at base, as well as a smaller V-shaped piece at middle of anterior margin, not occupied by eyes.
    e. Endopod of uropoda narrow, with outer margin prominently excised near the apex, which is rounded .. .. *antillensis*
    ee. Endopod of uropoda wide, with outer margin not excised and apex subtruncate.
      f. First five pleon segments, and at least last peraeon segment, with a row of tubercles along hinder margins .. .. .. *nodosa*
      ff. Dorsal segments of peraeon and pleon without tubercles.
        g. Shape of apex of telson unknown .. .. *cyclops*
        gg. Apex of telson subtruncate .. .. *meinerti*
        ggg. Apex of telson acute .. .. *spongicola*

It will be noticed that all of our species excepting those under section *ff* are readily separated; this last part of the key is very unsatisfactory. I have seen no specimens of *A. meinerti* and *A. spongicola*, and the telson of the type of *A. cyclops* is abnormal. It is assumed that in *A. spongicola* a small piece at the front of the cephalon is unoccupied by the eyes, although this condition is not shown in Thomson's figure of the species. If the eyes extend along the whole anterior margin of the cephalon, then this character distinguishes *A. spongicola* from all other Australian species.

AEGA ANGUSTATA, Whitelegge.

Aega angustata, Whitel., Mem. Austr. Mus., iv., 1901, p. 232, fig. 21*a*-21*f*.

♀. Form narrow, elongate, three and three-fourths times longer than wide. Surface rather finely punctate. Cephalon a little more than twice as broad as long; anterior margin with a prominent acute triangular process, the apex of which is slightly bent downwards, between the bases of the antennae, to meet the anterior margin of the frontal lamina. Eyes oblong, composite, extending along lateral margins of cephalon, and well separated one from the other, the narrowest interocular space being equal to the greatest diameter of an eye. Antennae short. First pair reaching beyond fourth peduncular article of second antennae; first

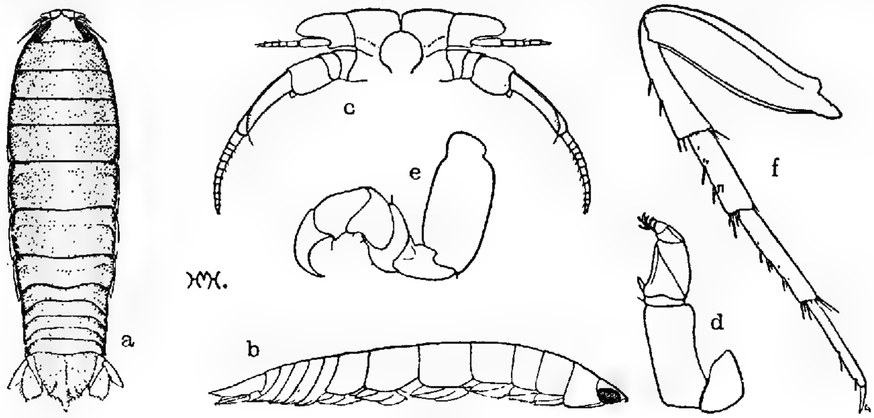

Fig. 20.

Aega angustata, female; a and b, dorsal and lateral views (2 diams.); c, frontal lamina and antennae (8 diams.); d, maxilliped (18 diams.); e and f, first and seventh peraeopods (9 diams.).

two articles of peduncle subequal in length, flattened, and considerably expanded; the anterior distal part of the second article is produced into a prominent lobe, extending as far as, and overhanging, the narrow third article, which is but half as long as the second; flagellum a little longer than last peduncular joint, composed of five articles. Second antennae reaching to about middle of length of lateral margins of first peraeon segment; peduncle compressed and dilated; fourth article almost as long as second and third together, on upper side with an acute lobe produced slightly outwards and backwards; fifth article a little curved, as long as first four articles together; flagellum equal in length to fifth peduncular article and composed of eleven articles. Frontal lamina subcircular, with surface concave. Medial length of first peraeon segment about equal to that of cephalon, the antero-lateral angles a little forwardly produced; first, second, third, and seventh segments shorter than the others. Coxal plates each with two oblique furrows; plates of second and third segments with posterior margins rounded, not extending beyond hinder margins of their segments, and with the lower, or submarginal, furrow terminating behind in a small projection; remaining coxal plates subacute posteriorly, extending beyond hinder margins of their segments.

Lateral portions of first to fourth pleon segments not separated from dorsal part, each with two furrows and with posterior angles subacute; telsonic segment slightly wider than long, its medial length equal to that of rest of pleon segments together; with punctures obsolete and much less distinct than on remainder of upper surface of peraeon and pleon; with an obsolete median carina, disappearing anteriorly, and a still less distinct lateral carina on each side of posterior fourth; lateral margins convexly converging and with three dentations on each side in front of the acutely produced apex, on each lateral margin of which are two tiny teeth. Uropods extending to level of second lateral dentation of telson; protopod produced nearly to apex of endopod, which is truncated posteriorly, with the hinder and postero-lateral margins serrate; exopod scarcely as long, and but half as wide, as endopod, subacute apically and with outer margin serrulate and set with spinules. First pair of peraeopods without spines but with several setae; ischium of second and third pairs armed with two, and merus with four, short spines on inner side; propodus of third pair with a subacute claw-like process emanating from inferior part of distal end, and extending nearly to apex of dactylus; last four pairs of peraeopods slender, with ischium, merus, carpus, and propodus armed with slender spines on inner and distal margins.

Colour in alcohol.—Light brown.

Length, 24 mm.

♂. The single type specimen, 15 mm. in length, proves to be a male. This example, which is fully described and figured by Whitelegge *(ut supra)* differs but slightly from the female described above. A male, 21 mm. in length, has six articles in the flagellum of the first antennae.

Loc.—New South Wales: Wata Mooli, 54-59 fms. (type); Eden, "on sawfish" (J. A. Boyd); off Botany (Prof. J. D. Ogilby).

Hab.—New South Wales.

The salient characters of this well-defined species are the expanded antennal peduncles and the serrated and apically acute telsonic segment and the widely separated eyes. A process of the propodus of the third pair, or both second and third pairs, of peraeopods is found in several other species of the genus, but apparently in none of them is it quite as prominent as in *A. angustata;* in the female described above the process lends the third pair of peraeopods somewhat the appearance of chelate limbs.

AEGA SERRIPES, Milne Edwards.

Aega serripes, M. Edw., Hist. Nat. Crust., iii., 1840, p. 241; Sch. and Mein., Naturh. Tidsskr., (3) xii., 1879, p. 355, pl. viii., figs. 1-4.

♂. Form elongate, about two and three-fourths longer than wide; sides subparallel. Surface punctate. Cephalon more than twice as wide as medial length; punctures between eyes a little larger than those behind eyes; anterior margin bisinuate, with a small median triangular process, which does not completely separate the first pair of antennae, and is not bent downwards to meet the frontal lamina. Eyes large, oblong, extending from lateral angles of cephalon, along anterior margin, but distinctly separated one from the other. First antennae reaching a little beyond fourth peduncular article of second antennae; with the first article of peduncle one-half as long again as second, and the third article about same length as, but much narrower than second; flagellum composed of nine articles. Second antennae reaching almost to posterior angle of first peraeon segment; first two articles short, subequal in length; third a little longer than second; fourth almost as long as first three together and slightly longer than the fifth; flagellum composed of twenty-one articles. Frontal lamina short, wider than long, medianly sulcate; with the anterior margin convex and the posterior margin slightly concave. First peraeon segment a little longer, and seventh shorter, than any of the others. Coxal plates each with two not very oblique furrows and with the posterior angle in all but the last pair obtuse; plates of second and third segments rhomboidal, not longer than lateral margins of segments; those of fourth to seventh increasing in length backwards, the fourth pair extending slightly beyond the posterior angles of their segment, and the last pair reaching about to middle of length of lateral margins of first pleon segment. Lateral portions of first to fourth pleon segments not separated from dorsal part, each with two furrows; telsonic segment more than one-third wider than long; with an obsolete median sulcus and a slight depression near each basal angle; lateral margins a little convex, converging to the widely truncate, crenulate, and very slightly emarginate apex. Branches of uropods of equal length, extending to apex of pleon; protopod produced almost to apex of endopod, which is crenulately truncate posteriorly; exopod rounded, narrower than endopod, with outer and posterior margin crenulate. Outer surfaces of first three pairs of peraeopods deeply and coarsely punctate; outer inferior margin of basos of third pair with a thin carina; merus of first pair armed with three short spines, of second and third pairs with six to seven spines; outer surface of fourth to seventh peraeopods with shallower and smaller punctures and outer inferior

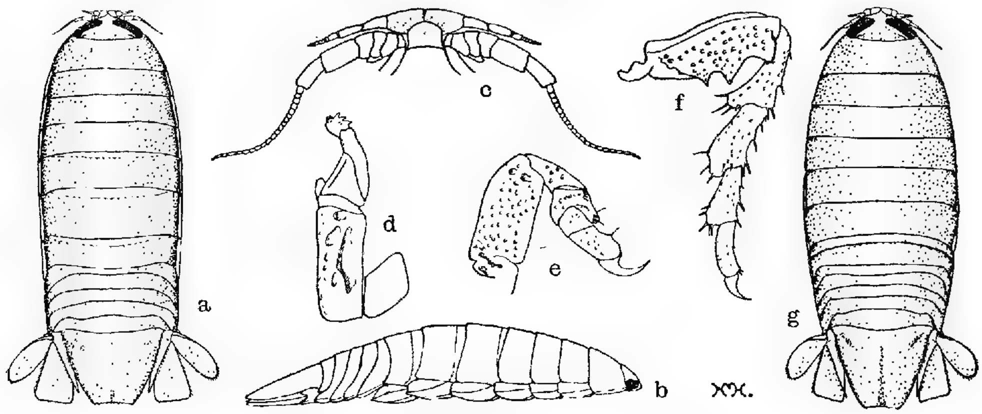

Fig. 21.

Aega serripes, male; a and b, dorsal and lateral views (1½ diams.); c, frontal lamina and antennae (6 diams.); d, maxilliped (9 diams.); e and f, first and seventh peraeopods (4½ diams.). Female; g, dorsal view (1¼ diams.).

margin of basos of these limbs produced into a thin carina, excised to form three prominent triangular lobes; sometimes one or two additional small teeth are present at the proximal end of carina; ischium, merus, and carpus armed with movable spines.

Length, 35 mm.

♀. Differs from the male in having the form relatively wider and of a more oval shape.

Length, 50 mm.

Colour during life.—The dorsum is brown, marked with longitudinal whitish streaks. The peduncles of the antennae are marked with dark brown, a brown bar connects the eyes, and there is a short dark-brown streak at the antero-lateral angles of the first peraeon segment.

Loc.—South Australia: Encounter Bay (Dr. R. H. Pulleine); Victor Harbour, from a skate (W. H. Baker); Port Willunga (S. Howe). New South Wales: Maroubra (Austr. Mus. Coll.). Victoria: Off Flinders Island, dredged in 10 fms. (Dr. W. E. J. Paradice).

Hab.—Southern and eastern Australia and Japan.

In some examples the carina of one or more of the last four pairs of peraeopods is divided into four large teeth, as in the Japanese specimen figured by Schioedte and Meinert. The number of articles in the flagellum of the second antennae is variable; the total length and number of articles in the second antennal flagellum of five females are as follow: 50 mm., 22; 43 mm., 18; 35 mm., 20; 23 mm., 13; 15·5 mm., 15.

The dark-brown bar which connects the eyes in living examples lends a somewhat deceptive appearance, and the eyes at first glance appear to be confluent. In one small example the interocular space is very narrow, being equal to the length of about three eye facets only. The species may be instantly recognized by the character of the posterior peraeopods, and the shape of the telson and uropods.

AEGA AUSTRALIS, Whitelegge.

Aega australis, Whitel., Mem. Austr. Mus., iv., 1901, p. 229, fig. 20*a*-20*f*.

♀. Ovigerous. Form oval, two and one-third times as long as greatest width. Surface shallowly punctate. Cephalon twice as wide as medial length, with a median triangular process which is not bent downwards to meet the frontal

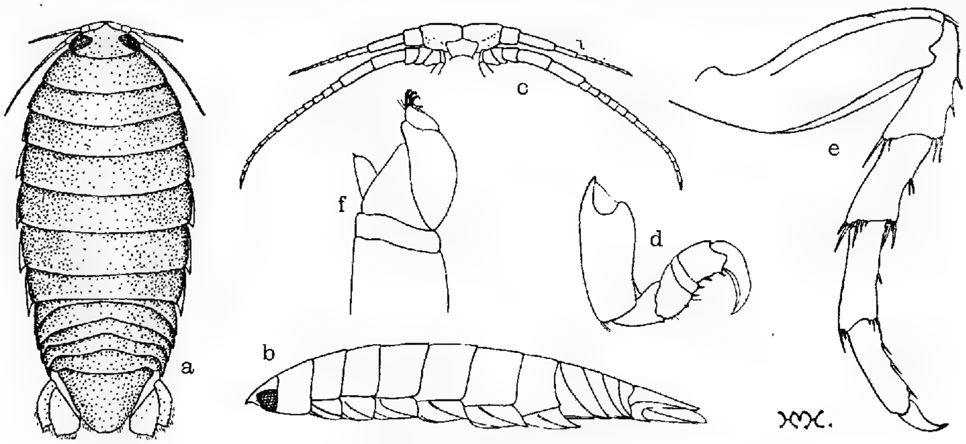

Fig. 22.

Aega australis, paratype ovigerous female; a and b, dorsal and lateral views (4 diams.); c, frontal lamina and antennae (8 diams.); d and e, first and seventh peraeopods (18 diams.). Type male; f, palp of maxilliped (45 diams.).

lamina. Eyes rather small, subtriangular, composite, well separated, the narrowest interocular space being equal to the greatest diameter of an eye. First antennae reaching well beyond end of peduncle of second antennae, with the first two articles flattened and somewhat expanded anteriorly; first article wider than, and rather more than twice as long as, second; third twice as long, and one-half as wide, as second; flagellum shorter than peduncle, composed of eight articles, the first of which is twice as long as any of the others. Second antennae reaching to beyond middle of length of third peraeon segment; first peduncular article longer than second or third; fourth and fifth articles subequal in length, each a little shorter than first three together; flagellum distinctly longer than peduncle, composed of fourteen articles. Frontal lamina short, nearly twice as wide as medial length; anterior margin bisinuate, medianly a little forwardly produced; antero-lateral angles acutely rounded and lateral margins converging posteriorly. First to sixth peraeon segments subequal in length, the second and third a little shorter than the others, which are about as long as cephalon; seventh segment the shortest. Coxal plates visible in dorsal view, each with two oblique furrows; those of second to fourth segments subrectangular, with posterior angles rounded, not extending beyond hinder margins of segments; remaining coxal plates reaching past hinder margins of their segments and with the posterior angles acute. First segment of pleon very short medianly, the second to fifth subequal in length; posterior angles of first to fourth segments acutely produced backwards; telsonic segment half as wide again as medial length, with lateral margins convexly converging to the obscurely subtruncate extremity; postero-lateral and apical margins crenulate, a slightly larger incision preceding the smaller crenulations on each side. Uropods reaching beyond apex of telsonic segment; protopod produced to about three-fourths of length of endopod, which is longer and much wider than the exopod and is subtruncate posteriorly; apical margins and posterior part of outer margins of both endo- and exopod crenulate and set with tiny spines. Merus and carpus of first three pairs of peraeopods armed with a short stout spine at inner distal angle, and with a few inconspicuous spinules on inner surface; propodus of these limbs with two spines on inner side; ischium of second and third peraeopods with a spine at outer distal angle; ischium, merus, carpus, and propodus of fourth to seventh peraeopods armed with spines on distal margins and a few on inner sides.

Colour in alcohol.—Yellowish, uniformly dotted with brown chromatophores.

Length, 11 mm.

♂. The type example is a male; in this specimen the form is slightly more slender than in the ovigerous female, the flagellum of the first antennae is composed of ten articles and that of the second of fourteen articles, and the coxal plates are not visible from above.

Length, 12 mm.

Loc.—New South Wales: Coogee Bay, 49-50 fms. (type), and off Wollongong, 55-56 fms. (Austr. Mus. Coll.).

Hab.—New South Wales.

A non-ovigerous female 9·5 mm. in length, together with the type male, paratype ovigerous female, and two smaller paratypes, comprising Whitelegge's original series, are the only specimens of this species before me; the two examples last mentioned are each 9 mm. in length, and have eight to ten articles in the flagellum of the first pair of antennae, and fourteen in that of the second pair. The apex of the telsonic segment is very slightly subtruncate in the ovigerous female, but in the other specimens it is obtusely rounded, as shown in Whitelegge's figure; in a young example from the brood pouch the flagellum of the first antennae consists of seven articles, that of the second of ten articles.

Aega vigilans, Haswell.

Rocinela vigilans, Hasw., Proc. Linn. Soc. N.S. Wales, v., 1881, p. 472, pl. xvi., fig. 2, and Cat. Austr. Crust., 1882, p. 285; Miers, Zool. "Alert," 1884, p. 304; Rich., Proc. Amer. Philos. Soc., xxxvii., 1898, pp. 9, 10.

Aega dubia, Rich., Wash. Bur. Fish., Doc. No. 736, 1910, p. 12, fig. 12.

♀. Ovigerous. Form oblong-oval, about two and three-fourths times longer than wide. Surface punctate, the punctures sparse on anterior portions of second to seventh peraeon segments. Cephalon more than twice as wide as medial length; anterior margin rounded, medianly produced downwards in a small triangular process, the apex of which almost meets the anterior end of the frontal lamina. Eyes very large, confluent, occupying the whole dorsal surface of cephalon excepting a small V-shaped piece at middle of anterior margin, and extending on to underside of cephalon. Antennae slender; first pair reaching to about sixth flagellal article of second antennae, which are long and extend to posterior angle of fourth peraeon segment. The first antennae have the second peduncular article a little longer and narrower than the first, and the third as long as the first and second together; the flagellum is composed of fifteen articles. The first and third articles of the peduncle of the second antennae are subequal in length and the third is a little shorter; the fourth is nearly half as long again as the third and about three-fourths as long as the fifth; flagellum composed of thirty-one articles. Frontal lamina narrow, considerably curved fore and aft, and widened anteriorly; surface at widest part concave. First, fifth, and sixth peraeon segments a little longer than the others. Coxal plates of second and third segments obtusely rounded posteriorly, not extending beyond posterior margins of segments, and with two oblique furrows; coxal plates of fourth to seventh segments each with two oblique furrows, the posterior of which extends from the margin adjoining the lateral edge of the peraeon segment to the posterior angle; plates of fourth segment angularly rounded posteriorly, reaching a little beyond level of hinder margin of segment; remaining pairs more acute, and extending distinctly beyond posterior angles of segments. Lateral parts of first to fourth pleon segments not separated from dorsal portion; each with two furrows; telsonic segment a little wider than medianly long, punctate, and with a median longitudinal line of punctures lying in a slight sulcus; lateral margins convex,

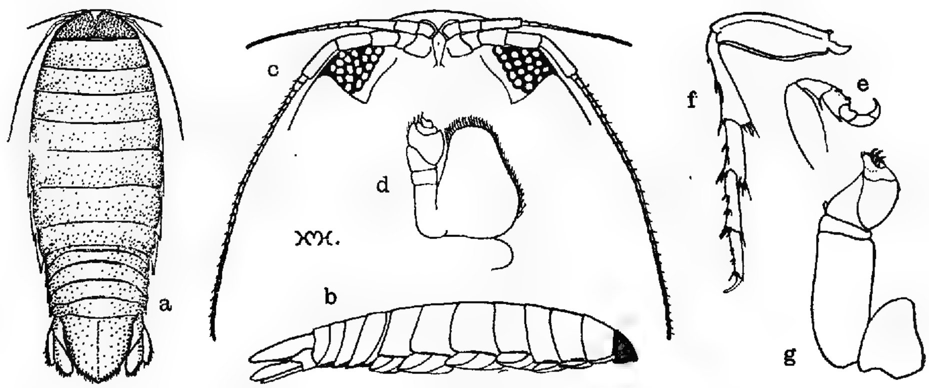

Fig. 23.

Aega vigilans, ovigerous female; a and b, dorsal and lateral views (4½ diams.); c, frontal lamina and antennae (11 diams.); d, maxilliped (18 diams.); e and f, first and seventh peraeopods (5 diams.). Non-ovigerous female; g, maxilliped (18 diams.).

roundly converging to the apex, which has a small triangular median projection, on each side of which are four to five smaller denticulations. Branches of uropoda obliquely truncate posteriorly, with outer and posterior margins ciliate, crenulate, and furnished with short spines; protopod produced to the first of the lateral denticulations of telson; endopod wider and longer than exopod, extending to apex of pleon. Ischium of first pair of peraeopods with a long spine at apex; merus with two short spines; ischium of second and third peraeopods with one long, and one or two short, spines; merus with three or four, and carpus with one or two short spines.

Length, 20 mm.

♀. Non-ovigerous. Differs in having the form narrower, three to three and one-half times longer than wide, and the cephalon scarcely more than twice as wide as long.

Length, 26 mm.

Loc.—Queensland: Holborn Island, near Port Denison, 20 fms. (type). Western Australia: Trawled between Fremantle and Geraldton (W. Austr. Mus.).

Hab.—Australia and Philippine Islands.

The mouth parts of Haswell's type, which is a female without ova, are missing, but a comparison of this specimen with Miss Richardson's excellent description and figure shows that *A. dubia,* from the Philippine Islands, is undoubtedly the same species. I have not seen a male, but Richardson says that this sex "differs in its smaller size . . . and in the different length of the segments of the thorax"; according to the figure, the male is of somewhat the same shape as the ovigerous female described above. This author describes the colour as "yellow, with numerous black and brown arborescent spots close together and covering the entire surface of the body except the posterior half of the terminal segment of the abdomen and the uropoda."

Richardson further remarks that *A. dubia* "is very close to *Rocinela vigilans,* Haswell, but differs in having a small V-shaped space on the dorsal surface of the head in front of the eyes, and in having the posterior extremity of the abdominal segments and the uropods denticulate, which are described by Haswell as 'smooth, entire.'" The posterior margin of the telsonic segment is certainly not so strongly denticulate in the type as in other examples, but nevertheless the denticulations of this segment, and of the branches of the uropoda, are quite distinct; a small V-shaped portion of the anterior surface of the cephalon is unoccupied by the eyes, which thus do not cover "all the upper surface of the head," as stated by Haswell.

There is very little doubt that the Indian specimen from "Mutwal Island," deemed by Stebbing[19] to be "the female or a younger form" of *A. ommatophylax,* Stebb., is a young example of *A. vigilans.* Stebbing's remarkable species differs from *A. vigilans* in that the head, at least in the male, has a prominent frontal process, while a pair of large cylindrical processes emanating from the anterior margin of the first free peraeon segment overhang the eyes; also the sides of the peraeon are subparallel and the form is distinctly stouter than in the male of the last-named species.

Aega antillensis, Schioedte and Meinert.

Aega antillensis, Sch. and Mein., Naturh. Tidsskr., (3) xii., 1879, p. 361, pl. viii., figs. 10-13; Rich., Proc. U.S. Nat. Mus., xxiii., 1901, p. 521; and Bull. U.S. Nat. Mus., liv., 1905, p. 170, fig. 149; Thielemann, München Abh. Akad. Wiss., ii., Suppl. 3, 1911, p. 26, pl. i., figs. 1, 2.

Aega excisa, Rich., Wash. Bur. of Fish., Doc. No. 736, 1910, p. 11, fig. 11.

♂. Form elongate-ovate, three times longer than wide. Surface punctate. Cephalon about three times as wide as medial length; punctures behind eyes small; anterior margin slightly bisinuate, with a small, median, triangular process partly separating the first antennae, but not bent downwards to meet frontal lamina. Eyes very large, confluent, occupying greater part of dorsal surface of head but leaving a small V-shaped piece at middle of anterior margin and a larger triangular portion at base of cephalon; not extending on to underside. First antennae reaching to middle of fifth peduncular article of second antennae; with the first article of peduncle less than half as long again and a little wider than second; third article about as long as first but much narrower; flagellum composed of ten articles, the first of which is very short and the second longer than any of the others. Second antennae reaching to hinder margin of first peraeon segment; first two articles subequal in length; third nearly twice as long as second; fourth twice as long as third and as long as fifth; flagellum imperfect. Frontal lamina in form of an oval disc, with surface concave and finely punctate. First peraeon segment longer, and seventh shorter, than any of the others. Coxal plates rather narrow, each with two oblique furrows, the upper of which extends diagonally across to the posterior angle in the plates of the fourth to seventh

(19) Stebb., Herdman's Ceylon Pearl Fish., Suppl. Rep., xxiii., 1905, p. 23, pl. v.*a.*

segments; plates of second and third segments scarcely longer than their segments, with the posterior angles rounded, the others with the posterior angle subacute or acute and produced beyond posterior angles of segments. Lateral portions of first to fourth pleon segments not separated from dorsal part, each with two furrows and acute posterior angles; telsonic segment as wide as medial length, with a very obscure median carina; lateral margins slightly sinuate, converging to the acute apex, which is a little upturned; postero-lateral margins crenulate, the crenulations set with tiny spines. Branches of uropoda subequal in length, reaching to apex of pleon and with the margins crenulate and set with tiny spines and short hairs; endopod with a conspicuous notch at about two-thirds of the length of outer margin; protopod produced nearly to level of marginal notch of endopod; exopod narrow, at greatest width scarcely wider than endopod, with apex subacutely rounded. Outer surface of peraeopods faintly punctate; propodus of first three pairs produced on inner side at distal end; the merus of the first pair has four short stout spines on inner side and two or three slender setae at outer distal apex, while the ischium bears two spines at the outer apex; the merus of the second and third pairs has seven to eight spines on the inner side

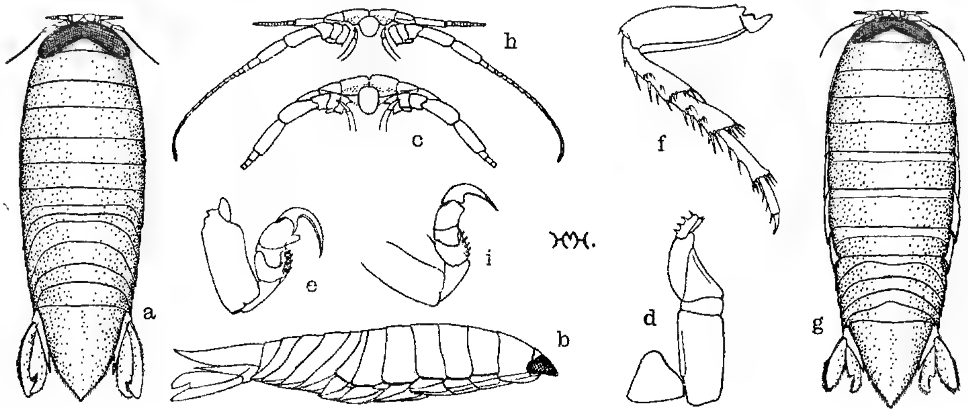

Fig. 24.

Aega antillensis, male; a and b, dorsal and lateral views (nat. size); c, frontal lamina (3 diams.); d, maxilliped (4½ diams.); e and f, first and seventh peraeopods (2⅔ diams.); Female; g, dorsal view (nat. size); h, frontal lamina and antennae (3 diams.); i, first peraeopod (2⅔ diams.).

and two on the outer distal apex; ischium of second pair with one spine at inner and two at outer apex, that of third peraeopods with two at inner and two at outer apex; ischium, merus, carpus, and propodus of fourth to seventh peraeopods with many spines on inner and apical margins.

Length, 48 mm.

♀. Head relatively smaller than in male. First antennae reaching almost to end of fifth peduncular article of second antennae; with flagellum composed of twelve articles. Second antennae reaching to posterior margin of first peraeon segment, with flagellum composed of nineteen articles. Frontal lamina somewhat obovate in shape, as wide as long. Uropods not reaching to termination of telson, but extending to level of six-sevenths of length of telson. Dorsum of telsonic segment concave in lateral view, but apex scarcely upturned. First three pairs of peraeopods less robust than in male with the propodus slightly produced distally; the merus of the first pair has five spines on the inner margin, and one strong spine and one seta at outer apex, while the outer apex of the ischium bears two setae and one tiny spine; the merus of the second pair has seven spines on the inner side and one strong spine at outer distal apex, while that of the third peraeopods has seven spines on the inner margin and two at the outer apex; ischium of both second and third peraeopods with two spines at inner apex and two at outer apex; basos of ambulatory legs more slender than in male.

Colour in alcohol.—Yellowish-brown.

Length, 47 mm.

Loc.—South Sea Islands (Austr. Mus. Coll.). New South Wales: "Dredged off coast" (Melbourne Ward). Tasmania: 100 fms. (C. Hedley). South Australia: Fowler's Bay, from basking shark *(Cetorhinus maximus)* (C. A. Tait).

Hab.—West Indies, Philippine Islands, Japan, and Australia.

A female, 30 mm. in length, dredged off Tasmania, has the distal part of the propodus more produced than in the female described above. The flagellum of the first antennae is composed of nine articles, that of the second of seventeen. The frontal lamina is much as in the male here figured. The merus of the first pair of peraeopods bears only two spines on the inner margin and one at outer apex, while the ischium has two spines at the outer apex; the merus of the second pair has five spines on the inner margin and one at the outer apex, that of the third pair six spines on the inner margin and two at the outer apex; the ischium in the second and third pairs is armed with one spine at the inner and two at the outer edge.

In a young female, 19 mm. in length, the flagellum of the first antennae consists of eight articles and that of the second of fifteen. The merus of the first pair of peraeopods has two spines on the inner margin and the ischium bears one spine at the outer apex; the merus of the second pair has four spines on the inner margin and two at the outer apex, while that of the third pair has six spines on the inner margin and two at the outer apex; the ischium in the second and third pairs of peraeopods bears two spines on the outer apex.

In these two females the apex of the telson is not at all upturned. The only other specimens before me are those described in detail above, a male in a dry state, and a gorged female. The latter example was taken from a basking shark, over 25 feet in length; a cast of this large fish is preserved in the South Australian Museum.

Mrs. H. Richardson Serle informs me that the single type specimen of *A. excisa* differs from *A. antillensis* in the following slight characters: "The number and arrangement of the spines on the prehensile legs, the narrower and longer uropods, which extend beyond the tip of the terminal abdominal segment, the slightly longer second antennae, and the less acutely pointed terminal abdominal segment." The tip of the abdomen is broken in the type of *A. excisa*. The other differentiating characters are variable in the Australian specimens, thus connecting the two species.

AEGA NODOSA, Schioedte and Meinert.

Aega nodosa, Sch. and Mein., Naturh. Tidsskr., (3), xii., 1879, p. 367, pl. ix., figs. 1-3.

♀. Ovigerous. Form oval, two and one-half times longer than wide. Surface with large shallow punctures. Cephalon more than two and one-half times wider than medial length; anterior margin bisinuate, with a small, median, triangular process, directed downwards and backwards and almost meeting anterior margin of frontal lamina. Eyes large, oblong, meeting for a short distance on mid-line of head, leaving unoccupied a large triangular basal part of dorsal surface of cephalon, and a small V-shaped piece at anterior margin; extending on to under surface. First antennae reaching to just beyond end of peduncle of second antennae; with first two articles subequal in length and third not as long as first two together; flagellum stout, densely fringed with hair on distal two-thirds; composed of sixteen articles, including a short basal jointlet and a tiny terminal style. Second antennae reaching slightly beyond hinder margin of second peraeon segment; first three articles of peduncle short, the third longer than the first or second; fourth article as long as first two together and about four-fifths as long as fifth; flagellum composed of sixteen articles. Frontal lamina narrow, anteriorly terminating in a little spherical knob. First to sixth peraeon segments not differing markedly in length; seventh much shorter, with a series of low tubercles along posterior margin. Coxal plates successively increasing in length backwards, the last reaching almost to posterior angle of third pleon segment; those of second and third segments obtusely rounded posteriorly, not backwardly produced; those of fourth and fifth segments acutely rounded posteriorly, extending a little beyond the hinder margins of their segments; posterior angles of last two pairs more acute, and produced well beyond hinder margins of their segments; oblique furrows of each coxal plate shallow. First segment of pleon concealed; second to fifth segments with a row of low tubercles along posterior margins, and with lateral parts not separated from dorsal portion; posterior angles of second to fourth segments acute; telsonic segment large, about as long as wide and longer than rest of pleon; subtriangular in shape, with the convex lateral margins evenly converging to the acute apex; with a shallow fovea on each side of basal part of dorsal surface; postero-lateral margins serrulate,

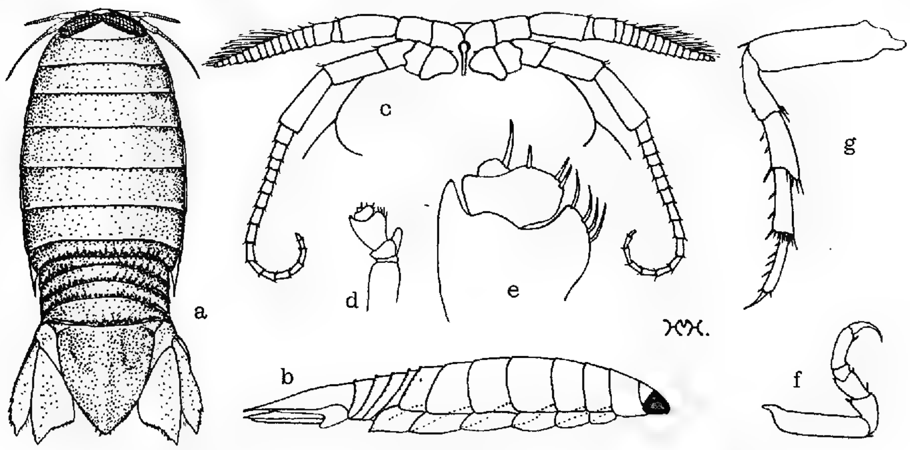

Fig. 25.

Aega nodosa, ovigerous female; a and b, dorsal and lateral views ($3\frac{1}{2}$ diams.); c, frontal lamina and antennae (10 diams.); d, palp of maxilliped (18 diams.); e, terminal articles of palp of maxilliped (90 diams.); f and g, first and seventh peraeopods (7 diams.)

armed with two short stout spines on each side of apex. Uropoda large; protopod produced to beyond middle of length of endopod, which is longer and much wider than exopod, and reaches beyond apex of pleon; hinder margin of endopod subtruncate, a little oblique, the outer posterior angle acutely produced; apex of exopod acute; hinder margin of endopod, and posterior portions of lateral margins of exopod, serrulate and set with short, stout spines. First three pairs of peraeopods rather slender, armed with a few small, sharp spines; ischium, merus, carpus, and propodus of last four pairs armed with acute spines on inner and apical margins.

Colour in alcohol.—Yellow.

Length, 15 mm.

Loc.—South Australia (? dredged, Sir Joseph Verco).

Hab.—Tasmania (Bass Strait; type) and South Australia.

The large telsonic segment and uropods, and the dorsal tubercles, are salient features of the species. The tubercles on the pleon and hinder part of the peraeon of the female described above are not as conspicuous as in the type, a "Mas adolescens," 16 mm. in length, described and figured by Schioedte and Meinert; the authors of the species state that in their specimen the hinder margin of the sixth, as well as of the seventh, peraeon segment is ornamented with small tubercles, and that four larger nodes are conspicuous, one at the middle of the posterior margin of the sixth peraeon segment, one on each side of the seventh segment, and one at the middle of the hinder margin of the fourth pleon segment. The difference in the sculpture is possibly sexual. In the type the flagellum of the first antennae is composed of fourteen articles, that of the second antennae of sixteen to seventeen articles.

Aega cyclops, Haswell.

Aega cyclops, Hasw., Proc. Linn. Soc. N.S. Wales, vi., 1881, p. 192, and Cat. Austr. Crust., 1882, p. 285.

♂. Form oval, nearly two and one-half times longer than wide. Surface with moderately large, shallow, and rather sparse punctures. Cephalon a little more than twice as wide as medial length; anterior margin rounded, with a small, median, narrowly-triangular process, directed downwards and backwards, and almost touching the anterior margin of the frontal lamina. Eyes very large, confluent, occupying greater part of dorsal surface of cephalon, leaving a tiny V-shaped piece at middle of anterior margin, and a triangular portion at base of cephalon; extending on to under surface. First antennae reaching slightly beyond end of peduncle of second antennae; with first article of peduncle slightly wider than, but equal in length to second; third article more slender, distinctly longer than first two together; flagellum composed of eight to nine articles, the first of which is much the longest. Second antennae extending beyond posterior angle of second peraeon segment; first three peduncular articles subequal in length; fourth one-third longer than third and more than two-thirds as long as fifth; flagellum of right side composed of fourteen articles, that of the left side imperfect. Frontal lamina small, convex, somewhat lozenge-shaped in outline. First to sixth peraeon segments subequal in length, the seventh a little shorter. Coxal plates successively increasing in width backwards, the seventh pair being more than twice as wide as first; each with two furrows, the posterior (or upper) of which, on the plates of fourth to seventh segments, extends from the upper margin to the posterior angle; first four pairs of plates with obtuse posterior angles, not or but slightly reaching past hinder margins of their segments; last two pairs with posterior angles acute, extending beyond hinder margins of their segments. Lateral portions of second to fourth pleon segments carinate, not separated from dorsal portions; first segment almost concealed beneath last peraeon segment, telsonic segment abnormal, irregularly subtriangular in shape. Branches of uropoda of equal length on right side, the exopod of left side abnormal; protopod produced beyond middle of length of endopod, which is wide, obliquely truncate posteriorly, with the outer apical angle produced into a spine, above which (on outer margin) are three smaller spines and some fine serrations; posterior margin of endopod with four serrations; exopod narrowly ovate, a little more than one-half as wide as endopod; apex produced into an acute process, above which, on the outer margin, are five spiny serrations. Ischium, merus, carpus, and propodus of last four pairs of peraeopods set with numerous spines.

Colour in dry state.—Whitish, with scattered brown dots on peraeon; near posterior margins of segments these spots are arranged in lines.

Length, 11 mm.

Loc.—New South Wales: Port Jackson.

The only specimen of this species before me is the type, here figured and described; it is a dried and, unfortunately, somewhat abnormal example, the telsonic segment and left uropod having been damaged, evidently during life, for the uneven edge of the telson is ciliate. Haswell describes the telsonic segment as "subtriangular, the apex rounded," but the normal shape of the apical margin is a matter for conjecture.

A. cyclops is rather close to the previous species, *A. nodosa,* but differs in having the antennae a little different, and the eyes considerably larger, leaving unoccupied a much smaller triangular space at the base of the head; in *A. nodosa* the eyes are in contact for a length of four facets, but in the present species five facets of each eye are contiguous.

Aega meinerti, Miers.

Aega meinerti, Miers, Zool. "Alert," 1884, p. 305.

Miers' diagnosis of *A. meinerti* is as follows:—". . . very nearly allied to *Aega cyclops,* Haswell, . . . but seems to be sufficiently distinguished by having the body very coarsely punctulated, the epimera of the fourth to seventh segments only subacute and (the last excepted) scarcely prolonged beyond the posterior margin of the segments; and particularly by the form of the terminal

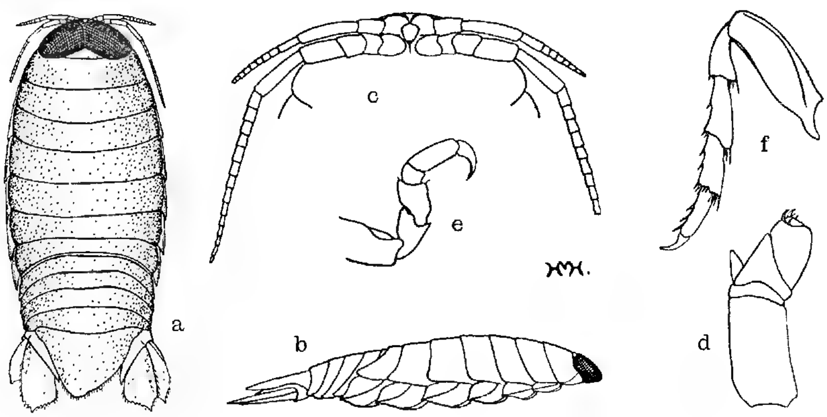

Fig. 26.
Aega cyclops, type male; a and b, dorsal and lateral views ($4\frac{1}{2}$ diams.); c, frontal lamina and antennae (11 diams.); d, maxilliped (35 diams.); e and f, first and seventh peraeopods (13 diams.).

postabdominal segment, which is truncated, not rounded, at its distal extremity; the outer ramus of the uropoda is ovate but not acute, the inner squarely truncated at its distal extremity; the distal process of the peduncle extends considerably beyond the middle of the inner ramus. This species, of which a single male is in the collection from King George's Sound . . . I propose to designate *Aega meinerti.* In the confluent eyes and the form of the terminal segment it somewhat resembles . . . *Aega crenulata,* Lutken, but the posterior prehensile limbs are without the cultriform process characteristic of that species. . . ."

Hab.—Western Australia.

In view of the fact that the telson of the type of *A. cyclops* is abnormal, there is no character mentioned in Miers' description that satisfactorily distinguishes *A. meinerti* from Haswell's species.

AEGA SPONGICOLA, Thomson.

Rocinela spongicola, Thoms., Proc. Roy. Soc. Tas., 1893, p. 57, pl. iii., figs. 3-8; Rich., Proc. Amer. Philos. Soc., xxxvii., 1898, pp. 9, 10.

Aega spongicola, Stebb., Herdman's Ceylon Pearl Fish., Suppl. Rep., xxiii., 1905, p. 24.

As remarked by Stebbing *(ut supra),* a reference to Thomson's rather poor figure shows that this species is undoubtedly an *Aega.* As the name implies, the two type specimens were found in a sponge. Judging from the figures the species is extremely close to *A. nodosa,* but apparently lacks dorsal tubercles.

Length, 15 mm.

Hab.—Tasmania.

The status of *A. meinerti* and of *A. spongicola* is unsatisfactory; it seems possible that *A. meinerti* is identical with *A. cyclops,* and that *A. spongicola* is synonymous with *A. nodosa,* but an examination of the types of the two species is necessary to settle the question.

ROCINELA, Leach.

Rocinela, Leach, Dist. Sci. Nat., xii., 1818, p. 348; Sch. and Mein., Naturh. Tidsskr., (3) xii., 1879, p. 380; Rich., Proc. Amer. Philos. Soc., xxxvii., 1898, p. 8; Sars, Crust. of Norway, ii., 1899, p. 65; Stebb., Herdman's Ceylon Pearl Fish., Suppl. Rep., xxiii., 1905, p. 23 (syn.).

Acherusia, Lucas, Explor. Algérie, Crust., 1849, p. 78.

Twenty-seven species, including a new form described below, have apparently to be referred to this genus; this number does not include the Indian Cymothoid named *Rocinella latis,* by Southwell,[20] nor the two Australian forms *Rocinela vigilans,* Hasw., and *R. spongicola,* Thoms., both of which are referred to *Aega.*

Only two representatives of the genus are known from our waters, and both belong to the group of species which have the eyes distinctly separated and the flagellum of the second antennae composed of fourteen to sixteen articles.

KEY TO AUSTRALIAN SPECIES.

a. Anterior margin of cephalon rounded. Lateral parts of second to fourth pleon segments not prominently produced .. .. .. *orientalis*

aa. Anterior margin of cephalon truncate. Lateral parts of second to fourth pleon segments prominently produced .. .. *sila*

ROCINELA ORIENTALIS, Schioedte and Meinert.

Rocinela orientalis, Sch. and Mein., *loc. cit.,* p. 395, pl. xiii., figs. 1, 2; Miers, Zool. "Alert," 1884, p. 304; Rich., *loc. cit.,* p. 11; Stebb., *loc. cit.,* p. 24; Rich., Wash. Bur. of Fish., Doc. 736, 1910, p. 17; Barnard, Ann. S. Afr. Mus., x., 1914, p. 369, pl. xxxviiD.

♀. Form oval, about two and one-half times longer than wide. Dorsal surface with shallow but distinct punctures. Cephalon less than twice as wide as long; dorsal surface with a shallow, ovate fovea; anterior part of head extending forward in front of eyes and overhanging the bases of the antennae; anterior margin rather obscurely trilobate. Eyes large, well separated, the interocular width being less than the length of an eye. First antennae reaching to about first third of length of fifth peduncular article of second antennae; first article of peduncle shorter than second, which is shorter than the third article; flagellum composed of five articles and a short, obliquely truncate, terminal style. Second antennae reaching to posterior margin of second peraeon segment; first peduncular article twice as long as second, and third slightly longer than first two together; fourth nearly as long as second and third together, with a seta at posterior side of distal end; fifth about one-seventh longer than fourth article; flagellum composed of thirteen articles and a narrow terminal style. Frontal lamina tiny, longer than wide. First to sixth peraeon segments not differing markedly in length; seventh shorter than the others; middle portion of anterior margin of

(20) Southwell, Rec. Ind. Mus., xi., 1915, p. 321, pl. xxviii., figs. 12-15.

first segment concave, lateral portions each excavate to receive bases of eyes. Coxal plates successively increasing in length backwards, none of them greatly produced, those of the seventh segment not reaching to level of postero-lateral angles of second pleon segment. Pleon segments with lateral parts not prominent and projecting; first segment almost entirely concealed beneath last peraeon segment, only a short portion of the posterior margin being visible on each side; fifth segment narrower and a little longer than any of the others, with postero-lateral angles almost covered by lateral parts of fourth segment; telsonic segment subtriangular, about one-fourth wider than medianly long; lateral margins slightly convex, converging to the rather angularly rounded apex; dorsum with a shallow, longitudinal, median furrow. Uropoda scarcely reaching to level of apex of pleon; protopod with a spine and some setae at outer posterior angle and with inner process reaching to beyond middle of length of endopod; exopod scarcely narrower but distinctly shorter than endopod, with the apex narrowly rounded; outer margins crenulate and furnished with small spines; apex of endopod rounded, outer and apical margins provided with small spines; margins of both rami, and inner margin of process of protopod with plumose hairs. Inner edge of propodus of first pair of peraeopods with three spines; ischium of seventh pair

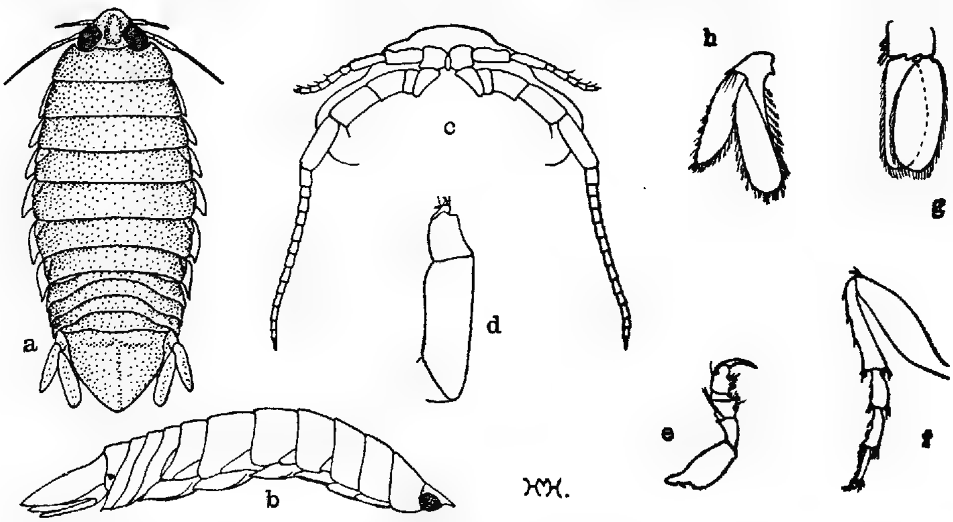

Fig. 27.

Rocinela orientalis, female; a and b, dorsal and lateral views (3 diams.); c, antennae and frontal lamina (9 diams.); d, maxilliped (28 diams.); e and f, first and seventh peraeopods (6 diams.); g, first pleopod (6 diams.); h, uropod (5 diams.).

more than twice as long as merus, which is subequal in length to the carpus and to the propodus. Outer ramus of first pair of pleopods slightly longer and wider than inner branch.

Colour in alcohol.—Brownish-yellow, marked with tiny brown chromatophores.

Length, 16 mm.

Loc.—Queensland: Port Molle (C. Hedley and A. R. McCulloch).

Hab.—India, Philippine Islands, South Africa (*fide* Barnard), and Northern Australia.

A second female, also 16 mm. in length, is very similar to the specimen described and figured above, but has the apex of the telson rather more rounded. The margins of the uropods are furnished with tiny spines as in the examples figured by Stebbing, but the inner process of the protopod is relatively less produced in both specimens before me. Stebbing's illustration of a specimen 11·3 mm. in length (dorsal view) differs from that of Schioedte and Meinert in having the cephalon extending less forwards in front of the eyes, in not having the anterior margin of the first peraeon segment biexcavate and in having the whole of the posterior part of the first pleon segment visible, while the cephalon is not shown to be "supra leviter excavata." The examples from Port Molle agree with the type as regards these characters, but differ in the shorter inner process of the base of the uropods and in having the margin of the cephalon in front of the eyes somewhat trilobate.

Rocinela sila, n. sp.

♀. Form suboval, about two and one-half times longer than wide. Dorsal surface finely and shallowly punctate. Cephalon one-third wider than medianly long; dorsum with a subquadrate, shallow fovea, at the middle of posterior part of which is a low tumidity; anterior part of cephalon extending forwards in front of eyes, overhanging bases of antennae and with apex slightly upturned; antero-

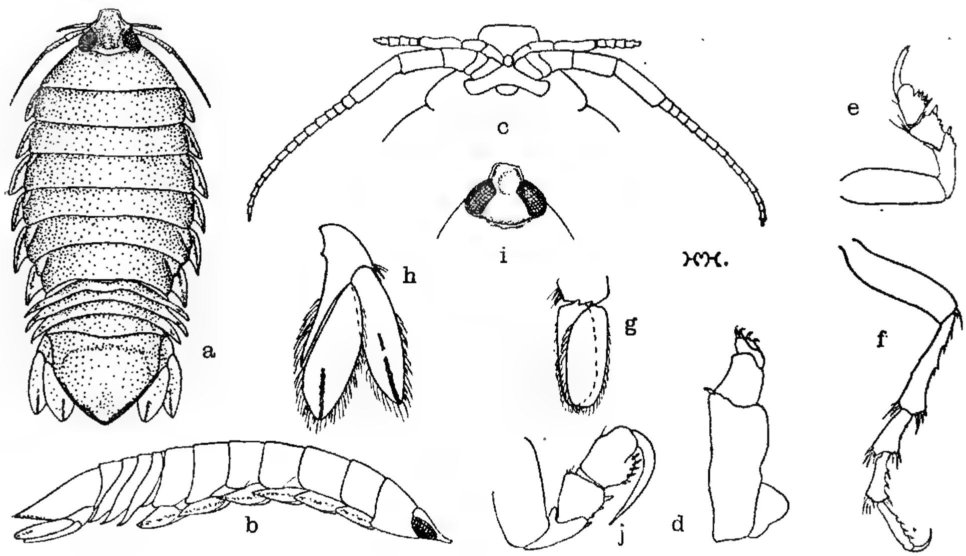

Fig. 28.

Rocinela sila, type female; a and b, dorsal and lateral views ($2\frac{1}{2}$ diams.); c, antennae, frontal lamina, clypeus and labrum (7 diams.); d, maxilliped (18 diams.); e and f, first and seventh peraeopods (5 diams.); g, first pleopod (5 diams.); h, uropod (5 diams.). Paratype female; i, cephalon ($3\frac{1}{2}$ diams.); j, first peraeopod (19 diams.).

lateral margins sinuate and incrassate, each almost as long as an eye; anterior margin truncate, a little incrassate. Eyes moderately large, well separated, the interocular width equal to the length of an eye. First antennae reaching to about first third of length of fifth peduncular article of second antennae; first and second articles of peduncle subequal in length, about two-thirds as long as third article; flagellum composed of four articles (not counting a very small and inconspicuous basal article) and a blunt terminal style which is united with the fourth article. Second antennae reaching very slightly beyond hinder margin of second peraeon segment; first article of peduncle more than twice as long as second, and third a little longer than first two together; fourth slightly longer than third and two-thirds as long as the fifth article; flagellum composed of fourteen articles and a narrow terminal style. Frontal lamina tiny, suboval in shape. Peraeon segments more or less subequal in length; anterior margin of first segment sinuate, with lateral portions slightly excavate. Coxal plates prominent in dorsal view, successively increasing in length backwards and with posterior angles subacute; plates of second segment reaching to level of posterior margins of segment; those of third segment extending slightly, and those of remaining segments more distinctly, beyond hinder margins of their segment. Greater part of first segment of pleon concealed beneath last peraeon segment, only a small part of the middle of the posterior margin and a short postero-lateral portion on each side being visible; lateral portions of second to fourth segments much produced, with the posterior angles acute and obscurely sub-bifid; width of second and third segments equal to that of last peraeon segment including the coxal plates; fifth longer than the others with the postero-lateral angles acute and partially covered by preceding segment; telsonic segment subtriangular, more than one-third wider than medianly long; antero-lateral margins sinuate and postero-lateral margins almost straight, converging to the angularly rounded apex, which is furnished with tiny spines and hairs. Uropoda not quite reaching to level of apex of pleon; protopod with a spine and three setae at outer posterior angle and with inner process reaching to about three-fourths of length of endopod; exopod scarcely shorter, but narrower than endopod, with apex subacute and with outer margin furnished with small spines; endopod with apex subacutely rounded and with outer and intero-posterior margins provided with tiny spines; margins of both branches and hinder half of inner margin of process of protopod with plumose hairs. Inner edge of propodus of first peraeopods with four spines; merus, carpus, and propodus of seventh peraeopods subequal in length; ischium about as long as merus and carpus together. Outer ramus of first pair of pleopods slightly wider than, and subequal in length to inner branch.

Colour in alcohol.—Yellow, closely dotted with brown chromatophores; lateral margins of first peraeon segment and of anterior parts of cephalon, and mid-line of each coxal plate, with a black stripe; telson with a suboval marking on middle of posterior fourth, and with postero-lateral margins black; each ramus of uropods with a median black streak on posterior half; projecting portions of pleon segments each with a small blackish marking.

Length, 20 mm.

Loc.—South Australia: Port Adelaide (type loc., W. H. Baker). Victoria: Port Phillip (Austr. Mus. Coll.). Type, female, in S. Austr. Mus., Reg. No. C281.

Only two specimens are before me. The Victorian example, which was collected many years ago, is mutilated; it is 23·5 mm. in length, and differs from the type in the following particulars: "the colour markings are more pronounced, the median black streak on the branches of the uropods extending for the whole length of each ramus, while the black line margining the postero-lateral parts of the telson is continued upwards as an inverted U-shaped marking. The eyes are a little larger, and less widely separated, and the propodus of the first peraeopods has five spines on the inner margin (fig. 28, *i* and *j*).

This species may be readily separated from *R. orientalis* by the characters given in the above key. In some respects it greatly resembles *R. japonica*, Rich.,[21] but differs in having the branches of the uropoda of different shape and not equal in width, in not having the lateral margins of the cephalon produced into a lobe in front of the eye on each side, and in having the telson relatively narrower.

(21) Rich., Proc. Amer. Philos. Soc., xxxvii., 1898, p. 15, figs. 7-9.

EVIDENCE AND INDICATIONS OF ALGAL CONTRIBUTIONS IN THE CAMBRIAN AND PRE-CAMBRIAN LIMESTONES OF SOUTH AUSTRALIA.

By D. Mawson, Kt., D.Sc., F.R.S.

[Read August 13, 1925.]

Plates XIII. to XV.

So far recorded, the only traces of organic life recognised in the Pre-Cambrian strata(1) of South Australia are, firstly, the discovery of radiolaria(2) in the Brighton limestone horizon and, secondly, the detection of possible fragments of crustacea(3) in beds immediately overlying this limestone.

Some years ago Cryptozoön(4) was reported as occurring in a limestone near the Burra in beds which have been demonstrated by Howchin to correspond to the Brighton horizon. On further investigation, however, this occurrence was determined(5) as pseudo-fossil and of inorganic origin.

Further up the stratigraphical sequence, in what is now generally regarded as the true Lower Cambrian, there are horizons rich in animal remains including Archaeocyathinae, mollusca, trilobites, pteropods, etc. That certain belts are rich in such forms has been long known. More recently a Girvanella horizon(6) has been discovered by Howchin in the Lower Cambrian of the Flinders Ranges.

Apart from the recognised fossiliferous belts in the Cambrian, there is a great development of limestones of Cambrian and Pre-Cambrian age in the State in which fossils have not been recorded and whose genesis is, so far, unaccounted. Curious and characteristic markings have long been observed in connection with certain of the outcrops, but so indefinite and wanting in cell structure are these features that geologists have hesitated to regard them as of organic origin.

Following upon the remarkable discoveries of algal remains in Pre-Cambrian formations in the United States,(7) Sir Edgeworth David(8) expressed the view that some of the older limestones of South Australia might prove to be algal. Evidence that such is the case is steadily accumulating. One more really clear and definite case has recently come under notice in the Flinders Ranges. This is an algal limestone composed almost entirely of Cryptozoön in which the structure is beautifully preserved. Elsewhere, also, markings strongly suggestive of algal forms have been noted. In the case of the banded limestones associated with the Archaeocyathinae horizon to the south of Adelaide their genesis can

(1) Adopting the suggestion made by Prof. Sir T. Edgeworth David that the "Adelaide Series" be regarded as Proterozoic in age (*vide* "Occurrence of remains of small Crustacea in the Proterozoic (?) or Lower Cambrian (?) Rocks of Reynella, near Adelaide," Trans. Roy. Soc. S. Austr., vol. xlvi., p. 6.

(2) "Note on the Occurrence of Casts of Radiolaria in Pre-Cambrian (?) Rocks of South Australia," by David and Howchin, Proc. Linn. Soc. N.S. Wales, 1896, part 4, p. 571.

(3) *Vide* Sir Edgeworth David, *loc. cit.*

(4) *Vide* Proc. Roy. Soc. S. Austr., vol. xlii., p. 297.

(5) "Geological Memoranda," by Prof. W. Howchin, Trans. Roy. Soc. S. Austr., vol. xlv., p. 27.

(6) "Geology of South Australia," 1918.

(7) "Pre-Cambrian Algonkian Algal Flora," by C. D. Walcott, Smithsonian Misc. Coll., vol. 64, No. 2, pp. 78-156.

(8) Private communication.

perhaps best be explained by assuming the co-operation of calcareous algal growths.

The Cryptozoön Beds of Italowie.

In the section across the Flinders Ranges, eastward from Copley, a region of limestones, slates, and quartzites is traversed. The evidence available, such as it is, indicates that the limestones, there met with, range in their stratigraphical position between the horizon of the Brighton limestone of the Adelaide Series (Proterozoic) and the limestones of the South Australian Lower Cambrian, typically represented by beds containing *Archaeocyathus*.

This inference of age is based, in the main, on indirect evidence. It rests for its lower limit on the fact that the tillite horizon of the Proterozoic, which is not very inferior to the horizon of the Brighton limestone, is either not met with at all in this section or, at least, certainly not to the westward of Italowie Gorge. Somewhat to the north, beyond Mount Rose, it does occur in strength, and is so disposed as to indicate the superior stratigraphic position of the rocks under question to the south. Though *Archaeocyathus* has not yet been clearly recognised along this line of section it does occur typically developed a few miles south of Copley (at the Ajax Mine), on the west side of the ranges, and on the east side at Wirrialpa, only a short distance to the south of Italowie. Further, some doubtful traces have been noted in the limestones in question, both at Balcanoona Station and in the succession of calcareous beds north of Campbell's Bald Hill Range. The lithological similarity of the greater portion of these beds with the succession recognised elsewhere in the Flinders Ranges as Lower Cambrian by Howchin,[9] coupled with the absence of fossils indicating a later age, and the absence of any obvious unconformity, fairly certainly limits the upward range of the age of these beds to the Lower Cambrian.

In a recent passage across the ranges, eastward of Copley, *via* Angipena to Balcanoona, the author hastily examined the limestones for fossil remains in several localities. At a point about one and a half miles west of Italowie Gorge, beds of limestone dipping at a moderate angle are traversed by the road, and even as viewed from a car are seen to exhibit curious markings. On inspection, this feature was found to be due to massed fossil heads of a Cryptozoön-like alga. It is developed in a massive formation, the algal remains constituting the bulk of at least some of the beds. The interspaces between the bluish-grey limestone of the algal beds is packed with calcareous silt of somewhat different texture and colour. The general macroscopic appearance of the Cryptozoön is illustrated in pl. xiii., in which the laminated structure is clearly indicated. A superficial comparison with the fossil algae discovered by Chewings[10] in the MacDonnell Ranges, and described by Howchin[11] as Cryptozoön, reveals no essential point of difference; there is good reason to regard them as identical species.

As there is no indication of this Flinders Ranges formation being younger than Lower Cambrian, an age no newer is suggested for the Cryptozoön limestones of the MacDonnell Ranges. This is in accordance with Chewings' views, but Mr. L. K. Ward[12] has recently suggested that the MacDonnell Ranges Cryptozoön horizon is probably a part of the Larapintine formation, and therefore Ordovician.

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(9) *Loc. cit.* (6). (Adopting the usage of Lower Cambrian as referring to the Archaeocyathinae-containing beds.)

(10) "Notes on the Stratigraphy of Central Australia," by Dr. C. Chewings, Trans. Roy. Soc. S. Austr., vol. xxxviii., p. 41.

(11) "The Occurrence of the Genus Cryptozoön in the (?) Cambrian of Australia," Trans. Roy. Soc. S. Austr., vol. xxxviii., p. 1.

(12) "Notes on the Geological Structure of Central Australia," Trans. Roy. Soc. S. Austr., vol. xlix.

The Cryptozoön limestone of the Flinders Ranges lies some distance above, and appears to be conformable with the Italowie Gorge quartzite which is perhaps the most conspicuous horizon of that region. Time did not permit of a proper search for Archaeocyathinae remains, but it is possible that the same may be located adjacent to the Cryptozoön-bearing limestone.

Limestones West of Wooltana.

In another area in the Flinders Ranges, some 35 miles north of Italowie and about 9 miles west of Wooltana Head Station, is a region of calcareous strata superior to the Proterozoic tillite horizon. Thereabouts curious markings were noted in the rocks in several places suggestive of organic origin. In the case of some boulders in the creek at McLeach's Well, the markings in the rock very closely resemble the packed fan-shaped segments of *Halimeda*.[13]

The limestones of this horizon appear to correspond to the Brighton horizon of the Adelaide Series, for they overlie laminated slates which, in turn, rest upon the Proterozoic tillite. Here, however, the calcareous series is of much greater thickness than near Adelaide; so it may be that in the northern Flinders Ranges there is a regular calcareous progression up into the Archaeocyathinae beds.

The rock with the markings resembling *Halimeda*, though not located *in situ*, is certainly amongst the highest of the members of the Series. None of the boulders noted showed a positive organic structure, and were discarded with the expectation of securing more definite material. But the traverse, after leaving McLeach's Well *en route* for Mount Painter, proved so strenuous, working pack camels through rough and almost virgin country, that no further attention was paid to the fossil contents of the limestones and, in the end, no single example of the rock in question was brought back for examination.

Limestones in the Vicinity of the Burra.

Some years ago the author located, in limestones near the Edelweiss Mine, fossil-like nodules of rather indefinite form. They are of smooth rounded or flattened horn-shaped outline up to 2 inches across. Though without definite internal structure they show an interesting cross-section. A horizontal cross-section of one of these examined microscopically is oval in outline, being $1\frac{1}{5}$ inches by $\frac{9}{10}$ of an inch in over-all measurement. The central portion is light coloured and surrounded by a peripheral ring, one-fifth of an inch broad, of a darker colour, in which the colouration is due to what appears to be carbonaceous matter. When collected it was thought that they possibly represented forms related to sponges, but it is now thought that they may possibly be of algal origin, which would be more in accord with their irregularity in form. It is hoped that better preserved examples may yet be found in order to clear up the matter.

In another locality, in what is probably the same horizon, about one mile north-west of the Thirty Pound Pool on the Burra Creek, indistinct fossil remains have recently been noted in limestone. These also are circular and elliptical in cross-section, and as much as $1\frac{1}{2}$ inches in major diameter. No cell structure is preserved in the examples so far collected, though the class of limestone in which they appear is most suitable for preservation of fossil remains. Here again the impressions may originate from an alga or from some member of the groups Porifera or Coelenterata.

Both these limestones in the neighbourhood of the Burra are taken to be referable to the Brighton limestone horizon of the Proterozoic.

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(13) "Halimeda Limestones of the New Hebrides," by Chapman and Mawson, Q.J.G.S., vol. lxii., p. 702.

Sellick's Hill and Normanville Limestones.

The belt of calcareous strata of Lower Cambrian age extending between Sellick's Hill and Normanville presents certain special features, the genesis of which is better comprehended on the assumption of algal co-operation. Sections of the strata have been examined both at Sellick's Hill and at Carrickalinga Head, near Normanville, and the succession appears to be comparable in both places. The section measured across the beds at Sellick's Hill proved to be as stated below, measured downwards from the lower of two very prominent flinty quartzite horizons which extend along the hillside above the limestone:—

12	feet	—Hard flinty quartzite (the lower of two such bands).
324	,,	—Sandstone series. Sandstones and sandy shales.
21	,,	—Grey marble.
372	,,	—Argillaceous sandstones, somewhat calcareous below.
135	,,	—Calcareous slate.
276	,,	—Slaty rock composed of lamellae one inch to half an inch thick of mud silt nature, alternating with others rich in calcium carbonate.
60	,,	—Principally "mottled" rock. A mixture of purer limestone nodules in a silt base.
396	,,	—Strong and massive Archaeocyathinae limestone.
27	,,	—"Mottled" rock.
174	,,	—A strong development of Archaeocyathinae limestone.
39	,,	—"Mottled" rock.
57	,,	—Banded calcareous beds. Bands of purer limestone alternating with others of the nature of calcareous silt. Laminations from 1 inch to 4 inches in thickness.
153	,,	—Calcareous slates in which are some thin calcareous laminae.
1,100	,,	—Slate series, darkened with carbonaceous matter in some horizons.

The massive Archaeocyathinae limestone, the banded limestones on either side of it (see pl. xiv.), and the "mottled" rock, composed of limestone cakes in a calcareous silt base are the features of special interest.

It is easy to account for the massive limestone of the central belt, in which traces of Archaeocyathinae are abundant, by regarding it as analogous to coral reef limestones of the present day.

The genesis of the banded beds of limestone and silt is perhaps best explained as alternating depositions of silt from some neighbouring land mass, and of calcareous mud from a nearby "coral" reef, the latter appearing in the section in the middle zone of the beds.

But in some of the stronger limestone bands considerably below the massive limestone occasional clearly marked forms of Archaeocyathus have been detected. This fact may be taken as evidence of organic growths *in situ,* which means that the calcium carbonate of the beds is not at all derived from transported calcareous mud. But there is a general absence of organic structure in the bands.

Of all the organisms of "coral" reef growths, the calcareous algae are perhaps the most prolific in the production of calcareous mud, for they readily disintegrate. Even when they are well entombed before disintegration, the cell structure usually quickly disappears, and at the most only the broad outlines remain.

Certain of the "mottled" rock formations at Sellick's Hill, and particularly at Normanville (see pl. xv.), in which cakes and patches of limestone are embedded in an intricate fashion in silt rocks, rather suggest the burial of limestone biscuit growths on a mud bottom. There are, however, no lines of growth showing. In the absence of the latter there is no positive evidence of the structure being organic.

An alternative explanation of the curious features of this rock is that of crush and working of the beds, which may have taken place during the period of orogenic movement which tilted and folded the series into the present position.

In the case of one class of mottled rocks from Sellick's Hill, the limestone fragments are rather angular and bedded in silt which shows stream lines around them. This appears to be a case of interformational breccia.

On a visit to Normanville some two years ago, in co-operation with Mr. C. T. Madigan, we noticed occasional organic markings on the faces of the calcareous sandy rocks of the shore line just north of the jetty near Carrickalinga Head. Some of these suggested worm burrows, but in one case an irregular form exhibited, on weathering, a meshwork within of what appeared to be undifferentiated cells. This suggests an algal growth.

It is confidently predicted that, with the stimulation of observation in this direction, the role of the algae in contributing to the building of the older limestones of the State will be found to be considerable.

DESCRIPTION OF PLATES XIII. TO XV.

Plate XIII.

Fig. 1. Cross-section of a Cryptozoön growth, Italowie.
Fig. 2. Longitudinal-section of same.

Plate XIV.

Fig. 1. A phase of the banded limestone below the Archaeocyathinae marble at Sellick's Hill.

Fig. 2. An exposure of the banded limestone near Carrickalinga Head.

Plate XV.

Fig. 1. Face of mottled rock near Carrickalinga Head. View perpendicular to the direction of strike.

Fig. 2. Ditto. View perpendicular to the foregoing.

THE TANUNDA CREEK GRANITE AND ITS FIELD RELATIONS.

By Paul S. Hossfeld, B.Sc.

[Read September 10, 1925.]

With Geological Map.

The granite described in this paper occurs in the Barossa Ranges to the south-east of Tanunda. Two disconnected outcrops are exposed in the bed of the Tanunda Creek and, so far as observed, this granite occurs only within the drainage area of that stream. The southern limits of the granite were not determined, but work in this direction is intended in the near future.

In addition to the outcrops of the Tanunda Creek granite, the other rocks in the vicinity were examined in detail, in order to ascertain their relation to the granite and the ages both of intrusive and intruded rocks. That all of these points have not been definitely decided is due to the comparatively small area examined, the extremely meagre information available about the adjoining areas, and the comparative scarcity of outcrops in many parts of the district. The rocks of the neighbourhood may be described under three main headings:—

1. The Sedimentary Rocks.
2. The Tanunda Greek Granite.
3. Other Igneous Intrusions.

1. The Sedimentary Rocks.

These fall naturally into two divisions: the Tertiary and Recent deposits, and the Palaeozoic rocks. A description of the former will be reserved for a future paper.

The Palaeozoic rocks are divisible into a newer and an older series.

The Older Series.

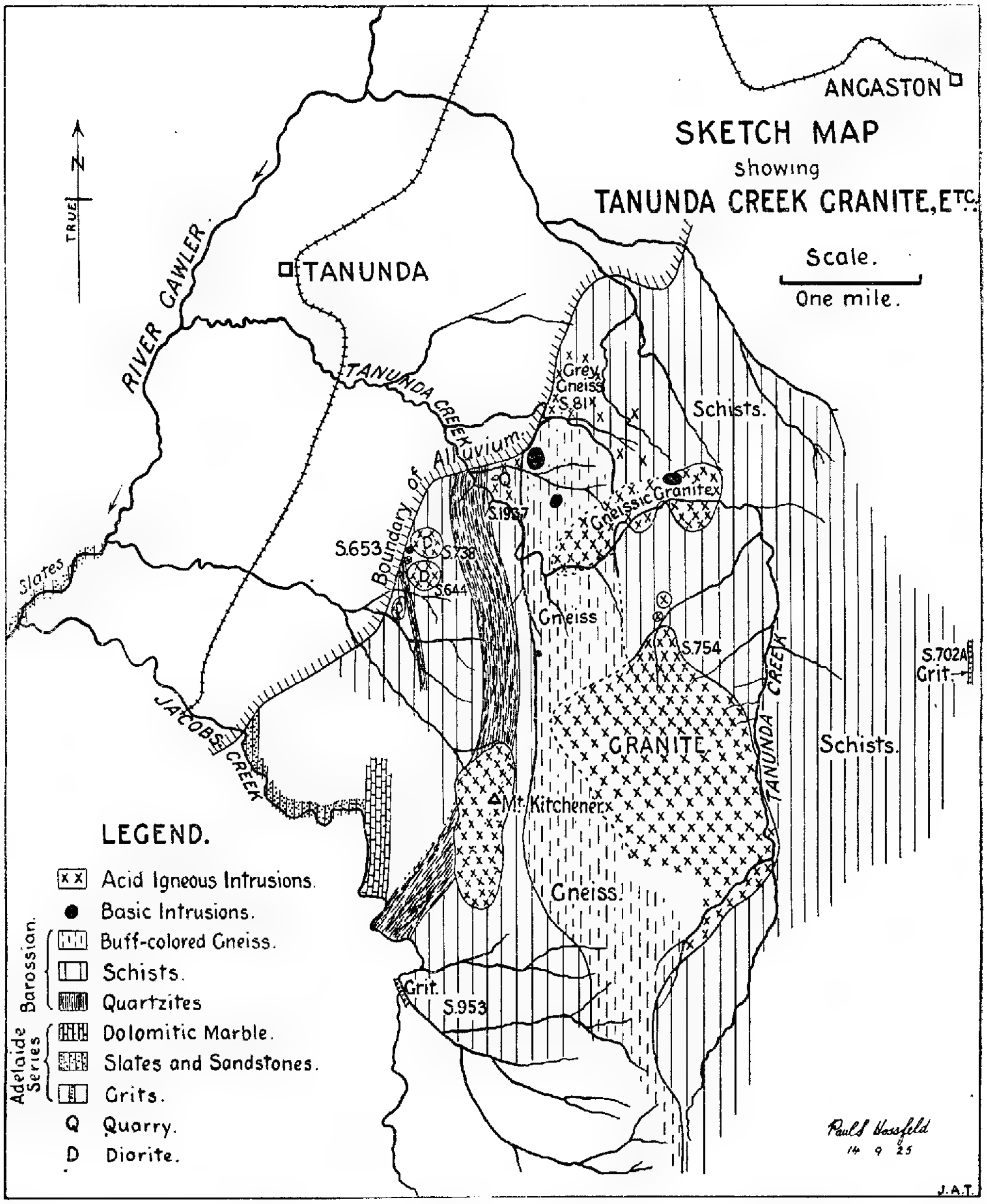
In the localities examined, they form the major portion of the Barossa Ranges, but do not outcrop outside that area. These rocks consist of schists, quartzites, and gneisses.

The schists include biotite-, muscovite-, and talc-schists, and vary from rocks containing no apparent quartz to some in which quartz is the predominating mineral.

The quartzites vary from an almost pure quartz rock, schistose in some exposures, to very much epidotized quartzites, and are everywhere very dense, having undergone extensive secondary silicification.

As is to be expected, the quartzites form the prominent outcrops, while the schists are frequently not exposed at all except in the creek beds. The strike of these rocks as determined at the junctions of quartzite and schist is in a general north and south direction, but somewhat variable. The schistosity has a general north and south trend, with an approximately vertical dip.

The gneisses outcrop along the central portion of this area. They occupy a belt of country of variable width, the average being about three-quarters of a mile. They end abruptly to the north in Section 82, Hundred of Moorooroo, but extend southwards to an as yet undetermined distance. These gneisses are in the main composed of quartz, felspar, and biotite, with textures ranging from granitic to saccharoidal. Where unaltered by igneous intrusion they are buff coloured. They form parallel ridges capped by huge tors, and are almost bare of vegetation. Occasionally, thin bands of very much altered schists can be



observed. These gneisses may be either of igneous or of sedimentary origin. In the opinion of the writer they will prove to be the remains of a series much older than the surrounding schists and quartzites, and probably represent a much altered complex of igneous and sedimentary rocks. These assumptions are based on the following reasons:—

1. If the gneisses represented an altered igneous rock intruded into the schists and quartzites, some evidence should be observable of contact metamorphism and pegmatization of the intruded rocks, but along the whole length of contact examined no such evidence could be found, and the transition from the gneiss to the adjacent rocks is everywhere sharply defined.

2. The detailed mapping of the rocks concerned shows that the outcrop of the gneisses is distinctly unconformable to the above-mentioned quartzites. Further proof is required before the matter can be said to be definitely settled. If, however, this is the case, then these rocks, that is, the schists, quartzites, and gneisses, which probably are the local representatives of the "Barossian Rocks," are divisable into two distinct periods.

The Newer Series.

These consist of sandstones, sandy slates, slates, and an occasional bed of grit and of dolomitic marble. Junctions with the older series were observed in Section 953, in a creek coming from the east, near its junction with the Jacob's Creek, and on Section 702A. In the former case the rock immediately succeeding the mica schist is a grit consisting of quartz, felspar, and mica. The direction of the junction is N. 35° W., while the strike of the grit is N. 22° W., both true.

Proceeding westwards across the strike, the beds are metamorphosed to a much lesser degree; in fact, the intense metamorphism so characteristic of the older series, ceases abruptly with the beginning of the grit, and the successive beds consist of dolomitic marble, siliceous sandstone, and slates.

On Section 702A the metamorphism likewise lessens abruptly, and the bed immediately overlying the schist is a white felspathic grit, the next outcrop visible to the east being a grey sandstone. From their similarity to the beds occurring a few miles to the north-east, which latter have been determined by the writer as definitely belonging to the Adelaide Series, the beds of the above newer series are taken to represent the lower members of the Adelaide Series.

2. The Tanunda Creek Granite.

This granite outcrops in the drainage area of the Tanunda Creek, and is exposed over an area of approximately two and a half square miles. It is intruded into the schists and gneisses of the older series referred to above, but nowhere into the rocks belonging to the newer series.

The schists and gneisses have undergone much pegmatization in the vicinity of the intrusion. This is much more readily observable in the schists, but can frequently be detected in the gneisses by the presence of the pink felspar contributed by the granite.

The granite outcrops in two main areas: a smaller one in Sections 775 and 747, and a larger one to the south, with several small outcrops between the two. The most northerly area is very much gneissified, the gneissic structure becoming less pronounced towards the south, being least so in the area around Section 754, in the vicinity of which some of it has been quarried and, it is said, used for monumental work.

The granite occurs in more or less disconnected tors, separated by sandy soil containing felspathic fragments. The whole of the area immediately underlain by the granite is covered by a dense scrub of stringybark and grass trees, so that it is impossible to see even the largest outcrops from a greater distance than a hundred yards. This is in marked contrast to the mica schist areas which are characterized by open country with occasional big timber, while the buff-coloured gneisses are almost bare of all vegetation.

The specimens for chemical analysis, microscopic examination, etc., were selected from Section 754, where the granite, although still very slightly gneissic, exhibited the smallest degree of gneissification observed. The slides were cut in various directions in order to minimise any error liable to be introduced by this structure.

Macroscopically examined the rock is medium-grained and holocrystalline. It contains felspar, quartz, and biotite. The felspar consists mainly of flesh-coloured crystals of orthoclase which give the whole rock a pink tinge. Occasionally crystals of white plagioclase can be seen. The quartz is grey and transparent with a vitreous lustre. A few flakes of black biotite occur.

Microscopic Description.

The rock is holocrystalline and possesses an allotriomorphic granular texture. The crystal components are of variable size, the average being from 1 to 2 mm. The minerals present are the following:—

Quartz: colourless, transparent, with few inclusions. Many show some evidence of strain shadow extinction. The quartz is distributed irregularly, and occasionally shows micrographic intergrowth with the felspar.

Felspars: microcline and andesine.

The microcline is the most abundant mineral. The crystals are up to 4 mm. across, and exhibit the crosshatching caused by the presence of both pericline and albite lamellae. According to the relative thinness of the lamellae and the chemical composition of the rock, this mineral must contain a relatively high percentage of soda.

The plagioclase felspar is much less abundant and appears in smaller individuals. A number of the crystals show dusty inclusions. The lamellae are somewhat broader than is usual in albite. As determined on a number of pairs of extinction angles on crystals showing twinning according to both the albite and the carlsbad laws, this plagioclase was found to correspond to the formula Ab_5An_3, which places it amongst the andesine felspars.

Biotite.—A few crystals scattered irregularly through the rock. They exhibit pleochroism varying from dark greenish-brown to light yellowish-brown. Some of them contain pleochroic halos, generally with a small crystal of colourless zircon at the centre.

Muscovite.—Occurs in small amount, both free and included in the felspar.

Zircon.—Clear, colourless crystals occur occasionally both in the biotite, and in association with the magnetite. They are small and exhibit the usual optical properties.

Magnetite.—This occurs in irregular patches frequently associated with biotite and zircon. According to the chemical analysis, it probably is a titaniferous magnetite. Some of the magnetite occurs filling spaces between the quartzes and felspars.

The Mode.

The data for the calculation of the mode were obtained by the Delesse-Rosiwal method of micrometric analysis. Owing to the irregularity in distribution of the minerals, especially of the quartz, the results are not as accurate as could be desired, but are sufficiently exact to enable comparison to be made with the norm and the specific gravity of the rock. After due consideration of the optical properties of the minerals, the specific gravities used were chosen as being approximately correct.

	Total Diameter.	Relative Volumes.	Specific Gravity.	Total Weight.	Percentage Weight.
Quartz ..	622	36·6	2·65	96·99	36·06
Microcline ..	824	47·9	2·56	122·62	45·59
Plagioclase ..	190	11·1	2·65	29·41	10·94
Biotite ..	41	2·4	3·0	7·20	2·68
Muscovite ..	10	·6	2·7	1·62	·60
Magnetite ..	33	1·9	5·1	9·69	3·60
Zircon ..	6	·3	4·7	1·41	·52
	1726	100·8		268·94	99·99

This would give for the specific gravity:—

$$\frac{268{\cdot}94}{100{\cdot}8} = 2{\cdot}668$$

The Chemical Analysis.

	Percentage of constituent.
Silica (SiO_2)	77·05
Alumina (Al_2O_3)	12·24
Ferric Oxide (Fe_2O_3)	·47
Ferrous Oxide (FeO)	·54
Magnesia (MgO)	·10
Calcium Oxide (CaO)	·20
Soda (Na_2O)	4·24
Potash (K_2O)	4·86
Water below 110° (Hygroscopic)	·10
Water above 110° (combined)	·21
Carbon Dioxide (CO_2)	n.d.
Titanium Dioxide (TiO_2)	·36
Phosphorus Pentoxide (P_2O_5)	·02
Sulphur and Sulphur Trioxide (SO_3)	absent
Baryta (BaO)	·01
Manganous Oxide (MnO)	·06
Zirconia (ZrO_2)	·10
Total	100·56

The CO_2 was not determined, as no effervescence could be observed.

The Norm.

	Percentage.	Group of Standard Minerals	
Quartz	33·30	Q=33·30	Salic Group= 98·02%
Orthoclase	28·91	F=64·54	
Albite	35·63		
Zircon	·18	Z= ·18	
Diopside: CaO, SiO_2 ..	·46	P= ·89	Femic Group= 2·38%
Diopside: MgO, SiO_2 ..	·30		
Diopside: FeO, SiO_2 ..	·13		
Magnetite	·70	M= 1·46	
Ilmenite	·76		
Apatite	·03	A= 0·3	
Water	·31		
Total	100·7		

In the C.I.P.W. Classification the rock, therefore, is a Liparose.

The specific gravity of the granite was determined by weighing the rock in water on a chemical balance after having first boiled it to expel all the air, and, later, the weight in air was determined after drying the rock at 100° C. until constant.

The specific gravity obtained equals:—

$$\frac{\text{Weight of Rock}}{\text{Volume}} = \frac{15\cdot4534}{5\cdot8759}\text{ grms.} = 2\cdot6399$$

3. Other Igneous Intrusions.

These may be divided into Acid and Basic Rocks.

The Acid Igneous Rocks.

These occur in two separate areas:—

a. The Mount Kitchener Intrusion.
b. The other Acid Intrusions.

a. The Mount Kitchener Intrusion.

Mount Kitchener, formerly known as The Kaiserstuhl, is the highest point in the Barossa Ranges. It is a long hill with its axis in a north and south direction. The igneous rock is intruded into the rocks of the older series, and chiefly into quartzite, some of which appears to have remained as a roof pendant. The intruded rock is a yellowish biotite granite, containing quartz, felspar (microcline and some plagioclase), and very abundant biotite.

b. The other Acid Intrusions.

These occur along the western margin of the Barossa Ranges. Three distinct types are recorded. A grey gneiss occurring on Sections 81, 80, 1936, and 1937, several outcrops of a diorite on Sections 738, 644, and 643, and a small area of syenite on Section 653.

No large body of gneiss could be observed, but the whole of the intrusion seems to consist of closely spaced veins. This rock consists of microcline, plagioclase, quartz, and some sphene. It intrudes the quartz biotite schists, and, in a quarry face on Section 1936, forms at least one-third of the rock. Its schistosity is always parallel to the walls of the veins which may be several feet wide, and at various angles to the foliation of the intruded rock. It is therefore to be regarded as a primary gneiss of the flow type.

The diorite consists of hornblende, plagioclase, and a little quartz, with occasional crystals of pyrites.

A small outcrop on Section 653 probably represents a hornblende syenite. The component minerals are: hornblende, felspar (which appears to be dominantly orthoclase), and a little pyrites.

The Basic Intrusions.

These are fairly numerous and occur mainly as dykes, although a few larger intrusions were observed. Several varieties occur.

The one specially examined occurs on Section 738 as a coarsely crystalline dyke, and consists of pyroxene, plagioclase, and some iron ore.

Summary.

The locality described in this paper has an area of, approximately, 15 square miles. The Palaeozoic rocks in this district have been divided into two unconformable series: the Adelaide Series and the Barossian. The writer has stated it as his opinion that the latter consist of the rocks of two periods, the buff-coloured gneisses being the most conspicuous representatives of the older one.

A large number of igneous rocks have been collected, many of them not described in this paper. The Tanunda Creek granite has been determined to be a potash-soda granite, and, in the C.I.P.W. Classification, a Liparose. The igneous intrusions are confined to the rocks older than the Adelaide Series, although but a few miles to the north of Angaston, the writer has mapped a number of igneous rocks intrusive into that Series. They are, however, all small and of an entirely different character from any seen in the Barossa Ranges.

All the evidence available at present indicates that these igneous intrusions are Post-Barossian and Pre-Adelaidean.

Acknowledgments.

The writer is indebted to Professor Sir Douglas Mawson for his assistance and advice in the preparation of this paper, and to Mr. and Mrs. B. Lindner, of Krondorf, whose hospitality and help have greatly facilitated the geological examination of the district, and also to Dr. Fenner for his assistance in the publication of the accompanying map.

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University, Adelaide.

THE GEOLOGY OF THE FLEURIEU PENINSULA.
PART I.—THE COAST FROM SELLICK'S HILL TO VICTOR HARBOUR.

By C. T. Madigan, M.A., B.Sc.

[Read September 10, 1925.]

Plates XVI. to XX.

For a commencement of the further study of the geology of the Mount Lofty Ranges, their southern extremity, the coast of the Fleurieu Peninsula, offered obvious advantages. The coast is precipitous, with good rock exposures in the cliffs and numerous creeks, and also a large part of it has not previously been visited by geologists. The following paper is the result of eight weeks of field work during 1924 and 1925, covering six separate excursions. The whole of the coast from Sellick's Hill to Victor Harbour, about 65 miles, was traversed on foot, and several sections were run inland on the west coast.

The sections given are drawn to true scale from the field survey plans, and show correct dips, with due regard to the direction of section, and widths of outcrops. The thickness of formations was graphically determined from the plans and sections. Owing to the large area covered, detailed plans are not reproduced, but a locality map of the whole area is included, with the broader formations shown in colour with as much accuracy as the scale permits.

The paper contains no detailed petrographical work, but deals only with the field observations of the broader features. The bearings given are all magnetic. The variation is about 6° E.

Sellick's Hill.

This is the starting point, and is fairly well-known ground. Little time was spent here, as Professor Howchin has published an account of the beds (Trans. Roy. Soc. S. Austr., vol. xxi., 1897, and Geol. S. Austr., p. 370, fig. 287). Section I. was compiled from the author's own observations, and shows the broader features. It is included for comparison with other sections, and for the same reason a brief description must be given here. The lower beds at the base of the hill are dark slates weathering to a purple or yellow colour near the surface, fairly soft, and jointed, but with cleavage not well developed. Their thickness to the point where they disappear under the outwash fan of clays and gravels on the lower slopes is 1,800 feet. The most interesting feature about them is the occurrence in the slate of small black nodules, about the size of a pea or less, throughout the whole series, often only a few inches apart, or in clusters. These were first noted by Howchin *(loc. cit.)* and are receiving special attention from Sir Edgeworth David.

Above, the slates merge into mottled limestone, a shaly limestone with irregular lenses of argillaceous matter interleaved with the limestone. This formation is the subject of a paper in this volume by Sir Douglas Mawson. The bed is here narrow and soon merges into solid Archaeocyathinae limestone, in which fossils are numerous at the base at the junction of creeks above the bridge, rarer at the top in the neighbourhood of the quarry just off the main road up the hill, a thickness of 600 feet. The quarry is on the border of the massive limestone and the overlying flaggy limestone beds. These upper beds show a strong resemblance in their mottled appearance to the beds below the fossiliferous horizon, though in this section they are in narrow and better defined bands, and weather to serrated blocks on the surface, of very striking appearance (pl. xvi., fig. 1), characteristic of both the upper and lower flaggy beds, though more noticeable in the upper bed here. This feature is frequently referred to below. Howchin mentions the ease with which the Archaeocyathinae limestone may be followed by means of these outcrops. The total thickness of the calcareous series is 850 feet.

Above this bed the quartzites begin, and in the quartzites are two well-defined horizons whose outcrops can be seen as white parallel ridges running for miles to the N.N.E. over the foothills. They are both dense, fine-grained quartzites, 50 to 60 feet thick, showing faint bedding planes. The quartzites are much coarser in parts below. Above the second white belt the series becomes more slaty, and bright yellow, red, and chocolate-coloured arenaceous slates continue to the top of the hill, the Hundred boundary. The strike of the beds is N. 23° E., and dip 60° easterly.

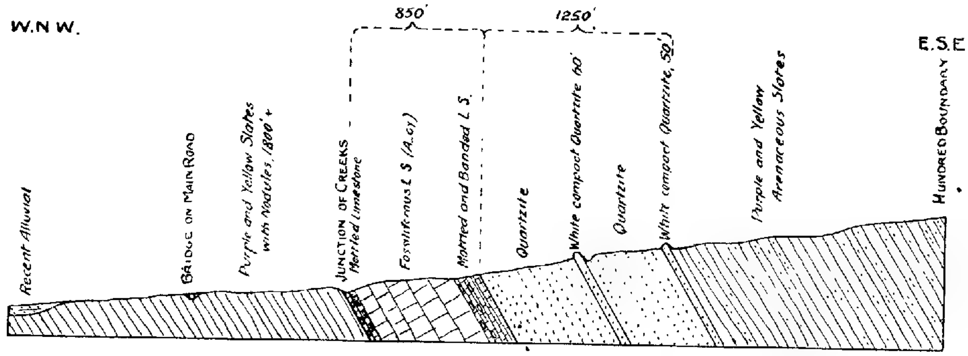
Sellick's Hill is at the western extremity of the Willunga scarp, and here the flat beaches of the alluvial and Tertiary plains to the north give way to a rocky elevated coast deeply dissected by streams, which continues with rock exposures all round the peninsula, with the exception of the Yankalilla valley at Normanville. The Sellick's Hill formations may be followed with ease all along the coast to Normanville, a distance of 12 miles.

Miocene limestone occurs on the beach, near Sellick's Hill, in small patches, showing much tilting in places, as described by Clark (Trans. Roy. Soc. S. Austr., vol. xxiv., 1899) and Howchin *(Ibid.,* vol. xxxv., 1911), but at no other point on the coast between this locality and Victor Harbour.

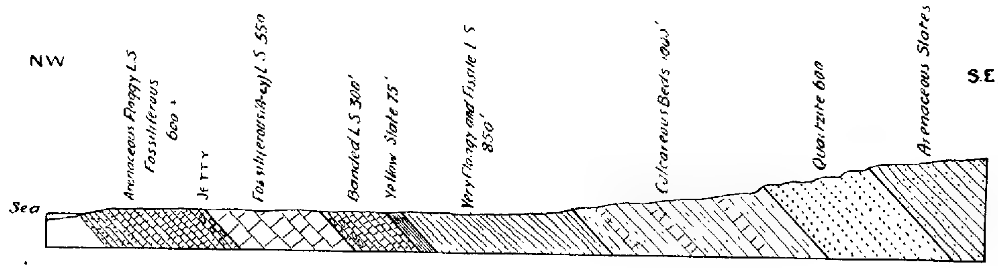
Myponga Jetty.

More detailed work was done in this locality, and sections were run up two small creeks from the Myponga River, one from the first bend in the river near the bridge, south-east, into Section 685 (Hd. Myponga), and one south from the same point into Section 661, about two miles. The rocks at the coast are the lower flaggy beds below the Archaeocyathinae limestone. To the east of the jetty, at the point on the east side of the cove, there are great blocks of the flaggy limestone weathered in the typical serrations (pl. xvi., fig. 2). These beds form the cliffs, with massive Archaeocyathinae limestone beginning at the top of the cliffs and extending inland to the road in Section 688. Fossils were found in the field between the cliff and the road.

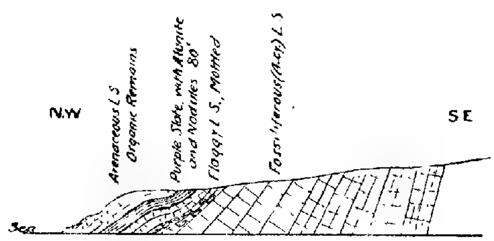
On the west side of the cove, from the river mouth to the old jetty, Archaeocyathinae limestone occurs, with fossils to be seen in the rock quarried for flux on the spot, piled at the end of the now useless jetty. Following the shore towards the western point, the flaggy beds are again entered. The coast follows the strike of the rocks, W. 28° S., for half a mile in a straight line from the western side of the cove, and this stretch was found to be of very particular interest. The flaggy beds are here variable and more arenaceous, though still showing the typical serrated structure in weathered boulders. In the cliffs themselves are seen great masses of black limestone up to 10 feet in diameter, in a yellow arenaceous slate, an extreme case of the "mottled" limestone, but it is in the blocks and slabs on the shore that the chief interest lies. On the faces of many of these are standing out in relief countless tube-like ridges, varying in size from one-quarter inch to one-thirty-second inch in diameter, crossing in and out amongst each other and never running straight for more than a few inches at a time, with here and there flattened nodules the size of peas and larger. They resemble, at first sight, worm casts or burrows, but they never appear to enter one another, and the sizes are quite mixed. They give the impression of flattened interlaced branches and twigs of trees, with occasional remains of fruits. They are almost certainly of organic origin, probably an algal type, and a new form below the Archaeocyathinae



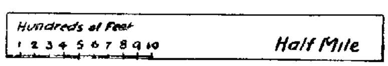
S. I. SECTION AT SELLICKS HILL, 1¼ MILES



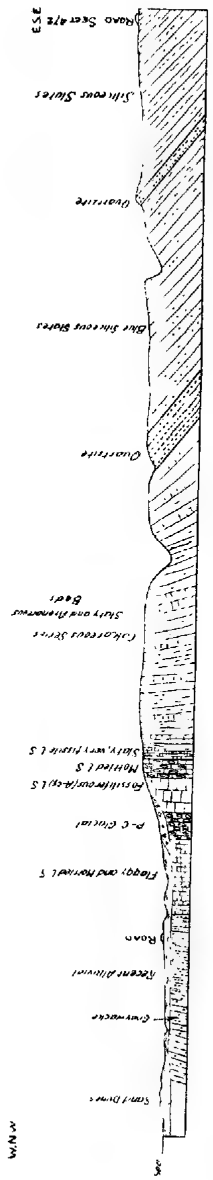
S II SECTION S.E. FROM MYPONGA JETTY, 1 MILE.



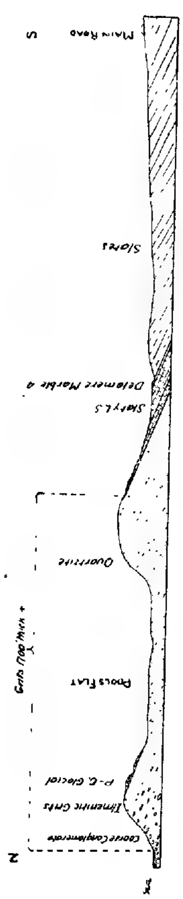
S.III. SECTION AT CARRICKALINGA HEAD, ½ MILE



Scale of Sects I - III (Hor = Vert.)



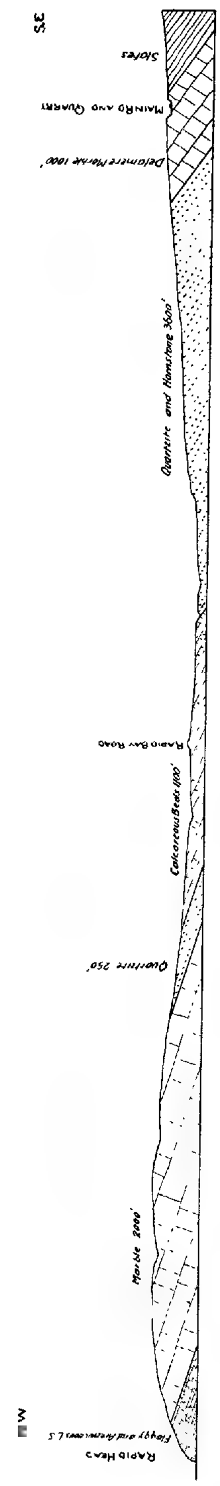
S IV Section up Carrickalinga Creek, 2 Miles



Hundreds of feet 1 2 3 4 5 6 7 8 9 10 Half Mile

Scale of Sects IV and V (Hor. Vert)

S V Section up R Congeratinga, from Pools Flat to Main Rd. 1½ Miles.



S VI Section from Rapid Head S E. to Main Road, 4 Miles. (Scale = 2/3 that of Sects IV and V) limestone, with doubtless an important bearing on the nodules referred to at Sellick's Hill. Several large slabs were brought in, and the occurrence will be dealt with in a separate paper after further investigation. The appearance of these slabs is most remarkable, and quite unlike anything ever seen before by the author. Other fossils also occur in this horizon. Miss M. U. Pitt, B.Sc., found a slab covered with pteropods standing out in strong relief, but was unable to discover any others in the locality, though she searched along the strike. The pteropods are in the same yellowish arenaceous limestone as the other markings. Weathering has brought the sand grains into relief. The remains were found 500 feet below limestone containing Archaeocyathinae.

The lower flaggy beds are here exposed to a thickness of 500 feet, and pass under the sea. Section II. runs from the western side of the cove in a south-easterly direction, inland, for a mile. Above the upper mottled beds, which are well exposed in the river bank just above the bridge and are in regular bands 2 inches wide, a narrow yellow slate 75 feet thick occurs, followed by very fissile and uniform flaggy limestone for a thickness of 850 feet. The river takes the last sharp turn when it meets this hard belt, following the strike of the beds for some distance in Sections 683 and 684. Above this formation are more variable calcareous beds, mainly of a flaggy nature, with belts of stronger limestone for a further thickness of 1,000 feet, giving a total thickness for the calcareous series from the top to the sea, which is probably very near the base, of 3,375 feet. Quartzites again overlie the calcareous series with a definite thickness of 600 feet. In places they are a fairly coarse grit, and, again, fine-grained and flinty. They give rise to small falls and rapids in the creek flowing north along the western sides of Section 675 and in the north-eastern corner of Section 450. Above the quartzites the slates were followed for a mile inland across the strike. These slates are of an arenaceous nature as at Sellick's Hill. The strike is remarkably constant at about N. 55° E. across the section, and the dip 50° S.E.

The sand dunes in the centre of the cove have been a much frequented camping ground for natives. Kitchen middens and chipped stones are plentiful. There are also large patches of cementation sandy tubes standing up vertically out of the sand where the dunes have been somewhat denuded.

Carrickalinga Head.

The beds swing round to a more southerly direction from Myponga Jetty, the coast following the strike of the lower flaggy beds. Carrickalinga Head, Carrickalinga Creek, and the vicinity of Haycock Point Jetty, make a very interesting locality, particularly as the Yankalilla valley follows, with a break in the continuity of the outcrops.

Section III. runs inland from Carrickalinga Head. Just north of the head, in Section 265, is a deep, steep, and short gully running down to the sea, providing instructive exposures. In one other locality only, an isolated outcrop at Waitpinga Beach, in the whole area under review, is there a reversal of dip, which is here on the western side of the strike. In all other places it is to the eastern side. At the beach, at the Head itself, the dip is as low as 30° west, but rapidly steepens up to 70° as we go inland. The fact that the dip increases so quickly, the beds are not repeated inland, and are here found to be in reverse order, discounts the possibility of anticlinal folding. The reversal of dip is ascribed to the outward thrust of the sinking blocks of the Gulf Rift Valley.

On the beach itself are the lower flaggy beds, followed from Myponga Jetty, with bands of limestone and shale 2 to 3 inches wide. In the cliffs, in the gully section, is seen a bed of reddish to dark-coloured slate 80 feet thick, found to contain dark nodules exactly resembling the lower beds at Sellick's Hill, and above this, yellowish arenaceous beds with minute mica flakes, referred to as graywacke in this section. In the bottom of the gully is flaggy limestone, exposed on the beach, forming a dip-slope. The graywacke near its contact with the slates contains large spherical masses of dark limestone, like cannon balls, many of which have weathered out, corresponding with the bed at Myponga Jetty. This series corresponds exactly with the series on the western side of Myponga Jetty, but in the reverse order of superposition, so that there is no doubt that the change in dip is merely a local reversal, unless, indeed, the whole of the rest of the area shows reversed dip, and this is normal. There are alunite workings in the slate at the top of the cliff, described by R. Lockhart Jack in the "S.A. Mining Review," No. 19, of 1914.

A quarter of a mile south of the Alunite Mine, in a creek running west, the flaggy beds are exposed for a short distance at their contact with the Archaeocyathinae limestone, and fossils were found in the creek on the western boundary of Section 263. The dip is here 70° W. The overlying quartzite is entered a mile up this creek, where the dip is 62° W. The strike in this section is N., to N. 8° E.

There is a sandy bay, a mile long, between the Head and Haycock Point Jetty, with more gentle slopes inland, covered with Permo-Carboniferous glacial deposits, including "varve" shales and many erratics. The purple slate outcrops at several points on the slopes for three-quarters of a mile south from the Alunite Mine.

The rock is yellowish graywacke in the neighbourhood of the jetty, forming the point and hill at the jetty. The upturned and eroded edges are well exposed on the north side of the jetty on the beach for a short distance, soon disappearing under the sand. It was here that markings of a possibly organic origin were first noticed by Sir Douglas Mawson and the author, to be found later remarkably developed in the same beds at Myponga Jetty. The dip in the graywacke varies from 75° E. to 75° W. in 50 yards, and the strike is N. 42° E., swinging to the north in a curve before disappearing under the sand. Its thickness at the jetty is 3,000 feet as far as exposed. All along the western side of the peninsula the coast follows the strike of the beds in a most marked manner, conforming to the smallest changes.

Near the jetty no contact, such as is well shown at the Head, is seen between the graywacke and the limestone owing to the mantle of glacial material inland, but the Archaeocyathinae limestone is well exposed along the creek due east of the jetty in the north-west corner of Section 1028. The Wheal Mary Mine, a series of shallow prospecting shafts along the strike, is situated here. Fossils are fairly abundant (Howchin, Trans. Roy. Soc., vol. xxi., 1897, p. 75). Following the creek up, the quartzite is entered in Section 454, the creek there flowing along the junction of the beds, which strike north-east and dip at 75° N.W. The mine was opened for lead, and galena may be seen in juxtaposition with Archaeocyathinae in the dump. The massive belt of limestone is 500 feet across at the mine.

Carrickalinga Creek.

The Archaeocyathinae limestone may be traced southward across the Carrickalinga Creek to the south-west corner of Section 1022. The fossils are indistinct but obtainable. The massive limestone forms the top of the scarp along the line. To the westward the land slopes to the sea, as seen in Section IV., with glacial deposits on the steeper grade and sand dunes along the beach. The road along the southern boundaries of Sections 1022 and 1030 [Hd. of Yankalilla] marks the end of the outcrops of the series, where they disappear under the glacial sands filling the Yankalilla Valley. The seaward slopes of Sections 1019 and 1017 are a good locality for glacial boulders and erratics.

There is a road-metal quarry in the south-west corner of Section 1022, in the Archaeocyathinae limestone, which is here yellow and dolomitic. A minute fossil bivalve was found at the quarry, and indications of Archaeocyathinae. A yellow, slaty band, corresponding with the one near the bridge at Myponga Jetty, marking the upper limit of the fossiliferous zone, is seen on the east side of the quarry. In a trial pit in this limestone, large crystals of barytes were found, but the pit has now been filled in. The Carrickalinga Creek itself, which flows across the strike of the beds, gives excellent exposures, and Section IV. was made here. The first rock encountered as one walks up from the road is the top of the fossiliferous horizon with traces of Archaeocyathinae. The upper mottled beds immediately follow. After crossing these for a hundred yards they become very fissile, as at the Myponga Jetty section, though here only some 50 yards across the strike. This is followed by a narrow purple slaty belt, and then for another mile up to the quartzite the calcareous series is very variable, being alternately argillaceous and arenaceous. The total thickness of the calcareous series, including the lower flaggy beds not exposed on this line of section, is 3,900 feet.

A tributary entering on the northern side of the Carrickalinga Creek, in Section 480, flows along the junction of the calcareous series and the overlying quartzite, which is at first white and flinty, as at Sellick's Hill, and 300 feet thick. It merges into blue siliceous slates which are very hard, giving rise to very precipitous sides to the gully and sharp bends in the creek. In the south-western corner of Section 447 another belt of purer quartzite about 100 feet thick forms a ridge, again as at Sellick's Hill, from which bed the slates become redder and more jointed and foliated, and intruded by quartz veins along the strike. Prospecting has been done in the vicinity. These siliceous slates continue to the end of the section at the road near where the creek crosses it in Section 472. The section bears a very close resemblance to the Sellick's Hill section, and no repetition of the beds below the fossiliferous zone is encountered.

The Little Gorge.

Continuing southward along the coast, one crosses the low Yankalilla Valley filled with glacial deposits. There is a gap of 2½ miles in the older rocks between the quarry in Section 1022, Hd. of Yankalilla, and the exposures on the other side of the valley near the coast. The road between Sections 1007 and 1010, in the lower slopes of the southern scarp of the valley, provides some good sections in glacial sands, up to 16 feet deep, in the cuttings. Boulders and erratics are plentiful.

The old rocks are first met with south of the valley in a ridge running parallel to the coast and beginning in Section 1002. The ridge is cut through by the River Yankalilla, near its commencement, and 1½ miles further south, by the Little Gorge. The coastline is precipitous from this point to Cape Jervis, the cliffs rising from 300 to 400 feet almost from the water's edge, dissected at intervals by creeks and small valleys. Beyond the Little Gorge the country rises inland gently from the coastal cliffs, but for the 2 miles preceding it a coastal ridge is noticeable. This is due to igneous intrusions in the area of a syenitic nature, unfortunately altering the sedimentaries at an important point from the point of view of tracing the formations from the northern side of the valley. The sedimentaries are here very varied in character owing to high pegmatization, being, in the main, micaceous and sericitic schists, but they are obviously altered grits, with many large quartz pebbles forming "augen." Massive igneous rock, a syenite, is exposed in the first small creek in the ridge in Section 1002. It carries much pyrites here, and some prospecting for copper, of which there are traces, has been done on the hillside. The shafts may be seen from the road. Igneous rock outcrops along the top of the ridge on the western side of the River Yankalilla, and is here more of a diorite, characterized by much epidote, and of a green colour resembling the Houghton diorite, certainly, in appearance. Mr. H. N. England, B.Sc., who has accompanied the author on several trips in this region, followed the River Yankalilla inland for a mile, and reports that at the bend on the eastern side of Section 1101 there is a patch of granite exposed in the schist, followed upstream by pegmatized quartzite which soon gives way to glacial drift. The intrusion is of a more acid nature, from the data to hand, than the Houghton intrusion. The main road runs along at the foot of the talus slopes, for over a mile, close to the beach, and then turns inland at the Little Gorge, where the sandy beach gives way to a rocky wave-cut terrace. Pl. xvii., fig. 1, shows the coastline from this point to Rapid Head, 7 miles away, and pl. xvii., fig. 2, a closer view of the upturned edges of the beds on the terrace, dipping S.E. into the cliffs. The strike runs slightly more northerly than the coast at this point. Looking northwards along the strike one is looking directly towards the Archaeocyathinae Series north of the valley, just as on the Archaeocyathinae limestone at Carrickalinga Head one looks straight along the strike to Second Valley and Rapid Head, where one would go to find the continuation of the beds. The main result of this survey is to show that the coastal formations south of the Yankalilla Valley may indeed be a continuation of the Archaeocyathinae Series.

The beds exposed on the beach are of a very interesting character. They are a coarse conglomerate, in part, with large rolled-out pebbles, very similar to the Grey Spur conglomerate, and, in part, of much finer grain, well banded with dark lines of ilmenite. The ilmenite occurs also in large slugs up to 50 lbs. in weight, and, in places, there are loose rounded pebbles of ilmenite of all sizes up to that of a football. In lenses, alternating with the conglomerate, grit, and quartzite are white masses of siliceous marble, 90 per cent. of which will dissolve in hot dilute hydrochloric acid. As mentioned above, these beds dip in towards the cliffs. The beds forming the cliffs conform in dip with them and are also grits, more or less altered. There is no doubt that the igneous rock is intruded into this series; in fact, there are intrusions seen on the beach itself. These intrusions are themselves rich in ilmenite. In the cliffs, notably at the little hanging valley and waterfall, between Sections 75 and 79, large masses of ilmenite occur in pegmatite veins. South-west of the Little Gorge there are no major intrusions but only narrow pegmatites. There are two generations of ilmenite, one in the sedimentaries, and another introduced by the intrusions in them. There is no evidence to support the idea that the conglomerates are a basal bed resting on the igneous masses, as the igneous rock so obviously intrudes the conglomerates. The abnormal size of the slugs of ilmenite in the sedimentaries may be ascribed to the pegmatitic invasions taking up and accreting ilmenite in the sedimentaries. The intrusions may even not have carried notable quantities of ilmenite at all. None is seen in the two thin sections of the massive formations so far examined. Continuing south along the shore one gets lower in the series as the strike is somewhat in towards the cliffs. At the headland, in Section 1587, the beds have become very calcareous and somewhat flaggy. There is a large cave here, always a sign of limestone along this coast. Right at water level thin bands of marble, some of it pink, appear. The grits become more calcareous below, but along this part of the coast the limestone is mainly under the sea, appearing only at the capes, as in this case. Round the point one enters a bay at the locality known as Pool's Flat.

Pool's Flat.

On the beach at Pool's Flat the conglomerate is very coarse, with boulders up to 9 inches in diameter. Some of these are of granite. One boulder of dark siliceous limestone was noted. The strike is here N. 50° E., parallel to the coast, and dip 26° S.E. The landward side of the coastal cliffs forms dip slopes on each side of the river mouth. On the western side, in Sections 1578 and 1579, there is an interesting patch of glacial deposits with washouts exposing the smooth slopes of the underlying grits which are quite coarse. No good pavements, however, were discovered. On the seaward slopes the glacial beds are exposed to a thickness of 50 feet, with many polished boulders of granite, porphyry, etc. There is a large glacial area between the shore and main road, as shown on the plan, but the creeks give good exposures of the rock below. The grits may be followed along the strike, parallel to the coast, along the district road down to the sawmill at Second Valley Jetty. They become finer and show excellent ilmenite banding. The very coarse phase at Pool's Flat is local. On the sides of the gorge at Pool's Flat the boulders are drawn out as at the Grey Spur (pl. xviii., fig. 1).

Section V. is run from the beach at Pool's Flat, due south to the main road, this being approximately the course of the River Congeratinga, and somewhat inclined to the direction of dip. The strike (N. 50° E.) and dip (26° S.E.) are remarkably constant in this section, not varying a degree in the several determinations made. The thickness of the grits, which pass upwards into quartzite, is 1,700 feet, from the lower limit where they pass under the sea, which may be considered near their base, as they are so coarse there, to the calcareous series which is met with above the **S** bend in the centre of Section 1580. Near the contact with the calcareous beds the grits are very fine and take the form of a quartz schist, whose hardness causes the sharp turns in the river. The calcareous beds are very impure, and here 200 feet thick. At their upper limit is a bed of compact marble 4 feet thick, followed by arenaceous slates for a mile and a quarter up to the main road.

There is an old gold mine in the southern slopes of the hillside, in Section 1577, in the lower part of the calcareous beds. The workings mainly consist of a tunnel across the strike. Quartz veins are numerous, with much calcite and siderite rich in pyrites.

The marble bed cannot be followed along its strike in the vicinity owing to the glacial deposits, but in the direct line and at 1½ miles eastward it is picked up again just north of the main road, where it crosses the River Anacotilla, Section 1594. There is a quarry at the creek. The dip is still 26° S.E. and strike N. 55° E. The marble is here 500 feet thick. An attempt was made to follow the marble castward, but it is obscured by glacial deposits, a good section of which is seen on the main road at the cutting on the top of the rise on the western side of Section 1600. Here, boulders up to 3 feet in diameter are embedded in the sands. East of this an outcrop of gneissic igneous rock is met with in the glacial beds in Water Reserve No. 19.

This marble has been named the Delamere Marble, and from this, its northern extremity, it can be followed all along the main Cape Jervis road, through Second Valley and Delamere. Near the Talisker Mine, where the road turns westward, the marble leaves it and continues to the coast. The marble is coarsely crystalline and mainly of a blue-grey colour, often in narrow lighter and darker bands, and, in places, white. It is used as road metal throughout the district and there are many quarries.

Second Valley.

A mile and a half along the coast from Pool's Flat the cliffs are broken by Second Valley, with a beach some hundred yards in length. There is a high headland here, and the grits are passing inland, with the appearance in the cliffs and Marine Board Reserve of the lower calcareous series seen at the cave in Section 1589. The limestone is here dolomitic and arenaceous. The bluff, on the western side of the jetty, exposes the beds well. Narrow bands of white dolomitic marble are streaked through the beds, and on the seaward face they are considerably contorted. On the beach, on the east side of the jetty, dark siliceous limestone outcrops.

The valley itself is filled with alluvial and provides no exposures inland till the village of Second Valley is reached, at $1\frac{1}{4}$ miles from the beach, with the exception of a small bluff of flaggy limestones half-way up. The village is built on the Delamere marble, which is well exposed in the centre of the town, particularly round the school. The strike is still N. 50° E., and dip 25° S.E. The marble is 200 yards across the strike. Above the village the creek gives good exposures. A hundred yards above the bridge in the village, the marble ends and slate is entered. This becomes more arenaceous and passes upwards into compact hornstone in another quarter of a mile, in Section 1562. The hornstone was followed up for another mile across the strike, where the dip increased to 30° S.E.

Rapid Bay.

Two miles beyond Second Valley is Rapid Bay. The lower limestone here comes inland. It is seen in its upper slaty facies in the cliffs on the east side of the Bay. At the top of the cliffs are some alunite workings, the alunite occurring in rotten calcareous slate, in large nodules. On the west side of the Bay is Rapid Head and Mount Rapid, rising to 885 feet above the sea. This hill is almost entirely composed of a marble of a similar appearance to the Delamere marble. The strike has swung round somewhat across the Bay and is nearly east and west on the west side. The dip is 20° S. Following the coast round past the old jetty one finds oneself on the flaggy limestones typical of both sides of the Archaeocyathinae limestone (pl. xvi., fig. 3). As the Head is approached the flaggy limestones rise in the cliff face. They also here show a very arenaceous facies, in parts, and appear to correspond to the fossiliferous horizon of Myponga Jetty (pl. xvi., fig. 2). The marble goes right to the top of Mount Rapid and a little beyond, and its continuity is broken by only one important bed, a strong belt of quartzite, 250 feet thick, near the summit. This is on the same horizon as the Pool's Flat grits. The quartzite is well exposed in the lateral creek on the east side of the Bay in Section 29. The marble is intersected in places by quartz veins, and mining operations were attempted at sea level near the jetty. Galena occurs in numerous veins high up on the mountain on the northerly slopes, and has been recently prospected. The marble is 2,000 feet thick.

Section VI. is taken from Rapid Head across the strike to the main road where there is a quarry in the Delamere marble in Section 1455. The River Yatagolinga supplied most of the data. It flows along the section in its upper half. The calcareous series, 1,100 feet thick above the marble, is left in Water Reserve No. 8, as one goes up the river, and hornstone is entered. The gorge becomes narrow and there is a series of rapids and waterfalls in Sections 16 and 15. The strike remains constant at N.E., and dip increases from 20° at the coast to 33° near the road. The hornstone rock is 3,600 feet thick, and above it lies the Delamere marble, which is entered in the north corner of Section 1536. It is here pure white in parts, and 1,000 feet in thickness.

Between Rapid Bay and Second Valley the country rises to a height of 700 feet in smooth soil-covered hills, in consequence of which outcrops cannot be followed. Boulders of marble and quartzite are picked up in close proximity. The broad band of calcareous beds exposed in the River Yatagolinga, in the Rapid Bay valley, seems to become more siliceous and to lose its limestone character. In the Second Valley gully only one small limestone bluff is exposed in this horizon, as noted above.

Rapid Head to Cape Jervis.

After Rapid Head the field geology becomes very monotonous, as, with the exception of the Delamere marble beds on the south coast, the rocks preserve an extraordinary similarity of appearance in the hand specimens, consisting of quartzites, hornstone, and arenaceous schists, which only detailed microscopic work could differentiate. From Rapid Head to Cape Jervis the rocks swing somewhat in strike, which becomes more northerly, the coast line conforming to it. The strike in the quartzite at Yohoe Creek mouth was N. 57° E., and dip 40° S.E. At New Yohoe Creek the strike was N. 42° E., the dip remaining the same. There were numerous quartz intrusions along the bedding planes at the latter locality. Both these creeks flow across the strike of the quartzite for their whole length. There are patches of glacial sands with boulders in the centre of Section No. 177, near Yohoe Station, and also at the coast on the north side of the new Yohoe Creek.

At Tea Tree Creek the strike is N. 25° E., and dip 36° easterly, while at the Lighthouse they are N. 12° E. and 50° easterly, respectively.

Cape Jervis.

The surveyed road (not in use) from Salt Creek Hill south to the main road, and thence south-westerly to the coast, at Fishery Creek, forms a scarp from which one looks down on to the comparatively flat, low area of the Cape, some 2 miles wide by 4 miles in length, north and south. The rock is a quartzite or hornstone all along the ridge, and the same round the coast, where it is well exposed along the beaches. The flat is covered by glacial material, with a large patch of travertine in the south-western corner, of considerable thickness, quarried for road metal and building stone. Just behind the Lighthouse there are large granite erratics, and these are specially plentiful and of considerable variety for a mile and a half along the coast to the north of the Lighthouse, on the coastal cliffs (see Howchin, Trans. Roy. Soc. S. Austr., vol. xxi., 1897, p. 64).

No direct evidence of faulting was seen along this scarp or to any notable extent along the south coast, and the author is inclined to the opinion that the low-level area of the Cape is due merely to glacial erosion, the Cape having been planed off by the same ice movements as scooped out Backstairs Passage, separating the Peninsula from Kangaroo Island, a movement parallel with the direction of the Inman Valley. The problem of Backstairs Passage is discussed by Benson (Trans. Roy. Soc. S. Austr., vol. xxxv., 1911), and the author supports the glacial origin alternative as against subsidence.

The South Coast.

From Land's End, near the Cape, to the Tunkalilla Beach, a distance of 14 miles, the strike of the rocks is perpendicular to the coast. This portion of the coast is deeply dissected by numerous steep-sided gullies parallel to the strike. It is a succession of rocky bluffs and small shingly coves, the ridges between the gullies rising to 200 or 300 feet. The going is extremely difficult and tiring. In one day, from 8 a.m. to 7 p.m., only 6 miles were covered. Most of the gullies carry streams, and their outlets are very similar in character, with dip slopes on the western side and rugged bluffs on the eastern. The stream beds rise rapidly inland to the comparatively level and swampy tableland along which the boundary of the Yankalilla and Waitpinga Hundreds runs east and west. This boundary, down the centre of the peninsula, is along the top of the watershed, from which the streams run north and south. A couple of miles back from the coast the going is very much easier.

In the littoral area, south of Section 99 and east of Fishery Creek, there is an arsenic mine recently opened, but only in the initial stages of development. The rock is banded grit, dark and flinty, showing stream bedding, cut across by numerous quartz veins and stringers. One quartz vein was 11 inches wide and carried two 1-inch bands of mispickel pyrites in it. A costeen had been dug along this vein. Most of the veins in the vicinity show some mispickel. Quartz veins are common in the hornstone all round the coast.

The Talisker Mine, once extensively worked for lead and silver, is inland, only 2 miles north-easterly of this point, in arenaceous slate. It is not on the line of strike, but considerably above the beds at Fishery Creek. The strike is here N. 33° E., and dip 45° S.E.

At Campbell's Creek, which flows down from the Talisker Mine, the beds are dark and arenaceous, with a strike of N. 30° E., and dip somewhat steeper. Quartz stringers along the strike are numerous.

A mile to the east of Campbell's Creek, in Sections 132 and 120, the rock is very calcareous, a flaggy limestone. There is a long narrow cave, entered from the end of the sharp, rocky point south of Section 132. The surface stones are covered with travertine in the vicinity. These beds are the southern extremity of the Delamere marble.

At the Blowhole Creek (pl. xviii., fig. 2) the strike is N. 42° E., and dip 51° S.E., at Tent Rock Creek, 38° and 50° respectively, the rock continuing remarkably uniform in appearance (a dark hornstone), and also in dip and strike.

At the creek, in Section 215, for the first time a disturbed area was noted. On the east side of the gorge the dip was vertical, on the west side it was normal to near the shore, where an east-west fault line was seen in the hillside. On the seaward side of the fault the remaining portion of the bluff showed a small synclinal fold.

For another mile to the eastward the hornstone is more massive, with strike and schistosity less pronounced, and weathering irregularly. As Porpoise Head is approached the rock becomes a true quartzite, with pebbles standing out on the weathered surfaces in Section 35.

At the Deep Creek, a very precipitous and winding gully with running water in January, the first met eastwards of the Cape, the dip has flattened out to 30° S.E. The rock is a fine-grained banded-quartzite, similar in appearance to the Aldgate grits. At Tapanappa Creek, 2 miles further on, the strike is N. 35° E., and dip 22° S.E. The rock is in bands of quartzite, 3 to 6 feet wide, with softer beds between, less resistant to the action of the sea. At Boat Harbour Creek the dip has steepened up to 45°, the strike remaining constant and the beds uniform. There was running water in both this and Tapanappa Creek.

At this point the straight four miles of Tunkalilla Beach is entered upon, a welcome relief. The beach is 100 to 200 yards in width, with a sandy margin and good soil inland, some of which has been cropped in the past. The flat is formed of alluvial from the steep hills in the background, and is intersected by watercourses strewn with boulders of country rock, but no erratics were seen. There are a few small patches of sand dunes. Towards Tunk Head, the eastern extremity of the beach, the strike swings easterly, reaching N. 85° E. at the Head, with a dip of 36° to the south. The dyke-like outcrops of the hornstone may be seen running inland over the hills.

On the eastern side of the Head there is another area of disturbance, which may only be local (pl. xix., fig. 1). The upturned edges of the beds, seen on a small marine platform on the beach, appear to show a buckling in, shorewards, the strike being east and west, each side of the bay, and north and south in the centre. Continuing east the beds became more fine-grained and schistose.

At the Callawonga Creek the beds were a knotted schist with a strong development of mica in a small local variation. From Tunk Head the strike is again parallel to the coast, and the whole country is at a lower level and less deeply and frequently dissected by streams. The going is very much better and the larger streams all carried running water.

At Coolawang Creek the strike swings round to the east, with the coast, with a dip of 26° to the south. There are dip slopes all along the coast from Tunk Head to Waitpinga Beach (pl. xvii., fig. 3). The quartz veins here run north and south across the strike. There is a wide sandy beach along Sections 1327, 1323, and 1328 (Hd. of Waitpinga), with dunes and low ground to the north. At the east end of the beach there is a low rocky point, and the beds here strike N. 8° E., and dip 37° W., the first reversal of dip noted along the south coast. This is an isolated outcrop, and the relation of the beds to those of normal dip and strike cannot be traced. The rock is banded ilmenitic grit. This point is followed by Waitpinga Beach, 2 miles long, with sandhills inland and granite erratics on the shore. The beach is terminated by Newland Head, where the strike is again N. 36° E., and dip 47° S.E.

From Newland Head to King's Point, 4½ miles, the coast follows the strike absolutely. The cliffs are about 200 feet high, and from their top an undulating plateau stretches back some 3 miles. This is covered with glacial sands, with beds of travertine on the surface used for lime-burning. This area is not dissected at all but is remarkably level, an old glacial platform where sands have absorbed the precipitation and prevented the formation of streams (see Howchin, Trans. Roy. Soc. S. Austr., vol. xxxiv., 1910, p. 1). The area from Tunk Head to the Coolawang Creek, though more dissected and without the sandy covering, is much more at a general level also (pl. xvii., fig. 3).

At one point along this stretch the strike was N. 30° E., and dip 75° S.E. The steep dip-slopes give rise to a remarkably straight uniform and precipitous coastline. It is only possible to climb down to the water at a few points, and there is no beach, the waves breaking against the foot of the slopes. Near the summit of Newland Head there are several horizontal benches of reddish sandstone in the cliff side, 10 to 20 feet in thickness. They are crowded with shell fragments and are probably Recent blown sands. At King's Point the hornstone becomes a knotted schist, and the area affected by the granite intrusions of Victor Harbour is entered. The petrography of the area was dealt with by Brown (Trans. Roy. Soc. S. Austr., vol. xliv., 1920, p. 1). The hornstone appears at intervals, right to Middleton Beach, where it is still striking east and west, and parallel to the coast.

A thickness of some 40,000 feet of altered grits and quartzites is crossed between the Delamere marble and Newland Head. There was no obvious evidence of repetition of beds. These quartzites and hornstones form almost the whole of the peninsula. They are exposed in the bed of the Inman at Selwyn's Rock and the neighbouring hillsides, as glacial pavements. In the Yankalilla valley, near Torrens Vale, a belt of strong quartzite, 1¼ miles wide, striking north-east, crosses the main road, forming a divide across the valley. This being the only point in the valley where the outcrops may be followed across it, will receive further attention later.

The only inland locality visited was the waterfall, 6 miles S.S.E. of Normanville. This is in Section 1121, up a gully half a mile west from the road (a poor one and disused from this point, but passable to motor cars), which runs on south to Tunkalilla Beach. The falls are at the head of the River Yankalilla, here called Waterfall Creek. The total fall is about 100 feet in two parts. The upper fall is shown in pl. xix., fig 2. The rock is quartzite, fine-grained and banded, with dark lines of ilmenite. It is probably the same belt as seen crossing the valley at Torrens Vale. The quartzite strikes E.N.E. and dips 45° southerly.

An interesting patch of Miocene limestone was found in the Hundred of Myponga, in Section 709, on the west side of the main road to Yankalilla. It is in the east end of the section, and a quarter of a mile from the road, among trees and undergrowth, which made it difficult to determine its extent. It is pinkish, coarse-grained and crystalline, due to solution and re-deposition, somewhat cellular, and crowded with polyzoan fragments. It is very pure and makes a good lime. It is at least 800 feet above the sea, a reduced level obtained by Mr. R. J. M. Clucas, from the Hydraulic Engineer's Department, at the Myponga Creek, three-quarters of a mile to the north, being 700 feet. This provides additional evidence of the elevation of the peninsula block. Miocene limestone occurs at sea level, near Sellick's Beach, 4 miles to the north.

Summary.

The Archaeocyathinae Series appears to continue down the coast from Sellick's Hill to Rapid Head. The calcareous series widens out as it goes southward and the lower slates, seen at Sellick's Hill, become more and more arenaceous as Normanville is approached. Across the Yankalilla valley the coastal exposures are in the grits and quartzites overlying the Archaeocyathinae limestone. These grits are intruded by igneous rock, locally, and in the lower members, exposed on the beach, grit and limestone are alternating and mixed. This denotes shallow water conditions and probably frequent alternations of level. Further south the grits become very coarse, with limestone both above and below them. The coarse phase again gives way to finer quartzites, and at Rapid Head the section shows three well-defined calcareous belts separated by quartzites. Grits occur below the Archaeocyathinae limestone on Yorke Peninsula, across the Gulf, and the grits of Pool's Flat and quartzites at other points are correlated with the Ardrossan grits, though on this side of the Gulf there are several alternations of grit and limestone. Above the highest limestone (Delamere marble) there is a great thickness of quartzites and hornstone from the Cape to Victor Harbour. The dip is everywhere to the south-east, and all these beds thus appear to lie above the Archaeocyathinae limestone, the Victor Harbour granite being of younger age. No signs of major fault lines were observed, other than the west coast.

The following is a list of the points leading to the conclusion that the Rapid Head marble is in the Archaeocyathinae Series:—

(1) The similarity, lithologically and in sequence, of the series north and south of the Yankalilla valley.

(2) The strike is remarkably uniform on both sides of the valley, the dip corresponds, and the formations are in a direct line with one another.

(3) The characteristic flaggy beds which both overlie and underlie the Archaeocyathinae limestone are seen at Rapid Head (pl. xvi., figs. 1, 2, and 3).

(4) Quartzites overlie the limestone everywhere, and the underlying beds become more arenaceous as one goes south. There is no sudden change in the latter.

(5) There is a much more marked continuity and absence of faulting than in the Adelaide Series.

(6) Galena occurs throughout the limestones, and alunite in the associated slates both sides of the valley.

Against the theory it must be stated that no fossils have yet been found south of the valley, the beds being more crystalline, though marbles are common in the Archaeocyathinae beds themselves. Also the age determination by R. Grenfell Thomas (Trans. Roy. Soc. S. Austr., vol. xlviii., 1924) of the intrusions at the Little Gorge, 1,000 million years, is higher than is ascribed to the Cambrian. The author is not in a position to criticise this valuable piece of work, though it may be remarked that the intrusions are notably lead-bearing. The structure is simple, and the field relations are all in favour of the Cambrian age of the Fleurieu Peninsula. It will be very difficult to find any positive evidence to the contrary.

The roads shown on the map are the only ones possible to vehicular traffic in the area.

DESCRIPTION OF PLATES XVI. TO XX.

PLATE XVI.

Fig. 1. The upper flaggy limestone beds, Sellick's Hill.

Fig. 2. The lower flaggy limestone beds, Myponga Jetty, looking west. The new organic remains were found at sea level just round the headland on the right, in the flaggy beds there visible, dipping into the hill. Archaeocyathinae occur at the end of the jetty.

Fig. 3. The lower flaggy beds at Rapid Head.

PLATE XVII.

Fig. 1. Looking south-east along the coast from Little Gorge to Rapid Head in the distance. Second Valley Jetty is at the headland next on the left from Rapid Head, and Pool's Flat at the inlet in the middle distance.

Fig. 2. Nearer view of the beach at the Little Gorge. The beds are mixed ilmenite grits, coarse conglomerates, and white siliceous marble. They are seen dipping south-east into the cliffs, where ilmenitic pegmatites occur in the grits.

Fig. 3. Looking west from the west side of Waitpinga Beach, South Coast. The dip here is much flatter, 20° to the south-east. The level surface inland, due to ice action, is very noticeable.

PLATE XVIII.

Fig. 1. The coarse conglomerate, Pool's Flat.

Fig. 2. At the mouth of the Blowhole Creek. Altered, banded grits dipping south-east, typical of the South Coast.

PLATE XIX.

Fig. 1. A disturbed area on the South Coast, east side of Tunk Head. The grits are buckled inwards in the centre of the cove.

Fig. 2. Upper half of the waterfall, 6 miles south of Normanville. Banded, ilmenitic quartzites dipping 45° S.E.

PLATE XX.

Geological map of the coastal regions of the Fleurieu Peninsula.

ON AUSTRALIAN STAPHYLINIDAE (COLEOPTERA). PART II.[1]

By ARTHUR M. LEA, F.E.S., Museum Entomologist.

(Contribution from the South Australian Museum.)

[Read September 10, 1925.]

Part II. deals with the subfamily Staphylinides, the subfamily which contains the largest species of the family, many genera, and even species of world-wide distribution; already many species described as Australian have proved to be synonymous with well-known European and Asiatic ones, and it is probable that more of them will be so regarded. Remarkable combs are present on the males of many species of *Quedius,* and other genera, although, being placed amongst dense clothing on the legs, some manipulation is usually necessary before they can be clearly seen.

METOPONCUS, Kraatz, Cat., p. 290.

ATRICEPS, Macl. Q.
var. *piceus,* Macl.
CRIBRATUS, Fvl. *(Xantholinus),* Cat., p. 301. V., Tas., S.A.
enervus, Oll.
CYANEIPENNIS, Macl. *(Leptacinus).* Q., N.S.W., Lord Howe Island.
var. *cairnsensis,* Blackb.
nigricollis, Bernh., Arkiv för Zool., Band 13, No. 8, p. 15.
FUGITIVUS, Oll. Lord Howe Island.
LURIDIPENNIS, Macl. *(Leptacinus).* Q., N.S.W., V., S.A., W.A.
novaehollandiae, Fvl. *(Leptacinus).*

METOPONCUS CRIBRATUS, Fvl.

M. enervus, Oll.

On Tasmanian specimens of this species the whole of the upper surface is usually black or blackish, except that the tip of the abdomen is sometimes obscurely diluted with red; but on mainland ones the prothorax is sometimes paler (although not conspicuously reddish), sometimes both prothorax and elytra are paler. A specimen from South Australia was taken by Mr. R. F. Kemp from a nest of the green-head ant, *Ectatomma metallicum.*

The type of *M. enervus* is in the South Australian Museum, and structurally agrees perfectly with specimens that agree with the description of *M. cribratus.*

METOPONCUS CYANEIPENNIS, Macl.

M. cairnsensis, Blackb., var.

M. nigricollis, Bernh.

This beautiful and widely distributed species has several conspicuously coloured varieties, one of which was named as a distinct species, *cairnsensis,* by Blackburn, and the same form as a variety, *nigricollis,* by Bernhauer. A specimen of the typical form was taken from a nest of ants, *Euponera lutea,* at Dorrigo.

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(1) Part I. was published in these Transactions for 1923.

var. **howensis**, n. var.

Two specimens from Lord Howe Island, taken in company with typical ones under bark of banyan figs, have the black prothorax of the variety *cairnsensis*, but have only the second and third segments of abdomen black, the first is of a paler flavous than the four apical ones.

var. **basiflavus**, n. var.

A specimen from Kuranda (in the British Museum) probably represents another variety. It is smaller, 6·5 mm., than any other specimen before me; its prothorax is black, and abdomen black, except that the basal segment only is pale flavous.

METOPONCUS RUFULUS, Broun, var. **norfolcensis**, n. var.

Four specimens from Norfolk Island appear to represent a variety of *M. rufulus*.(2) They are all smaller (6-9 mm.) than New Zealand ones (10-11 mm.). Structurally they are fairly close to *M. cyaneipennis*, but the head is shorter, with different impressions, and the colours are very different, the elytra being reddish at the basal third and blackish posteriorly. The abdomen of the type was described as having two segments partly dark, on two New Zealand specimens in the Museum three are partly dark; on the Norfolk Island variety all have five segments partly dark, and less of the elytra pale.

There are three combs in a notch on the front tibiae of the males of both the typical form and variety; the combs are composed of numerous teeth somewhat as on the species of *Domene*, but their positions are not quite the same, and I have not been able to count their teeth owing to the density of the adjacent clothing. Combs are present on the males of *M. cyaneipennis*, *M. cribratus*, and probably of many other species of the genus.

Metoponcus brevipes, n. sp.

♂. Black; prothorax, antennae, palpi, and legs red; tips of three apical segments of abdomen obscurely reddish. Elytra and abdomen with sparse and rather short pubescence; the sides with a few bristles.

Head longer than wide, sides feebly dilated to near base, with two short deep sulci in front, and a shallow notch near each eye; with dense and sharply defined punctures of moderate size, but absent from a narrow median line. Antennae short, fourth to tenth joints strongly transverse. Prothorax slightly longer than head, widest near apex, where the width is slightly more than that of head; with punctures as on head, but somewhat sparser, and with the impunctate median line slightly wider. Elytra slightly longer than prothorax, and slightly wider than its widest part; with crowded punctures, slightly smaller than on head. Abdomen parallel-sided to near apex; with crowded punctures, much smaller than on elytra. Legs short; front tibiae stout, notched, and with three combs at and near apex. Length, 7·5 mm.

Hab.—Victoria: Melbourne (E. Fischer, No. 1409). Type (unique), I. 12886.

The prothorax is bright red as in *M. cyaneipennis*, but the punctures are very different (on the head they are much as in *M. cribratus*), abdomen with no segment entirely pale, etc. The punctures on the pronotum are fairly dense up to the median line, so that the seriate arrangement of those adjoining it is not very evident. There are three combs on each front tibia, but one was not detached for examination under the microscope.

(2) Broun, Man. of the N.Z. Col., 1880, p. 106.

Metoponcus planatus, n. sp.

♂. Head blackish, the muzzle paler, prothorax blackish-brown, diluted with red in front, and almost flavous at base, elytra and abdomen flavo-testaceous, four of the median segments of the latter partly blackish; antennae, palpi, and legs more or less reddish.

Head, excluding muzzle, slightly longer than wide, parallel-sided behind the eyes, with four impressions in front, the median ones shorter and less close together than usual, the others oblique and each terminating in a small fovea; with a few large punctures towards sides, and numerous small ones scattered about. Antennae short, fourth to tenth joints transverse. Prothorax slightly shorter and narrower than head, widest near apex, base truncated; with two punctures on each side of middle, and a few marginal and submarginal ones; a feeble medio-basal impression. Elytra slightly longer and very little wider than prothorax; with sparse, small, and somewhat rugose punctures. Abdomen almost impunctate. Tibiae stout, the front ones notched near apex and with three combs. Length, 5-6 mm.

Hab.—Queensland: Cairns (A. M. Lea). Type, I. 12701.

A thin, highly-polished species, much flatter than any other *Metoponcus* known to me. On each side of the under surface of the head there is a narrow groove, with seriate punctures, bounded externally by a fine carina. The sides are sparsely setose, but no part is truly pubescent. On the larger of two specimens the head is almost black, on the smaller it is scarcely darker than the front part of the prothorax.

LEPTACINUS, Er., Cat., p. 292.

BATYCHRUS, Gyll.(3) V., Tas., S.A.
Introduced.
var. *linearis*, Grav.
FILUM, Blackb., n. pr. N.S.W., V., S.A., W.A.
MINIMUS, Bernh., Arkiv för Zool., Band 13, No. 8, p. 15. Q.
PARUMPUNCTATUS, Gyll.(4) V., S.A.
Introduced.
SOCIUS, Fvl. *(Xantholinus)*. N.S.W., V., Tas., S.A., W.A.
anthracinus, Broun.
picticornis, Blackb.

LEPTACINUS SOCIUS, Fvl.

In the Catalogue (p. 294) *L. picticornis*, Blackb., was noted as a good species, but Blackburn himself called attention(5) to the fact that the name was a synonym of *socius*.

Mr. J. Clark took three specimens of the species, from nests of *Iridomyrmex conifer*, at the Swan River, and two from another species of *Iridomyrmex* at Encounter Bay.

Leptacinus blackburni, new name.

L. filum, Blackb. (1886), n. pr.

In the Catalogue (p. 294) *L. filum*, Blackb., was placed as a synonym of *L. socius*, Fvl., in error. *L. filum*, Blackb., differs from *socius*, in being much smaller and thinner, with very different punctures on all parts of the upper surface, and the sutural region different. As, however, the name *filum*(6) was previously used in the genus, I propose the above substitute. Mr. A. H. Elston took two specimens of the species, from moss, at Myponga.

(3) Eighteen synonyms and varieties are noted in the catalogue.

(4) Ten synonyms and one variety are noted in the catalogue.

(5) Trans. Roy. Soc. S. Austr., 1887, p. 190.

(6) *L. filum*, Kraatz, 1859, from Ceylon.

Leptacinus parumpunctatus, Gyll.

A specimen from St. Kilda (Victoria) in Mr. Oke's collection is probably an immature specimen of this species; it has the elytra bright flavous, except for an infuscated triangle extending from the entire base to the apex of the suture.

Leptacinus quadrisulciceps, n. sp.

Black, shining; antennae, palpi, and legs of a more or less dingy brown. Elytra and abdomen with sparse ashen pubescence; the sides (including those of head and prothorax) with a few bristles.

Head slightly longer than wide, slightly wider near base than elsewhere, with four deep impressions in front, the lateral ones oblique and touching the eyes; with large irregularly distributed punctures but numerous on sides. Antennae short, fourth to tenth joints decidedly transverse. Prothorax distinctly longer than wide, widest near apex, thence gently decreasing in width to base, which is evenly rounded; with a few well-defined marginal and submarginal punctures, and a conspicuous row on each side of middle. Elytra slightly longer than prothorax, feebly dilated to apex, a narrow elevation on each side of and close to suture; with fairly numerous punctures, smaller than on prothorax, and in places subseriate in arrangement. Abdomen with irregularly distributed punctures, distinct towards base of each segment. Length, 3·5-4·5 mm.

Hab.—Tasmania: Launceston (Aug. Simson), Hobart (A. M. Lea). Type, I. 12696.

A thin, dark species, about the size and much the colour of *L. blackburni*, but with much sparser punctures on head and pronotum, and the latter with impunctate spaces between and at the sides of the seriate rows; it is close to *L. batychrus*, but the elytra are uniformly coloured, and with somewhat different punctures; its sutural region is somewhat as in *L. socius*, but it is a much smaller species, and the oblique impressions on the head are well defined instead of being represented by subconjoined punctures. Owing to the depth of the frontal impressions the head appears to be tricarinate in front. On one specimen the elytra are as black as the prothorax, on two others they are obscurely paler, and on one of the latter the sutural region is not much darker than the legs.

Leptacinus bisulciceps, n. sp.

Blackish-brown; prothorax, mouth parts, antennae, and legs more or less reddish. Elytra and abdomen with sparse ashen pubescence, the sides with a few setae.

Head longer than wide, almost parallel-sided behind the eyes, with two short deep impressions in front; with numerous well-defined punctures, somewhat sparser in middle than elsewhere. Antennae short. Prothorax distinctly longer than wide, distinctly narrowed from apex to base, which is gently rounded; with fairly numerous punctures in front angles, a distinct row on each side of middle, and sparse elsewhere. Elytra almost parallel-sided, slightly longer than prothorax and very little wider than its apex, sutural region narrowly depressed but not carinated; punctures fairly numerous, but smaller than on pronotum. Abdomen long, thin, and parallel-sided to near apex; punctures fairly distinct about base of each segment. Length, 4-4·5 mm.

Hab.—Western Australia: Bridgetown, Pinjarrah (A. M. Lea).

A very thin species, which differs from *P. blackburni* in its paler prothorax, with very different punctures, and by the sutural region; the polished space there is much less pronounced than on *P. socius*. The apices of the abdominal segments are usually paler than the other parts; on one specimen the elytra are not much darker than the prothorax. The sublateral impressions of the head are practically absent, being represented by a feeble notch on each side, immediately behind the clypeus. From some directions some of the elytral punctures appear to be feebly seriate in arrangement.

Leptacinus suturalis, n. sp.

Reddish; most of head, apical two-thirds of elytra, metasternum, and parts of abdomen darker, antennae and legs paler. Elytra and abdomen sparsely pubescent.

Head rather long, almost parallel-sided behind eyes; with two narrow deep impressions in front; with numerous well-defined but not very large punctures, sparser in middle than elsewhere. Antennae short. Prothorax slightly shorter and narrower than head, sides feebly diminishing in width to base; punctures fairly numerous and well defined, but absent along middle. Elytra parallel-sided, slightly longer than prothorax, and very little wider than its apex, suture narrowly and suddenly depressed; punctures numerous and rather well defined. Abdomen with fairly distinct punctures about the base of each segment. Length, 3·25 mm.

Hab.—New South Wales: Galston (A. M. Lea).

A thin, minute species, readily distinguished from all previously described from Australia (except *L. minimus)* by its small size and pale base of elytra; *minimus* is an even smaller species, and apparently has different prothoracic punctures. From some directions there appears to be a narrow carina on each side of the suture, but this is really due to the sudden way the suture is depressed below the adjacent parts.

Leptacinus megacephalus, n. sp.

♂. Bright reddish-castaneous, most of head and usually apical half, or more, of elytra darker. Elytra and abdomen with sparse pubescence.

Head unusually large and flat, with two narrow deep impressions in front, and remnants of two others; with dense and sharply defined punctures, except along a narrow median line. Antennae short. Prothorax much narrower than head, obliquely narrowed to neck, sides diminishing in width to base; with an impunctate median line, elsewhere with dense punctures somewhat smaller than on head. Elytra slightly longer than prothorax and wider than its widest part, parallel-sided, suture slightly carinated; punctures about as large but slightly denser than on prothorax. Abdomen somewhat dilated in middle, with numerous small punctures. Length, 2·5-3·5 mm.

♀. Differs in having the head smaller, and no wider than elytra, abdomen almost parallel-sided to near apex and legs shorter and thinner.

Hab.—Lord Howe Island (A. M. Lea). Type, I. 12707.

A small species, flatter than usual, and with an unusually large head. The elytra vary in colour, on some specimens being entirely pale, on others infuscated posteriorly somewhat as on the preceding species, from which it differs in its much larger head (even on the female) with very different punctures, etc. The legs are usually almost flavous. In some respects it appears to approach the description of *L. minimus,* from Queensland, but the smallest specimen is somewhat larger than the size noted for that species. On many specimens, when viewed from behind, the pronotum appears to have a feeble basal tubercle, but this is due to the shining median space being even to the apex, whilst the adjoining surface is punctate and slightly depressed. Twenty specimens were obtained on *Kentia* palms.

Leptacinus opacipennis, n. sp.

Flavo-castaneous, most of head and of abdomen darker, antennae and legs paler. Elytra, for the genus, rather densely clothed with short, ashen pubescence, becoming sparser on abdomen.

Head moderately large, sides feebly dilated to near base, with two narrow deep impressions in front and remnants of two others; with fairly dense, sharply defined punctures, except on a narrow median line. Antennae rather short. Prothorax distinctly longer than wide, sides narrowed from near apex to base; with rather dense punctures, except on a narrow median line. Elytra parallel-sided, no wider than head, opaque; with crowded and small punctures; suture very narrowly elevated. Abdomen with crowded punctures, fairly well defined except about the tips of the segments. Length, 3-3·5 mm.

Hab.—Norfolk Island (A. M. Lea). Type, I. 12706.

A rather flat species, approaching the preceding one, but with smaller head and opaque elytra. On each of the two specimens before me there is a minute black spot on each side of the prothorax, near the apex, but it could be easily overlooked.

Leptacinus sexsulciceps, n. sp.

Of a dingy reddish-castaneous, most of abdomen darker, palpi and legs paler. Elytra and abdomen very sparsely pubescent, sides with a few setae.

Head rather large and flat, with six frontal sulci, the two median ones short and closed, the intermediate ones longer and oblique, their tips almost directly behind the tips of the median ones, the side ones passing the eyes for a short distance, and joined to the intermediate ones in front, with sparse punctures. Antennae short. Prothorax almost twice as long as the basal width, widest near apex, with sparse and small punctures. Elytra almost parallel-sided, slightly longer than prothorax, and slightly wider than its widest part; suture depressed at base, but not posteriorly; with rather sparse and small punctures. Length, 4·5-4·75 mm.

Hab.—Victoria: Melbourne (E. Fischer), Belgrave, in April, C. Oke. Tasmania: Launceston (British Museum). Type, I. 15888.

The size and outlines are somewhat as on *L. batychrus*, but otherwise the two species are very different. The punctures are sparser and smaller than on any other species of the genus before me; even the seriate ones on the pronotum are rather inconspicuous, on the type there are five on one side and nine on the other, on the Launceston and Belgrave specimens they are five and four in number (but reversely placed); the elytral punctures from directly above appear to be fairly sharp, although small, from oblique directions they are less defined, but appear somewhat larger and rugose, the abdominal punctures are scarcely visible. The Victorian specimens appear to be males, the Launceston one is probably a female, as its head is smaller, it differs also in having the colour somewhat brighter, except that the elytra are almost as dark as the abdomen.

Xantholinus, Serv., Cat., p. 299.

Many Australian species at various times have been referred to this genus, but the smaller ones have mostly been removed to *Leptacinus* and *Metoponcus*, and the larger ones to *Thyreocephalus* and *Eulissus*. It is probable that no typical species of the genus really occurs in Australia.

albertisi, Fvl. Q., New Guinea, etc. — sideralis, Fvl. W.A.
dubius, Macl. (Gen. dub.). Q.

Xantholinus albertisi, Fvl.

This beautiful and variable species is fairly common in the Cairns district.

EULISSUS, Mannerh., Cat., p. 310.

CHALCOPTERUS, Er. *(Xantholinus)*. Q., N.S.W., V., Tas., S.A., W.A.
cyaneipennis, Macl. *(Xantholinus)*.
CHLOROPTERUS, Er. *(Xantholinus)*. Q., N.S.W., V., Tas., S.A.
CYANOPTERUS, Er. *(Xantholinus)*. V., Tas., S.A.
ERYTHROPTERUS, Er. *(Xantholinus)*, Cat. p. 302. Q., N.S.W., V., S.A.
cervinipennis, Macl. *(Xantholinus)*.
HAEMORRHOUS, Fvl. *(Xantholinus)*. Q.
HUMMLERI, Bernh. Q., N.T.
OLLIFFI, Lea *(Xantholinus)*. N.S.W., V., Tas.
ORTHODOXUS, Oll. *(Xantholinus)*, Cat., p. 306. N.S.W.
PHOENICOPTERUS, Er. *(Xantholinus)*. Q., N.S.W., V., Tas., S.A., W.A., N.W.A., N.T.
TAITIENSIS, Bohem. *(Xantholinus)*. Q., N.S.W., S.A., W.A. Introduced.
holomelas, Perr. *(Xantholinus)*.

EULISSUS HAEMORRHOUS, Fvl.

A specimen identified by Dr. Bernhauer, and sent by Dr. Sjostedt, as *E. haemorrhous* certainly belongs to *E. erythropterus;* in the description of *E. haemorrhous*, however, the head is noted as having "*sulco subtilissimo a basi ultra medium longitudinaliter impresso*"*;* a character I have not seen on any one of numerous specimens of *erythropterus*.

EULISSUS HUMMLERI, Bernh.

Six specimens from the Mary River and Darwin (Northern Territory), and the Coen River (Queensland) appear to belong to this species; but on only one of them could the elytra be fairly called reddish-brown, on all the others they are blackish at the base, becoming obscurely paler posteriorly, but all have a distinct metallic gloss, which becomes more pronounced on the abdomen. The head of the male is much larger than that of the female, even larger than on the male of *Thyreocephalus lorquini*.

THYREOCEPHALUS, Guer., Cat., p. 313.

COELESTIS, Fvl. *(Xantholinus)*. N.S.W., V., Tas. S.A.
LORQUINI, Fvl. *(Xantholinus)*. Q., N.S.W., V.
rufitarsis, Fvl. *(Xantholinus)*.

THYREOCEPHALUS COELESTIS, Fvl.

A specimen from Noble Park (Victoria) in Mr. Oke's collection has elytra of a brighter blue (the beautiful blue of *Belonuchus dohrni)* than ordinary, they are also somewhat flatter, and with their punctures more sharply defined.

THYREOCEPHALUS LORQUINI, Fvl.

Xantholinus rufitarsis, Fvl.

Two specimens, from the British Museum, labelled as having been named *X. rufitarsis* by Fauvel (they are from Rockhampton, a locality not mentioned in the original description), appear to me to be quite ordinary specimens of *T. lorquini*. Three specimens, sent by Dr. Sjostedt as *T. rufitarsis*, and so recorded by Dr. Bernhauer, also belong to the species. In *lorquini* the male has a much wider head than the female, the prothorax is wider at apex, and the antennae are slightly longer; the legs, independently of sex, vary slightly in colour; the elytra, on fresh specimens, have a beautiful violet gloss, that is usually lost with age.

DIOCHUS, Er., Cat., p. 319.

DIVISUS, Fvl. N.S.W.

OCTAVII, Fvl. Q., N.S.W., V.

DIOCHUS DIVISUS, Fvl.

Specimens of this species have been taken in abundance during floods on the Peel and Hawkesbury Rivers. The prothorax varies from a dingy red (usually with the sides obscurely darker) to black, and the elytra from about one-fourth to three-fourths pale; the extent of the pale portion of the abdomen also varies; on one unusually pale specimen only about one-fifth of the base of the elytra is slightly infuscated.

DIOCHUS OCTAVII, Fvl.

Specimens of this species before me vary from 4 mm. in length with the abdomen contracted, to 6 mm. with it fully extended; they are from New South Wales (Sydney, Tamworth, and Clarence River) and Queensland (Cooktown and Mulgrave River).

NEOBISNIUS, Ganglb., Cat., p. 322.

PROCERULUS, Grav. N.S.W., S.A., C.A. Introduced.

semipunctatus, Fairm. (*Actobius*).

PHILONTHUS, Curtis, Cat., p. 326.

AFRICANUS, Fvl. (? Recorded in error, Cat., p. 327, as Australian).
ANTIPODUM, Fvl. N.S.W., S.A., W.A., Lord Howe Island.
DISCOIDEUS, Grav. Q., N.SW., V., Tas., S.A., W.A., N.W.A. Introduced.
GLENELGI, Blackb. V., S.A. (Omitted from Catalogue.)
HEPATICUS, Er. S.A. Introduced.
LONGICORNIS, Steph. Q., N.S.W., V., Tas., S.A., W.A., Norfolk Island. Introduced.
laetabilis, Oll. (*Cafius*).
MACELLUS, Fvl. Q., N.S.W., V., S.A., N.W.A., C.A.
MINUTUS, Bohem. Q., N.S.W. Introduced.
NIGRITULUS, Grav. N.S.W., V., Tas., S.A., W.A. Introduced.
OREOPHILUS, Fvl. Q.
ORNATUS, Blackb. Q., N.S.W., V., S.A., C.A.
PERTHENUS, Bernh., Arkiv för Zool., Band 10, No. 5, p. 5. W.A.
PILIPENNIS, Macl. Q.
POLITUS, Linne. N.S.W., V., Tas., S.A. Introduced.
aeneus, Rossi.
amblyterus, Oll. (*Cafius*).
laeus, Oll. (*Cafius*).
QUISQUILIARIUS, Gyll. N.T. Introduced.
SORDIDUS, Grav. N.S.W., V., Tas., S.A., W.A. Introduced.
SUBCINGULATUS, Macl. Q., N.S.W., V., S.A., W.A., N.W.A., C.A. Omitted from Catalogue.
sanguinicollis, Fvl.
VENTRALIS, Grav. Q., N.S.W., V., Tas., S.A., N.W.A., N.T. Introduced.

PHILONTHUS GLENELGI, Blackb.

A specimen of this species, from Lucindale, differs from the type in being slightly smaller (5·25 mm.); of the series of punctures on its pronotum the one on the left consists of four, but on the right of five.

PHILONTHUS ORNATUS, Blackb.

The elytra of this species vary from a bright red, except for a very faint infuscation at the base and in the external apical angles, to almost entirely dark, except that the suture is obscurely reddish.

PHILONTHUS SUBCINGULATUS, Macl.

A specimen of this species was taken at Gawler from the nest of a species of *Pheidole.*

PHILONTHUS MINUTUS, Boh.

An introduced species, in appearance rather close to *P. discoideus,* but tips of elytra more narrowly pale, the suture also more narrowly pale (if not entirely dark); the front angles of the prothorax are also more rounded off. The punctures in the rows on the prothorax are usually five in number, but are sometimes four on one side and five on the other. Four synonyms are noted in the Catalogue.

PHILONTHUS QUISQUILIARIUS, Gyll.

In the Catalogue (p. 352) this species is noted as cosmopolitan and eleven synonyms and varieties are recorded. The only Australian specimen before me, that agrees with European ones so named, is in the National Museum from Oenpelli (Northern Territory).

PHILONTHUS THERMARUM, Aube.

Fauvel recorded this species from New Guinea, and in the Catalogue it is noted as cosmopolitan. I have not seen any Australian specimens, however, that agree with two Indian ones received from Dr. Cameron, and know of no actual Australian record.

Philonthus dolichoderes, n. sp.

♂. Black, shining, with a faint bronzy gloss, abdomen with bluish iridescence; antennae, mouth parts, and legs of a more or less dark brown. Elytra with rather sparse, depressed, blackish setae, becoming longer on abdomen; sides and legs with blackish bristles.

Head rather large, slightly transverse (excluding neck), angles rounded off; with a few large punctures, and numerous minute ones. Eyes slightly longer than third joint of antennae, and almost twice as long as wide. Antennae rather long, first joint almost as long as second and third combined, third longer than second, the others gradually decreasing in length to tenth, which is distinctly shorter than eleventh. Prothorax with front margin almost straight and much wider than base, which is gently rounded, sides finely margined; all margins with some large punctures, a few others scattered about, each discal row composed of three or four punctures irregularly spaced, minute ones scattered about. Elytra slightly wider than prothorax, sides gently rounded; with fairly dense and rather large punctures. Abdomen with punctures somewhat sparser but more sharply defined on upper than on lower surface; anal styles rather long. Legs moderately long and stout, front tarsi dilated. Length, 11-17 mm.

♀. Differs in having the head somewhat smaller, antennae shorter and front tarsi thinner, with sparser clothing.

Hab.—Lord Howe Island (Australian Museum and A. M. Lea). Type, I. 12685, in South Australian Museum.

A large species, with the general appearance of *P. politus,* but the prothorax is much longer (suggestive of that of *Xantholinus),* head and antennae longer, and punctures different. Some specimens have the prothorax and elytra obscurely diluted with brown. From some directions the abdomen appears to be black, but the iridescence is conspicuous in most lights. The elytral punctures are frequently confluent, but viewed directly from above it each one usually appears to be sharply defined and isolated. In certain lights the pronotum appears to be faintly shagreened. The three basal joints of the antennae are shining, the first appears to be always partly black, the second and third are sometimes deeply infuscated. Thirteen specimens were obtained, including one from the summit of Mount Gower.

Philonthus cupreotinctus, n. sp.

♂. Deep black and shining, with a faint coppery gloss; antennae (except the three shining basal joints), palpi, tarsi, and tips of lower surface of abdominal segments obscurely brownish. Elytra, abdomen, and under surface with rather sparse, short, blackish pubescence; a few bristles scattered about.

Head (excluding neck) slightly wider than long, hind angles gently rounded; with large punctures about base, margining eyes and fairly dense in hind angles, four isolated ones on disc; minute punctures scattered about. Antennae rather thin, but not very long, first joint almost as long as second and third combined, third distinctly longer than second. Prothorax slightly longer than apex, which is almost truncated, base rather strongly rounded and narrower than apex, sides very finely margined; with minute scattered punctures, some rather large marginal ones, and two irregular median rows. Elytra subquadrate, slightly wider than widest part of prothorax; with dense and comparatively coarse, sharply defined punctures. Abdomen with a well-defined narrow impression, on the upper surface, across most of the segments, but curving around the spiracle on each side, five of them with two discal impressions; punctures well defined but much smaller than on elytra, anal styles obtuse but fairly long. Legs rather thin but not very long; front tarsi dilated. Length, 12 mm.

Hab.—Queensland: Cairns (E. Allen), unique.

A glossy-black species, without abdominal iridescence, about the size of *P. politus,* but narrower, prothorax decidedly longer, head flatter with larger and more numerous punctures, and elytra with coarser punctures and shorter and sparser pubescence. The seriate punctures on the pronotum are irregularly spaced, four on the left of the middle, and five on the right.

Philonthus oviceps, n. sp.

Black, shining; elytra not quite black and less shining, palpi and legs of a dingy brown, antennae darker, except the two apical joints. Elytra and abdomen with dense, depressed, dark pubescence; with a few bristles, mostly marginal.

Head comparatively small and oval, distinctly longer than wide; with rather large, irregularly distributed punctures, and very minute ones. Antennae rather long and thin, first joint distinctly shorter than second and third combined, about the length of eleventh, and slightly shorter than eyes. Prothorax rather thin, slightly longer than wide, apex (which is truncated) scarcely wider than base (which is evenly rounded); with some large marginal and submarginal punctures, and a row on each side of middle. Elytra slightly longer than wide, conspicuously wider than prothorax, suture evenly raised, punctures dense, small, and partly concealed. Abdomen long and parallel-sided to near apex; punctures more irregular than on elytra, but in parts concealed; anal styles long and acute. Legs rather thin. Length, 7 mm.

Hab.—Queensland: Townsville (E. Fischer). Type (unique), I. 15886.

In general appearance rather close to *P. quisquiliarius,* but hind angles of head completely rounded off and elytral punctures finer. In some lights the pronotum has an opalescent gloss; it has five seriate punctures on the right of the middle and six on the left. As the tip of the lower surface of the abdomen is slightly notched the type would appear to be a male, although its front tarsi are rather thin.

Philonthus anthracinus, n. sp.

♀. Deep black and shining; head, pronotum, and elytra with a faint bronzy gloss, tips of mandibles, palpi, and tarsi dark brown. Elytra and abdomen with rather sparse, short, dark, depressed pubescence; bristles sparse and marginal.

Head, between labrum and neck, distinctly transverse, hind angles gently rounded; with large punctures about eyes and base, and two isolated ones between eyes. Antennae moderately long, first joint almost as long as second and third combined, distinctly longer than eleventh, and slightly longer than eyes, three subapical ones slightly transverse. Prothorax about as long as wide, apex truncated, base evenly rounded; with a few large marginal and submarginal punctures, and three evenly spaced ones on each side of middle. Elytra scarcely longer than their greatest width, distinctly wider than prothorax, suture elevated throughout; punctures dense and sharply defined, but not very large. Abdomen with punctures of varying size, but mostly smaller than on elytra. Length, 7 mm.

Hab.—Western Australia: Albany. Type (unique), in British Museum.

The size and outlines are somewhat as on *P. discoideus* and *P. macellus*, but the colour and punctures are different. At first glance the type appears to be entirely black; in some lights the head and pronotum appear to be very faintly shagreened, and parts of the abdomen to be faintly opalescent. Only the bristles of the anal styles are visible.

Philonthus apicipunctus, n. sp.

Black and very shining, legs of a rather pale brown, the femora almost flavous, basal and apical joints of antennae paler than the others, which are more or less deeply infuscated. Elytra and abdomen with moderately long, sparse, depressed pubescence; with a few marginal bristles.

Head, between labrum and neck, slightly transverse, hind angles rounded off; with a few distinct marginal punctures. Antennae rather short, first joint almost as long as second and third combined, and very little longer than eyes, second slightly longer than third, fourth to tenth transverse. Prothorax slightly longer than wide, apex truncated, base evenly rounded, sides almost parallel; with a few fairly large marginal and submarginal punctures, and three evenly spaced ones on each side of middle. Elytra not much wider than prothorax and slightly transverse; with sparse and small punctures. Abdomen impunctate, except at tips of segments. Length, 5 mm.

Hab.—Queensland: Cairns (F. P. Dodd). Type (unique), I. 12682.

The size and colours are much as in *P. ventralis* and *P. oreophilus*, but the punctures are much sparser, and the seriate ones on each side of the pronotum are but three in number. The tip of the under surface of the abdomen is slightly notched, so the type is probably a male, although its front tarsi are rather thin. It was trapped by a sticky seed of *Pisonia brunoniana*.

Philonthus incisiventris, n. sp.

♂. Black, elytra bright castaneous; antennae, mouth parts, and legs somewhat paler, tips of abdominal segments obscurely pale. Elytra and abdomen with not very dense, depressed pubescence; sides with rather numerous bristles, becoming dense on tip of abdomen.

Head rather large, slightly transverse between labrum and neck; with large marginal and submarginal punctures, two isolated ones between eyes, a shallow depression in middle just behind clypeus; minute punctures scattered about. Antennae rather short, first joint as long as second and third combined, and scarcely longer than eyes, second slightly shorter than third, fourth and fifth slightly transverse, sixth to tenth strongly so. Prothorax almost as long as wide, front truncate and slightly wider than base, which is evenly rounded; with a few distinct marginal and submarginal punctures, and four evenly spaced ones on each side of the middle. Elytra slightly transverse, sides gently dilated to near apex, suture slightly elevated; punctures sharply defined but not very large or dense. Abdomen with denser and smaller punctures than on elytra, tip of under surface deeply notched; anal styles moderately long. Legs not very long, femora stouter than usual, front tarsi dilated. Length, 5-5½ mm.

Hab.—Queensland: Cairns (E. Allen), Mulgrave River (H. Hacker, No. 70).

The colours are much as in the European *P. fulvipes*, but otherwise the two species differ considerably. From some directions the prothorax appears to have a faint satiny lustre; the abdomen is somewhat opalescent. On one specimen the wings are exposed and brilliantly coloured.

Philonthus victoriensis, n. sp.

♂. Black, shining; elytra castaneous, parts of mouth and of legs obscurely brown. Elytra and abdomen with moderately dense, depressed, blackish pubescence; sides with sparse bristles, but becoming dense on apex of abdomen.

Head subovate, slightly longer than wide, hind angles rounded off; with rather large marginal and submarginal punctures, and two isolated ones between eyes. Antennae not very long, first joint almost as long as second and third combined (these subequal) and slightly longer than eyes, fourth to tenth more or less transverse. Prothorax slightly narrower than median length, apex truncated, base evenly rounded, sides almost parallel; with fairly large marginal punctures, and a row on each side of middle (four on the right and five on the left). Elytra slightly dilated to apex, where the width is about one-fourth more than that of prothorax, suture narrowly elevated; punctures small and not very dense, but sharply defined. Abdomen with unevenly distributed punctures of different sizes, mostly smaller than on elytra; tip of under surface with a rather wide triangular notch. Front tarsi dilated. Length, 5 mm.

Hab.—Victoria: Melbourne (E. Fischer). Type (unique), I. 15887.

The colours are somewhat as in the European *P. salinus* and *P. fulvipes*, except that the antennae and legs are darker; the punctures, however, are very different. From the preceding species it differs in being narrower, with darker antennae and legs and much less sharply defined punctures. The antennae at first glance appear to be entirely black, but parts of the second and third joints are obscurely red. The anal styles are concealed on the type.

Philonthus multicolor, n. sp.

♂. Black; prothorax, elytra (except about base), and front and middle coxae bright red, femora flavous, rest of legs infuscated, antennae infuscated, four apical joints almost white. Elytra sparsely clothed with dark pubescence, becoming slightly denser and longer on abdomen; sides with a few bristles.

Head rather small, excluding neck about as long as wide, hind angles rounded off; with fairly large marginal and submarginal punctures, and two isolated ones between eyes. Antennae not very long, first joint as long as second and third combined, and about the length of eyes, fourth to tenth more or less transverse, the eleventh conspicuously produced on one side of apex. Prothorax (along middle) slightly longer than wide, apex truncated, base evenly rounded, sides feebly narrowed to apex; with rather large marginal and submarginal punctures, and a row of four on each side of middle. Elytra scarcely longer than prothorax, but distinctly wider; with few and small punctures. Abdomen long, parallel-sided to near apex; with sharply defined punctures near base of each segment, the tips also with distinct ones, tip of under surface obtusely notched; anal styles long and thin. Legs not very long, front tarsi dilated. Length, 6 mm.

Hab.—North-western Australia: Behn River (R. Helms). Queensland: Coen River (H. Hacker).

The colours, except of the antennae, are much as in the European *P. tenuis*, but the sculpture is very different. All the discal punctures of the elytra are inconspicuous; on one specimen the left seriate row on the pronotum consists of five punctures.

Philonthus cruenticollis, n. sp.

♀. Head black; prothorax and front coxae bright red, elytra deep blue, abdomen of a dull red, each segment obscure at base, the subapical one (except at base) and apical one bluish-black, all segments more or less brightly iridescent, legs and palpi brownish, the antennae darker except the base of the first and second joints. Elytra and abdomen with fairly dense blackish pubescence, the sides with rather numerous bristles.

Head slightly longer than wide, hind angles rounded off; with large punctures about base and margining eyes, and two isolated ones nearer eyes than usual. Antennae moderately long, first joint slightly shorter than eyes, and than second and third combined, these subequal, some of the subapical ones transverse. Prothorax slightly longer than wide, apex truncated, base evenly rounded, sides almost parallel; with rather large marginal and submarginal punctures, and a distinct row (six on the left and five on the right) on each side of middle. Elytra distinctly wider than prothorax, and almost twice the width of head, suture faintly elevated; punctures dense and rather small but sharply defined. Abdomen with punctures about base of each segment, much as on elytra, but becoming smaller to the tips, where they almost vanish; anal styles long and thin. Legs rather long. Length, 9 mm.

Hab.—Queensland: Townsville (R. E. Turner). Type (unique) in National Museum from C. French's collection.

A beautiful species, the only *Philonthus* known from Australia with blue elytra; the colours are much as in some varieties of *Paederus cruenticollis.* The front tarsi of the type are wider and more densely clothed than is usual in females, but the tip of the abdomen is not at all notched.

Cafius, Steph., Cat., p. 361.

australis, Redt. *(Ocypus).* N.S.W., V., Tas.
areolatus, Fvl.
catenatus, Fvl. N.S.W.
corallicola, Fairm. W.A. Introduced.
occidentalis, Blackb.
nasutus, Fvl. (Needs confirmation as Australian.)
nauticus, Fvl.
densiventris, Fvl. Q., N.W.A., Baudin, Condillac, Low Rocks, Adele, and Lord Howe Islands. Introduced.
pacificus, Er. *(Philonthus).* Q., N.S.W., V., Tas., S.A., W.A., King, Rottnest, Pelsart, and Carnac Islands.
littoralis, Fvl.
sabulosus, Fvl. Q., N.S.W., V., Tas., S.A., Lord Howe Island.
seriatus, Fvl. V., Tas., S.A., W.A.
sericeus, Holme *(Philonthus* and *Remus).* V., Tas., S.A., W.A. Introduced.
velutinus, Fvl. N.S.W., V., Tas., S.A., W.A.

Cafius australis, Redt.

C. areolatus, Fvl.

This species varies considerably in size (11-18 mm.) and colour, but may be distinguished from all other Australian ones, except *C. sabulosus,* by the absence of punctures from the prothorax, except at the angles; from *sabulosus* itself it is distinguished by the larger size and much larger and sparser punctures on the elytra. One female before me has the prothorax reddish, except for a large discal infuscation, the three basal joints of its antennae are reddish, the others black; the punctures on its elytra are all sharply defined, with the adjoining surface not at all wrinkled. On males the prothorax is usually deep black; with the elytra densely and finely wrinkled between the punctures, the antennae are sometimes entirely dark, on several specimens parts of the three basal joints are black, the others obscurely reddish. The elytra vary (apart from sex) from castaneous-brown to black, with the inflexed sides paler and the tips narrowly pale; on one male the prothorax (except for a slight infuscation), elytra, and abdomen (except for an infuscated spot on each segment) are entirely castaneous-brown. On the males there are sometimes two or three sharply defined punctures between the eyes, but these are usually absent or faintly indicated. On the females the elytra are seldom conspicuously wrinkled between the punctures, and on some males the wrinkles are very feeble, although usually distinct. On some males the head is not much larger than on females, but on others it is twice the size. The type of *C. australis* was an unusually small and brightly coloured male, that of *C. areolatus* a male of medium size; the synonymy is now first recorded.

Cafius pacificus, Er.

C. littoralis, Fvl.

I have seen but one specimen that agrees perfectly with the description of *C. pacificus*, and that was from King Island, where it was taken in company with typical specimens of *C. littoralis*, which has now to be recorded as a synonym of the species. It varies considerably in size (8-12 mm.) and is widely distributed. The common form is black, with the inflexed sides of the elytra and parts of the abdomen obscurely reddish; on a few specimens the anterior angles and sides of the prothorax are very obscurely diluted with red.

Cafius nauticus, Fvl.

Readily distinguished from all other species occurring in Australia by the highly polished median line of prothorax bounded by dense punctures, and continued on to the head. On some specimens the suture is narrowly reddish throughout, on others at the tip only, on several not at all; the head of the male is considerably larger than that of the female; the size ranges 7-9 mm.

Cafius velutinus, Fvl.

The species identified as *C. velutinus* by Blackburn, Olliff, and myself is a widely distributed one, ranging 6-8·5 mm. in length, with two rows of punctures on the prothorax, the head opaque but with a shining lanceolate median space; on all specimens of it the inflexed sides of the elytra are flavous or almost so.

A specimen of the species, in the British Museum from the Sharp Collection, was labelled as *C. catenatus*, Fvl., but probably incorrectly so.

Cafius corallicola, Fairm.

C. occidentalis, Blackb.

A cotype of *C. occidentalis*, and a specimen from the Swan River, agree well with Fauvel's description of *C. corallicola*, and also with a specimen from Seychelles sent under the latter name by Dr. Bernhauer.

Six specimens, from Adele and Baudin Islands, in the British Museum, appear to represent a variety; they have the prothorax reddish and somewhat paler than the parts behind it; the antennae of three of them have the second and third joints distinctly infuscated, on another they are faintly infuscated, on the others no darker than the adjacent joints; the long median line, more conspicuous from some directions than from others, and coarse punctures on the shining head are exactly as on typical specimens.

HESPERUS, Fvl., Cat., p. 363.

AUSTRALIS, Macl. *(Philonthus)*. Q., N.S.W., V.
HAEMORRHOIDALIS, Macl. *(Philonthus)*. Q., N.S.W.
mirabilis, Fvl.
PACIFICUS, Oll. Lord Howe Island.
PULLEINEI, Blackb. S.A.
SEMIRUFUS, Fvl. Q., N.T.

HESPERUS HAEMORRHOIDALIS, Macl.

On an occasional specimen only two of the apical joints of the antennae are pale, instead of three or four.

Hesperus gloriosus, n. sp.

Pale castaneous, elytra metallic-blue or purple, the suture black, metasternum and abdomen black, three basal joints of antennae pale castaneous, the five next black or deeply infuscated, the apical three almost white. Elytra and abdomen with rather sparse, dark pubescence; with long dark bristles, dense on the abdomen, numerous on the elytra, but almost confined to the sides on the head and prothorax.

Head distinctly transverse between clypeus and neck; with a few large, irregularly distributed punctures. Antennae rather short, first joint slightly longer than second and third combined, and longer than eyes, seventh to tenth rather strongly transverse. Prothorax about as long as wide, slightly narrower than head across eyes, base rounded, front angles gently rounded; a few large punctures scattered about, and an irregular row on each side of middle. Elytra subquadrate, distinctly wider than head, suture slightly raised; punctures fairly dense and small but sharply defined, a few large ones scattered about. Abdomen evenly decreasing in width posteriorly; with rather crowded and elongated punctures across the base of five segments, and at the tips of four. Length, 8-9 mm.

Hab.—Queensland: Coen River (H. Hacker), Cairns district (A. M. Lea). Type, I. 12661.

A very beautiful species, structurally fairly close to *H. semirufus*. In certain lights the blue or purple of the elytra changes to green, especially posteriorly; the abdomen is shining but not iridescent. On one specimen four of the basal joints of antennae are pale and only two of the apical. There are four punctures in line between the eyes, and between the median two, a short remnant of a median line; on two specimens there are three punctures in each of the seriate rows on the pronotum, on a third there are four on the left and three on the right.

Hesperus picticornis, n. sp.

♂. Black; basal half of elytra (except suture), mouth parts, and legs reddish; three basal joints of antennae, except tips of second and third, reddish, fourth to eighth black or infuscated, the apical three almost white. Elytra sparsely pubescent and with numerous bristles, becoming more numerous on abdomen, the sides elsewhere with a few bristles.

Head strongly transverse between clypeus and neck, with a few large punctures, of which six form an irregular row between the eyes. Antennae moderately long, seventh to tenth joints somewhat transverse. Prothorax slightly narrower than the median length, base evenly rounded, sides almost parallel; with a few large punctures scattered about, and three forming a row on each side of middle. Elytra slightly longer and wider than prothorax; with numerous (but not crowded) and rather small sharply defined punctures. Abdomen evenly diminishing in width posteriorly, each of the four basal segments with a row of punctures near base and another at apex, punctures irregular on the following segments; anal styles long and thin; tip of under surface triangularly notched. Front tarsi dilated and padded. Length, 10 mm.

Hab.—New South Wales: Tweed River, in October (H. J. Carter). Type, I. 12660.

Not very close to any other species before me. The black part of the elytra has a slight coppery gloss; the abdomen is brilliantly iridescent, its four basal segments are narrowly tipped with red, the subapical one has about one-fourth pale, the following one is pale, except for a transverse median infuscation.

BELONUCHUS, Nordm., Cat., p. 369.

BREVICOLLIS, Fvl. Q. DOHRNI, Fvl. Q., N.S.W., N.T..

BELONUCHUS BREVICOLLIS, Fvl.

The prothorax of this species at first glance appears to be deep black, but from some directions a slight silken iridescence becomes visible. The type was from Wide Bay, two specimens before me are from the Cairns district.

BELONUCHUS DOHRNI, Fvl.

This beautiful species is fairly common in the Cairns district on *Pandanus*, and there is a specimen in the National Museum, labelled as from New South Wales.

MYSOLIUS, Fvl., Cat., p. 373.

CHALCOPTERUS, Oll. Q.

ACTINUS, Fvl., Cat., p. 373.

IMPERIALIS, Fvl. Q. (also New Guinea). MACLEAYI, Oll. Q.

ACTINUS IMPERIALIS, Fvl.

In the description of this species the elytra (except at the sides and apex) were noted as green, and were so figured; but on numerous specimens before me from New Guinea the elytra (except at the sides and apex) are purplish, in parts, however, with a greenish gloss from certain directions; more than half of the sixth abdominal segment is flavous. Two specimens from the Coen River (Queensland) agree perfectly with them, except that a smaller portion of the sixth abdominal segment is pale.

ACTINUS MACLEAYI, Oll.

It is doubtful if *A. macleayi* is more than a variety of the preceding species. Specimens of *A. imperialis* differ considerably in the punctures of the head and prothorax, in the same way as those of *A. macleayi* from Cairns, so that the only apparently constant distinction is *imperialis* having one apical joint of antennae white, and *macleayi* two. The species is an extremely active one, and the most beautiful member of the family that I have seen from any part of the world.

OCYPUS, Steph., Cat., p. 383.

ATER, Grav. *(Tasgius)*. V. Introduced.

OCYPUS ATER, Grav.

A specimen of this species, now first recorded as occurring in Australia, was taken by Mr. F. E. Wilson at Kooyong, in May, 1919; it agrees perfectly with English specimens identified as such by the late Dr. D. Sharp and the late Rev. T. Blackburn; the species has also been taken in Victoria by Mr. Ejnar Fischer. In the Catalogue fourteen synonyms and varieties of the species are noted.

COLONIA, Oll., Cat., p. 397.

REGALIS, Oll. Q., N.S.W.

CREOPHILUS, Mannerh., Cat., p. 397.

ERYTHROCEPHALUS, Fabr. *(Emus)*. Q., N.S.W., V., Tas., S.A. W.A., N.W.A., N.T., C.A., King and Lord Howe Islands.
unipunctatus, Hope *(Staphylinus)*.(7)
lanio, Er.
var. *oculatus*, Fabr.(8)

ANTIMERUS, Fvl., Cat., p. 410.

PUNCTIPENNIS, Lea. Q., N.S.W.

SMARAGDINUS, Fvl. V.

Antimerus posttibialis, n. sp.

♂. Black; head and prothorax with a bronzy gloss, the elytra with a greenish one, five basal joints of antennae (the others missing), palpi, and tarsi more or less reddish. With dense, whitish pubescence, sparser on middle of head and prothorax, and on upper surface of basal segments of abdomen, than elsewhere, third, fourth, and fifth segments with denser clothing than elsewhere, and somewhat curved; sides with fairly numerous bristles.

Head large and flat; transverse between lip and neck; with crowded and sharply defined punctures of moderate size. Eyes large, oblong-elliptic, distinctly longer than basal joint of antennae. Mandibles rather thin, with an obtuse projection at base, the left one with a small tooth nearer the base than apex, the right one not interrupted there. Prothorax about as wide as head and slightly longer, median length equal to greatest width (across apex), base evenly rounded and finely margined, the sides also finely margined; punctures much smaller than on head but quite sharply defined; a narrow, impunctate median line. Elytra slightly longer and wider than prothorax, sides gently rounded, apices strongly so; with more crowded punctures than on head, but scarcely larger. Abdomen with dense punctures, except on the second and third segments, on which they are distinct only across the base; tip of under surface gently incurved to middle. Tibiae densely clothed, the tips spinose, hind pair suddenly incurved at apex; front tarsi strongly, the middle ones moderately, dilated. Length, 16 mm.

Hab.—Queensland: Kuranda (F. P. Dodd). Type (unique), I. 12698.

Only five joints of one antenna are left (less of the other), of these the two basal ones are pale castaneous and shining, the others are paler; all are longer than wide.

This and the following species are referred with doubt to *Antimerus;* they have the general outlines of the two previously named species of that genus; the head, including the mouth parts, the prothorax, and the greatly dilated front and middle tarsi are also in agreement; but the clothing and the finer details of sculpture differ greatly from those species.

Antimerus auricomus, n. sp.

♂. Black; head and prothorax shagreened and dark metallic-green, elytra, antennae, palpi, and legs reddish; tip of abdomen obscurely reddish. With

(7) Mr. Arrow informs me that the type of *Staphylinus unipunctatus* (Hope, in Gray's Zoological Miscellany, 1831, p. 32) from Nepal is in the British Museum, and that the name is a synonym of *C. erythrocephalus*.

(8) Fauvel, Ann. Mus. Civ. Gen., 1877, p. 250, records this well-known New Zealand form as occurring in Australia, but its presence requires confirmation.

fairly long and variegated pubescence; and sparse bristles becoming numerous posteriorly.

Head large and flat; transverse between lip and neck; with dense and rather small punctures. Eyes large, oblong-elliptic. Basal joint of antennae shorter than eyes, and shorter than the following joints combined, of these the second is slightly shorter than third (the others are missing). Prothorax slightly wider (near apex) than long, base gently rounded and, with the sides, very finely margined; punctures much as on head. Elytra slightly wider than prothorax and distinctly longer, sides slightly, the apices strongly rounded; with crowded and rather small punctures, in places coarser and confluent. Abdomen with dense more or less concealed punctures; under surface feebly incurved at apex; anal styles rather long. Tibiae with strong spines at apex, and with some thinner ones amongst the clothing elsewhere; front tarsi strongly, the middle ones moderately dilated. Length, 15 mm.

Hab.—New South Wales: Dorrigo (unique).

A beautifully coloured and clothed species. The clothing and the shagreened surface are very different from those of the preceding species, and the hind tibiae are not incurved at apex. On the head and pronotum the pubescence is mostly dark and inconspicuous, but in parts is golden and distinct, on the scutellum it is almost white, on the elytra it is golden except for a black patch about the middle, but it becomes white on the sides; on the three apical segments of the abdomen it is dense golden and waved, on the other segments it is mostly pale on the sides and black elsewhere (in some lights the black pubescence has a fiery-red gloss); on the under surface and legs it is entirely pale.

HETEROTHOPS, Steph., Cat., p. 411.

BIMACULATA, Fvl. N.S.W.
LATICEPS, Fvl. Q., N.S.W., V., Tas.
LUCTUOSA, Fvl. S.A.
MAGNICEPS, Bernh., Arkiv för Zool., Band 13, No. 8, p. 17. Q.
PICIPENNIS, Fvl.[9] N.S.W., V., Tas., S.A.
SEMICUPREA, Fvl. Q.
TIBIALIS, Fvl. N.S.W., V., Tas., S.A.
XANTHOLINOIDES, Macl. *(Philonthus* and *Quedius)*. Q., N.S.W., V.
flavicollis, Fvl.
fauveli, Bernh. and Schub.

HETEROTHOPS LATICEPS, Fvl.

A widely distributed species, stated by Bernhauer[10] to be synonymous with *H. xantholinoides,* but in this he was mistaken; *H. laticeps* is a larger, wider, and dingier species, with head much wider and differently impressed, and of which I have seen numerous specimens, including a cotype from the British Museum. The two species were, in part, described by Fauvel as follows:—

laticeps. *"fronte inter antennas leviter biimpressa."*
flavicollis. *"fronte inter antennas antice sat profunde impressa, post impressionem punctis 2 approximatis notata."*

HETEROTHOPS XANTHOLINOIDES, Macl.
H. flavicollis, Fvl.
H. fauveli, Bernh. and Schub.

Two specimens from Gayndah, probably cotypes, of *H. xantholinoides* have the base, suture, and apex paler than the rest of the elytra (although the elytra were simply described as "of a darker hue than the thorax"); they have a

(9) In error recorded by Bernhauer as *picipes.*
(10) Bernhauer, Arkiv för Zoologi, Band 13, No. 8, 1920, p. 17.

depression on the front part of the head, and close behind it two punctures close together. The species was described as a *Philonthus,* in the Catalogue it is placed as a *Quedius,* but it is a *Heterothops,* and the same species was named *H. flavicollis* by Fauvel, a name changed by Bernhauer and Schubert to *H. fauveli,* as being already in use in the genus, but their name is not now required. Three specimens from Tasmania appear to represent a variety of the species, they differ from typical specimens in having the head scarcely darker than the prothorax, and on one of them the suture is quite as dark as the adjacent parts of the elytra.

HETEROTHOPS TIBIALIS, Fvl.

On some specimens of this species the median joints of the antennae are but slightly infuscated; on the female the front tibiae are much thinner than in the male, and not notched.

HETEROTHOPS PICIPENNIS, Fvl.

Mr. F. E. Wilson took a specimen of this species from a nest of a jumper ant (*Myrmecia* sp.), at Belgrave (Victoria), in September.

HETEROTHOPS MAGNICEPS, Bernh.

A curious almost parallel-sided species, of which I took one specimen at Cairns; and another (apparently a cotype) was received from Dr. Sjöstedt.

Heterothops dolichocephalus, n. sp.

♂. Dark castaneous; antennae, palpi, and legs paler; a few dark hairs scattered about, and more numerous on abdomen than elsewhere; elytra, abdomen, and under surface with rather sparse, pale pubescence.

Head long and thin; with a few distinct punctures near eyes and before neck. Eyes rather small, with coarse facets, not extending half-way to neck and shorter than the inter-antennary space. Antennae with first joint almost as long as second and third combined, these subequal, none of the others transverse, eleventh about once and one-half the length of tenth. Apical joint of palpi very thin, about two-thirds the length of subapical one. Prothorax more than twice the width of head, sides rather strongly narrowed to apex; with two distinct submedian punctures in the usual positions and a few near all the margins. Elytra much shorter than prothorax and scarcely wider, apex conjointly arcuate; with fairly dense, sharply defined punctures of moderate size. Abdomen more than half the total length; with sparse punctures mostly in zones, tip of under surface bilobed. Front tibiae dilated to near apex, front tarsi moderately dilated. Length, 5-5·5 mm.

♀. Differs in having abdomen not notched at apex, and the front tibiae and tarsi thinner.

Hab.—Tasmania (Aug. Simson's No. 3696), Waratah, in moss (A. M. Lea). Type, I. 12502.

An apterous, long-headed species, with the general outlines of *Quedius baldiensis,* but with the palpi of *Heterothops,* and decidedly shorter elytra. On several specimens the prothorax and abdomen (except that most of the segments of the latter are paler at the tips) are darker than the other parts; the abdomen (both surfaces) is slightly iridescent; one male is shining black, except that the legs, antennae, palpi, and tips of some of the abdominal segments are obscurely reddish, its abdomen is very feebly iridescent, and most of the punctures on its upper surface are confined to the base and apex of each segment. Another male, except for its eyes and clothing is entirely pale flavous, but seems to be immature. The front tibiae of the male are dilated about the apical third, and then narrowed to apex, with on one side of the narrowed part a long comb of reddish bristles or teeth, but the comb is so placed that some manipulation is needed to see it under a compound power; the middle tarsi of the male have more numerous bristles than on the female, but they do not form a comb. As on many species of *Quedius* the tip of most of the abdominal segments on the upper surface appears finely serrated, owing to a setiferous row of punctures; the setae are very distinct from the sides.

Very close in general appearance to *Quedius longiceps*, Broun (from New Zealand, and which appears to be a *Heterothops)*, but distinguished by the abdominal punctures; on *longiceps* they are more densely crowded at the base of the segments, and are fairly numerous elsewhere; on that species also some of the antennal joints are transverse; the two are certainly very closely allied, and possibly the Tasmanian form should be regarded as varietal.

Heterothops apterus, n. sp.

Deep black and highly polished; antennae, some of the mouth parts, legs, and most of under surface of a more or less dingy red. Sides with a few dark hairs, becoming rather numerous on abdomen; elytra, abdomen, and under surface with sparse dark pubescence.

Head rounded, between front of eyes and neck slightly transverse; a few distinct punctures near eyes and just before neck. Eyes very large, extending almost to neck, almost twice as long as the inter-antennary space. Antennae with first joint almost as long as second and third combined, these subequal, the others gradually decreasing in length, but none transverse, eleventh almost twice the length of tenth. Apical joint of palpi very thin, slightly shorter than the subapical one. Prothorax slightly wider than the median length, strongly narrowed to apex; with some distinct punctures slight distances from the margins, and two submedian ones in the usual positions. Elytra much shorter than prothorax, sides slightly dilated posteriorly; with rather dense and not very large but sharply defined punctures. Abdomen more than half the total length; with numerous punctures; four segments very finely serrated at tips. Length, 4·25 mm.

Hab.—Tasmania: Cradle Mountain (A. M. Lea). Type (unique), I. 12485.

A deep black, apterous species; the type at first glance is like a black specimen of the preceding species, but the eyes are unusually large and of different shape, and the head is considerably wider. The two basal joints of antennae are paler than the others, which are rather deeply infuscated; under a magnifying glass several of their joints appear to be slightly transverse, but under a compound power even the tenth is seen to be slightly longer than wide. The type is probably a female, but its sex is doubtful, as the apical segment of the abdomen is withdrawn so that its tip cannot be examined, the front tibiae are moderately dilated to near the apex, with a rather dense fringe there, and the front tarsi are hardly dilated. It is rather close to *Quedius megophthalmus*, Broun (from New Zealand, and which is probably a *Heterothops)*, but its head is narrower so that the eyes occupy a larger proportion of the head, although their size is the same, but their inner sides are nowhere straight, as they partly are on that species.

Heterothops picticollis, n. sp.

♂. Of a rather dingy castaneous-brown but shining, sides of prothorax, basal joints of antennae, palpi, and most of under surface and of legs paler. Upper surface with rather sparse long hairs; elytra, abdomen, and under surface with pale and not very dense pubescence.

Head rather long, parallel-sided from eyes to near neck; with a few large punctures near the eyes and before the neck. Eyes small, distinctly shorter than the inter-antennary space. Antennae with first joint slightly shorter than second and third combined, second slightly longer than third, the others to tenth feebly decreasing in length, but none transverse, eleventh about once and one-half the length of tenth. Apical joint of palpi very thin, slightly longer than the subapical one. Prothorax scarcely wider than the median length, strongly narrowed to apex; with a few large irregularly distributed punctures, but with two submedian ones in the usual position. Elytra about once and one-fourth the length of prothorax, base as wide as its widest part, somewhat dilated posteriorly, a distinct depression on each side of suture; with dense and rather small punctures. Abdomen with rather inconspicuous punctures, the tips of four segments very minutely serrated; tip of under surface bilobed. Front tibiae dilated to near apex, front tarsi moderately inflated. Length, 4·5-5 mm.

♀. Differs in having the tip of the abdomen not notched and the front tibiae and tarsi thinner.

Hab.—Victoria: Dividing Range (Blackburn's Collection), Ferntree Gully in July (F. E. Wilson), Killara in August (C. Oke). Type, I. 12689.

The general outlines are much as in *H. dolichocephalus,* but the head is not quite as narrow, and the elytra are distinctly longer and probably cover wings. On some specimens the prothorax is more infuscated than on others, but its sides, on the five specimens before me, are always conspicuously paler than elsewhere, the basal sides of the head are also paler than the rest of the upper surface, on several of them the tips of the elytra are obscurely infuscated. The abdomen is rather feebly iridescent, and on the male the pubescence towards each side at the base of some of the segments has a golden appearance. On each elytron at about the basal third, near the subsutural depression, there appears from some directions a feeble elevation, but it is not a true tubercle, but rather an interruption of a feebly elevated line. The front tibiae of the male have a comb or fringe of reddish bristles much as on *dolichocephalus,* and the basal joint of the middle tarsi has more numerous bristles than the female.

Heterothops mediofuscus, n. sp.

♂. Pale castaneo-flavous; part of head (the rest deeply infuscated), sides of prothorax (the middle deeply infuscated), and parts of legs paler.

Head rather long, sides gently rounded; with a few large punctures near eyes and before neck. Eyes very small, scarcely extending one-third of the way to neck, and much shorter than the inter-antennary space. Antennae with first joint about as long as second and third combined, third slightly longer than second, the others gradually decreasing in length, tenth feebly transverse and somewhat shorter than eleventh. Apical joint of palpi very thin, slightly shorter than subapical one. Prothorax scarcely, if at all, wider than the median length, sides strongly narrowed to apex; with a few subapical, subbasal, and lateral punctures, two submedian ones rather closer together than usual, and two towards apex rather more distant. Elytra along middle distinctly shorter than prothorax; with rather dense and small, subasperate punctures. Abdomen more than half the total length; punctures not very sharply defined, tips of four segments minutely serrated; tip of under surface bilobed. Front tibiae moderately dilated to apex, and with an apical fringe of reddish bristles; front tarsi slightly dilated. Length, 4·5 mm.

Hab.—Tasmania: Waratah, in moss (A. M. Lea). Type (unique), I. 12688.

At first glance the type seems like a narrow pale variety of the preceding species, and its clothing is very similar, but the elytra at their longest, on the sides, are scarcely the length of the middle of the prothorax, whereas on that species they are decidedly longer, the suture and its vicinity are also on an almost even plane, instead of the suture distinctly elevated above subsutural depressions, the eyes are smaller, and the antennae are shorter; it also appears to be apterous, and the preceding one is probably winged. The dark part of the prothorax occupies about the median third from base to apex, on the abdomen (both surfaces) there is a feebly infuscated median line from the base to beyond the middle, the antennae are feebly infuscated in the middle; although highly polished the iridescence is very slight. The apical joint of the palpi is almost like a seta.

Heterothops rufosuturalis, n. sp.

♂. Blackish, prothorax obscurely paler, suture and extreme tips of elytra, tips of abdominal segments, legs, and some of the mouth parts more or less reddish. A few dark hairs scattered about, but becoming numerous on abdomen, especially on the anal styles; elytra, abdomen, and under surface with moderately dense, ashen pubescence.

Head rather long and thin, with a few distinct punctures touching eyes and before neck. Eyes small, not extending half-way to neck, distinctly shorter than the inter-antennary space. Antennae rather longer than usual, first joint as long as second and third combined, these subequal, the others to tenth gradually decreasing in length but all distinctly longer than wide, eleventh about once and one-half the length of tenth. Apical joint of palpi very thin, about half the length of the subapical one. Prothorax rather large, sides strongly narrowed to apex, with a few small punctures near apex and base, and two rather small submedian ones in the usual positions. Elytra distinctly longer than prothorax, slightly narrowed posteriorly; with dense and small, subasperate punctures. Abdomen with dense punctures, tips of four segments very finely serrated; tip of under surface feebly bilobed. Front tibiae dilated to near apex, and then with a large notch fringed with reddish setae; front tarsi moderately dilated. Length, 3·5-4·25 mm.

♀. Differs in having slightly shorter antennae, abdomen not notched at apex, front tibiae less dilated, with a smaller notch, and front tarsi very little wider than the middle ones.

Hab.—Queensland: Goodna in October (F. E. Wilson), Brisbane (A. J. Coates). New South Wales: Tweed River (A. M. Lea). Type, I. 12693.

In structure fairly close to a species identified by Blackburn as *H. luctuosa* (and which appears to be *analis,* Macl., referred by Macleay to *Staphylinus* and supposed by Fauvel to be a *Quedius),* but head thinner, with much smaller eyes, prothorax not black and suture red. The head is about the shape of that of *H. dolichocephalus,* but the elytra are much longer, and wings are exposed on several specimens. On two specimens the prothorax is obscurely reddish-brown, but on the others, although not black, it appears almost so at the first glance; the antennae are rather deeply infuscated in the middle, but become paler towards base and apex; on some specimens almost the whole of the under surface is obscurely reddish. Both surfaces are distinctly although not very brilliantly iridescent; the sides of the prothorax in some lights have a greenish, satiny lustre.

Two specimens, sexes, from South Australia (Myponga, A. H. Elston, and Lucindale, B. A. Feuerheerdt) probably belong to this species, but under a compound power the front tibiae are seen to have a much denser fringe of bristles, these, on both specimens, being so close together that they touch throughout their length; the suture and tips are no darker than the rest of the elytra. A female, from Tasmania (Launceston, Lea), resembles the South Australian female, but has the prothorax as black as the head, and the antennae dark throughout.

Heterothops mirus, n. sp.

♂. Piceous-brown; head almost black, elytra, apical segment of abdomen, most of subapical segment and tips of the others, antennae, palpi, parts of the mouth, and legs more or less flavous. With a few dark hairs at sides, becoming numerous on anal styles, elytra, abdomen, and under surface with short, pale pubescence.

Head subquadrate, with a few distinct punctures close to eyes and before neck (the neck unusually wide). Eyes small, not extending half-way to neck, distinctly shorter than the inter-antennary space. Antennae with first joint about as long as second and third combined, these subequal, sixth to tenth transverse. Apical joint of palpi very thin, much shorter than the subapical one. Prothorax slightly transverse, sides gently rounded, apex as wide as base; with two distinct submedian punctures in the usual positions and a few near the margins. Elytra not much wider than prothorax and distinctly longer, almost parallel-sided; with rather dense and small punctures. Abdomen with punctures about as large as on elytra but sparser, tip of under surface bilobed. Front tibiae moderately dilated to near apex, front tarsi slightly dilated, middle tarsi with a distinct dark comb on the basal joint. Length, 2·25-2·5 mm.

♀. Differs in having the head slightly smaller, abdomen not notched at apex, and middle tarsi combless.

Hab.—Lord Howe Island, on Kentia palms (A. M. Lea). Type, I. 12703.

A curious flat, subparallel-sided species, allied to *H. magniceps,* but smaller and narrower, prothorax paler and less iridescent. On some specimens the prothorax is almost as dark as the base of the abdomen, on some it is of a dull red, and it appears to be always darker than the elytra and paler than the head. The mandibles are asymmetrical, the right one about the middle has a small acute projection that fits into a notch on the left one; this appears to be a common feature in the genus, but it is usually difficult to force the jaws of these small insects apart without damaging the head. On the front femur of the male, but visible only under a high power, there is on its under surface, from about the middle to the apex, a closely placed series of short setae, they are exactly the same colour as the surrounding parts, and are perhaps used for stridulation; the front tibiae are moderately dilated to apex, with an apical fringe of reddish bristles; the front tarsi are only slightly dilated at the base; the middle coxae and femora are much thicker than the front ones; the middle tarsi have the basal joint large, with a conspicuous comb of long teeth, nine in number, certainly not bristles, accidentally appearing regular, but a distinct comb as on many species of *Quedius,* although with less numerous and longer teeth than on species of that genus. A female from Queensland (Mount Tambourine, Lea) possibly belongs to this species, but has the antennae shorter and darker, elytra darker, and less of the abdomen pale.

On this species the curious minute, dense, wavy lines that cover almost the entire body of many Staphylinidae of the present subfamily, and are invisible except under a high power, are unusually conspicuous, and visible under a considerably lower power than is usually the case. On specimens mounted in Canada balsam, or on greasy ones, I have been unable to see them at all, on most species they appear to be interrupted by the punctures, but on the species of *Actinus,* on which they are particularly beautiful, they traverse the sides and bottom of the punctures without apparent interruption.

Heterothops tantillus, n. sp. or var.

♂. Flavous, head and tips of elytra slightly darker than the adjacent parts. Length, 2 mm.

Hab.—Queensland: Cairns district (A. M. Lea). Type (unique), I. 12702.

The type is the smallest specimen I have seen of the subfamily, it is allied to *H. magniceps,* and it is structurally extremely close to the preceding species, although decidedly smaller and paler. A front and a middle leg have been mounted in Canada balsam, and under the microscope the latter is seen to be larger than the former, although not to such a disproportionate extent as on the preceding species; on the front femur I was unable to see the row of setae clearly, but it appears to be indicated; the front tarsi are more dilated than on that species, and the dark comb on the middle tarsi is slightly shorter but quite as distinct.

Heterothops ubiquitosus, n. sp.

Black; elytra piceous, prothorax dull red, tips of abdominal segments, legs, parts of the mouth and two or three basal joints of antennae, of a more or less dingy flavous. With a few dark hairs at sides but becoming numerous on tip of abdomen; elytra, abdomen, and under surface with ashen pubescence.

Head (excluding neck) about as long as wide; with a few distinct punctures close to the eyes, and before neck. Eyes small, not extending half-way to neck, and shorter than the inter-antennary space. Antennae with first joint as long as second and third combined, these subequal, sixth to tenth transverse. Palpi with apical joint very thin, about as long as the subapical one. Prothorax slightly longer than wide; with two distinct submedian punctures in the usual positions, and a few submarginal ones. Elytra at base slightly wider than prothorax, along middle slightly longer, and distinctly longer at sides; with not very crowded and small, but sharply defined punctures. Length, 2·75-3·5 mm.

Hab.—Tasmania: Mount Wellington (H. H. D. Griffith and A. M. Lea), Hobart, Huon River, Latrobe, Stanley, Ulverstone, Launceston, Frankford, Burnie (Lea). Victoria: Melbourne (E. Fischer, No. 4010), Beaconsfield, Emerald (E. Jarvis), Belgrave (F. E. Wilson and C. Oke), Ferntree Gully (Wilson). South Australia: Myponga (A. H. Elston), Lucindale (Lea). Type, I. 15254.

A narrow fusiform species, allied to *H. picipennis,* but consistently smaller and narrower, and prothorax and legs paler. The tibiae are usually darker than the rest of the legs; the prothorax is rarely of a bright red, and on such specimens the elytra are usually castaneous-brown, but sometimes scarcely darker; occasionally the elytra are almost as dark as the abdomen. On one specimen the shoulders are paler than the adjacent parts, and it has three punctures triangularly placed half-way between the eyes. The male is narrower than the female and has the tip of the abdomen notched, but the front and middle legs do not appear to vary sexually. The majority of the specimens were taken from moss or tussocks, one from a tree fern and others from flood *débris.*

Heterothops nigrofrater, n. sp.

Black; tip of abdomen, tips of most of the segments on the under surface, some of the mouth parts, basal joint of antennae and legs flavous. A few dark hairs scattered about, but becoming numerous on apex of abdomen; elytra, abdomen, and under surface with rather sparse dark pubescence.

Head longer than wide, sides very feebly rounded between eyes and neck; a few distinct punctures close to eyes and before neck. Eyes small, not extending half-way to neck, slightly shorter than the inter-antennary space. Antennae with first joint almost as long as second and third combined, these subequal, fifth to tenth transverse. Apical joint of palpi very thin, about as long as the subapical one. Prothorax slightly longer than wide, distinctly narrowed to apex; with two distinct submedian punctures in the usual positions, and a few submarginal ones. Elytra distinctly longer than prothorax, especially on the sides, sides slightly dilated posteriorly, suture feebly elevated; with fairly numerous, small but rather sharply defined punctures. Abdomen with punctures much as on elytra. Length, 3-3·25 mm.

Hab.—Victoria: Warburton, in tussocks, in March, and Belgrave in March (F. E. Wilson), Killara in August from a nest of ants, *Iridomyrmex* sp. (C. Oke);

Melbourne (Ejnar Fischer). Tasmania: Mount Wellington (H. H. D. Griffith and A. M. Lea). Type, I. 15255.

A highly polished black species, in general like *Diochus octavii* on a greatly reduced scale, but elytral punctures quite distinct and with palpi of *Heterothops;* it is like a rather narrow form of the preceding species, and similarly the sexes can scarcely be distinguished except by the tip of the abdomen, but the prothorax and elytra are quite as black as the head. The tibiae are somewhat infuscated. On some specimens the tips of the abdominal segments on both surfaces are pale, but on most of them only distinctly so on the under surface.

Heterothops clarki, n. sp.

♀. Black; elytra almost black, tips of abdominal segments, some of the mouth parts, basal joints of antennae and legs of a rather dingy brown. With a few dark hairs scattered about and becoming numerous on anal styles; elytra, abdomen, and under surface with ashen pubescence.

Head subquadrate between antennae and neck; with three large punctures touching each eye, and a few before neck. Eyes small, not extending half-way to neck, about the length of the inter-antennary space. Antennae with first joint about as long as second and third combined, second longer than third, fifth to tenth distinctly transverse. Apical joint of palpi very thin, about the length of the subapical one. Prothorax slightly longer than wide, sides slightly narrower at apex than at base; with two distinct submedian punctures in the usual positions, and a few about all the margins. Elytra almost parallel-sided; with rather dense and small punctures. Abdomen with somewhat similar punctures to those on elytra. Length, 2·75-3·25 mm.

Hab.—Western Australia: Swan River, five females from nests of *Iridomyrmex conifer* (J. Clark). Type, I. 12694.

An interesting species, with antennal joints so short as to be suggestive of many of the Aleocharides; the species forms another addition to the many inquilines taken by Mr. Clark from nests of the twig-mound ant. In general appearance it is close to the species identified by Blackburn as *H. picipennis,* but is consistently smaller, antennae shorter, with most of the joints transverse; from the preceding species it differs in its wider head, shorter antennae, and darker legs.

Heterothops obscuripennis, n. sp.

Black; elytra and most of under surface of a dingy brown, legs, some of the mouth parts, and two basal joints of antennae paler. With scattered dark hairs, becoming numerous on anal styles; elytra, abdomen, and under surface with dark pubescence.

Head rounded, excluding the neck scarcely longer than wide; with a few distinct punctures near eyes and before neck. Eyes large, extending almost to neck, distinctly longer than the inter-antennary space. Antennae with first joint slightly longer than second and third combined, third slightly shorter than fourth and still shorter than second, the others gradually decreasing in length, till the ninth and tenth are slightly transverse, eleventh longer. Apical joint of palpi thin, about half the length of the subapical one. Prothorax moderately transverse, decidedly narrowed to apex; with two distinct submedian punctures in the usual positions, and some in the lateral and basal margins, and near apex. Elytra with dense and rather small, asperate punctures. Abdomen with smaller and sparser punctures than on elytra, tips of four segments very finely serrated. Length, 3·5 mm.

Hab.—South Australia: Kangaroo Island, in moss on ground (A. M. Lea). Type, I. 12695.

In general appearance somewhat like *H. laticeps,* but head smaller and eyes much larger; at first glance it appears to belong to *Quedius,* but the apical joint of the palpi is very small. The sexes appear to differ externally only in the tip of the abdomen, that of the male being notched; the male before me is probably immature, as it is considerably paler than the female; the abdomen of both sexes is moderately iridescent.

Heterothops castaneus, n. sp.

Bright castaneous; part of abdomen and most of antennae more or less deeply infuscated. With a few rather short hairs, but becoming numerous on tips of anal styles; elytra, abdomen, and under surface with not very dense ashen pubescence.

Head subquadrate between front of eyes and neck; with two distinct punctures close to eyes, and a few before neck. Eyes small, not extending one-third of the way to neck, and much shorter than the inter-antennary space. Antennae with first joint about as long as second and third combined, these subequal, seventh to tenth transverse. Apical joint of palpi very thin, somewhat shorter than the subapical one. Prothorax along middle scarcely longer than the greatest width, moderately narrowed to apex; with two submedian punctures in the usual positions, and a few near or on all the margins. Elytra along middle not much longer than prothorax, but longer on sides; with fairly dense and rather small but sharply defined punctures. Abdomen with somewhat sparser punctures than on elytra. Length, 3·5-4·5 mm.

Hab.—Lord Howe Island, six specimens from fallen leaves (A. M. Lea). Type, I. 12691.

A narrow, pale species, with unusually small eyes; at first glance it resembles some of the narrower species of *Calodera;* it is fairly close to *H. xantholinoides,* but is narrower, with smaller eyes, elytra entirely pale, etc. The two apical segments of abdomen are usually entirely pale, the others each have more or less of the base infuscated, although on the under surface the infuscation is sometimes but slight; the scutellum on one specimen is infuscated. On the male the front tibiae are slightly more dilated to the apex than on the female, and the tip of its abdomen is notched.

Heterothops kentiae, n. sp.

♂. Black; elytra dull red, a large blackish spot on each; apical segment of abdomen and tips of the others, mouth parts, palpi, two or three basal joints of antennae and the legs more or less reddish. With scattered dark hairs, becoming dense on anal styles; elytra, abdomen, and under surface with ashen pubescence.

Head rather large, with a few large punctures near eyes and before neck. Eyes small, scarcely extending one-third of the distance to neck, and shorter than the inter-antennary space. Antennae with first joint not quite as long as second and third combined, these subequal, seventh to tenth transverse. Apical joint of palpi very thin, slightly dilated at base, almost as long as the subapical one. Prothorax slightly transverse near apex, scarcely narrower than near base; with two distinct submedian punctures, and a few in basal and lateral margins and near apex. Elytra with suture slightly but distinctly elevated; with fairly dense and small, sharply defined punctures. Abdomen with somewhat sparser punctures than on elytra, tip of under surface deeply notched. Length, 4-5·5 mm.

♀. Differs in having the head smaller, prothorax less transverse, abdomen wider and not notched at apex.

Hab.—Lord Howe Island, summit of Mount Gower, on *Kentia canterburyana* (A. M. Lea). Type, I. 12690.

Structurally rather close to *H. laticeps,* but very differently coloured, eyes smaller and abdomen less parallel-sided. On most specimens the extreme apex and base of the prothorax are paler than the rest of its surface, occasionally the whole prothorax is of an obscure reddish-brown, but the head, except for parts of the mouth, appears to be always deep shining black. The blackish spot on each elytron occupies more than half its surface, and usually touches the side, but not the base, apex, or suture; the femora are paler (sometimes almost flavous) than the rest of the legs. The head varies in size and, except for the neck, is usually transversely quadrate and wider than the prothorax in the male; quadrate and slightly narrower than that segment in the female, but sometimes it is of its exact width. There is a shallow inter-antennary depression with a shallow puncture on each side, but from some directions only the two punctures are visible. The jaws are usually clenched, but when they have been forced apart there may be seen two triangular teeth, a small notch and a wider one on the right side, and two wider teeth and one wider notch on the left side. The real tip of the abdomen of the male is deeply notched, but the segment with the notch is sometimes withdrawn so that the tip appears rounded, even when an oedeagus is protruding. My wife and I obtained numerous specimens, including many larvae, from fallen fronds and on wet parts of the palm trees; there is also a specimen in the Australian Museum from the same mountain.

Heterothops pictus, n. sp.

♂. Black; elytra (except for some dark spots), tips of abdominal segments, some of the mouth parts, two or three basal joints of antennae and the legs more or less reddish. With sparse dark hairs, but becoming dense on apex of abdomen; pubescence of elytra and abdomen variegated.

Head rounded and moderately transverse; with three or four punctures touching each eye, and a few before neck. Eyes very large, almost extending to neck, considerably longer than the inter-ocular space. Antennae with first joint as long as second and third combined, these subequal, the others to tenth gradually decreasing in length. Apical joint of palpi very thin, slightly shorter than the subapical one. Prothorax moderately transverse, distinctly narrowed to apex; with two conspicuous submedian punctures, closer together than is usual, and with a few on the lateral and basal margins and near apex. Elytra not much longer than prothorax, suture distinctly elevated, a shallow depression on each side of it; with rather dense, subasperate punctures. Abdomen with sparser and more irregularly distributed punctures than elytra; tip of under surface bilobed. Front tibiae moderately dilated to apex, and about apex with a fringe of reddish bristles; basal joints of front tarsi moderately dilated. Length, 4-6 mm.

♀. Differs in having the abdomen not notched at the tip, and front tibiae and front tarsi thinner.

Hab.—Victoria: Victorian Alps (E. Fischer, No. 1028), Dividing Range (Blackburn's Collection), Belgrave in March (F. E. Wilson), in September, and Ferntree Gully in June (C. Oke), Warburton in April (Wilson), Bright (H. W. Davey, No. 848), Wandin in August (National Museum), Emerald (E. Jarvis and A. M. Lea). Tasmania (Aug. Simson, No. 3133, in British Museum), Zeehan. Western Australia: Donnybrook (Lea). Type, I. 12673.

A beautiful species not very close to any other before me. The elytra have a curious mottled appearance, partly owing to the black or infuscated spots, of which there are usually three on each elytron (one medio-apical, one medio-lateral, and one medio-sutural), and partly to patches of somewhat golden pubescence, more numerous than the spots; but on an occasional specimen the infuscations almost disappear. On the abdomen, especially on the upper surface of the male, the pubescence is of a beautiful golden colour, and irregularly placed, somewhat as noted for that of *Quedius inaequalipennis;* its iridescence, although not very pronounced, combined with the golden clothing on the black and red surface, causes the abdomen to appear more beautiful than usual. On most specimens the head and prothorax have a slight coppery gloss; the prothorax is occasionally obscurely reddish; on some specimens the legs are mostly deeply infuscated, but on many of them the femora (the front ones to a greater extent than the others) are partly or entirely flavous. There are usually a few inconspicuous punctures, about six, on the front of the interocular space; the right mandible has a triangular tooth, which fits into a notch on the left one; probably no joint of the antennae is really transverse, but under a magnifying glass the tenth, especially when gummy, appears distinctly transverse; under a microscope, however, even the tenth is seen to be at least as long as wide.

QUEDIUS, Steph., Cat., p. 417.

On the males of many species of this genus the basal joint of the middle tarsi is elongated, and on one side, placed obliquely, it has a comb with teeth varying in numbers from sixteen to forty; the teeth are closely set and are longer in the middle than on the ends, but the variation in length is quite even. The comb, although of comparatively large size, is inconspicuous or concealed from certain directions, and to see it clearly it is often necessary to detach a leg and mount it for examination under the microscope; even then, unless mounted the right way up, the comb on several species could easily be overlooked, as the tips of the teeth only would show, and these could easily be missed amongst the bristles, but when properly mounted and in a good light the combs are abundantly distinct. In the literature to which I have access I cannot find that they have been previously commented upon, except in the description of *Q. pectinatus*, but they are present on many Australian species, and of those already named some comments, further on, will be found on those of *Q. diemensis*, *Q. hybridus*, and *Q. tepperi*. Some species instead of having a comb have rather dense setae or bristles, and others have such soft and dense hair there as to be almost furry. Under a magnifying glass the species having bristles on the basal joint sometimes appear combed, but in the really combed species the joint appears to have a distinct black or blackish rim (as on the front tarsi of species of *Carphurus*, *Helcogaster*, and other Malachiides); on the bristly species there is no blackish rim, the colour being as in the adjacent parts. On the females of some species whose males have combs, the joint is rather long, and some bristles cause a deceptive resemblance to a comb, but under a microscope the difference is at once apparent.

AENEUS, Fvl. V.
ANALIS, Macl. *(Staphylinus)*. Q., N.S.W., S.A.
ANDERSONI, Blackb. S.A., W.A.
BALDIENSIS, Blackb. V.
CUPRINUS, Fvl. N.S.W., V., Tas.
DICHROUS, Fvl. V.
DIEMENENSIS, Blackb. V., Tas.
DIVERSIPENNIS, Fvl. W.A.
FULGIDUS, Fabr. V., Tas., S.A.
HOLLANDICUS, Bernh. Australia.
HYBRIDUS, Er. *(Philonthus)*. Q., N.S.W., V., Tas., S.A., W.A.
taurus, Blackb. *(Heterothops)*, Cat., p. 414.
INCONSPICUUS, Blackb. Tas., S.A.
IRIDIVENTRIS, Fvl. Q., N.S.W., V., S.A., W.A.
KOEBELEI, Blackb. Q.
LURIDIPENNIS, Macl. *(Staphylinus)*. Q., N.S.W., V., S.A., W.A.
semiviolaceus, Fvl.
LURIDUS, Fvl. W.A.
MEDIOFUSCUS, Lea, Proc. Roy. Soc. Vict., 1909, p. 121. Tas.
MESOMELINUS, Marsh. V. Introduced.
METALLICUS, Fvl. Q.
NELSONENSIS, Blackb. V., Tas., King Island.
NIGRICOLLIS, Fvl. Q., N.S.W., V.
PECTINATUS, Lea, Proc. Roy. Soc. Vict., 1907, p. 151. King Island.

PICEOLUS, Fvl. N.S.W., V.
PICTIPENNIS, Blackb. V.
POLITULUS, Macl. *(Philonthus)*. Q.
RUBRICOLLIS, Fvl. N.S.W., V.
RUFICOLLIS, Grav. *(Philonthus)*. Q., N.S.W., V., Tas., S.A.
chalybeipennis, Macl. *(Philonthus)*.
SIDNEENSIS, Fvl. Q., N.S.W., V., Tas.
SULCICOLLIS, Fvl. N.S.W., V., Tas., S.A., W.A.
TEPPERI, Blackb. N.S.W., V., Tas., S.A.
ferox, Blackb.
blackburni, Bernh. and Schub.
THORACICUS, Fvl. Q., N.S.W., V., S.A., W.A.
VERSICOLOR, Fvl. Q.
VIRIDESCENS, Fvl. Q., W.A.
XYLOPHILUS, Lea, Proc. Roy. Soc. Vict., 1907, p. 152. Tas., King Island.

QUEDIUS TEPPERI, Blackb.

Q. ferox, Blackb.
Q. blackburni, Bernh. and Schub.

The type of *Q. tepperi* is in the South Australian Museum, and its prothorax and elytra are now (probably due to exposure) dark castaneous-brown; the species was originally described as "niger" and "with the . . . thorax deep black." Shortly afterwards *Q. ferox* was described from "a single specimen taken near Adelaide." The type of *ferox* is in the British Museum, but there are other specimens labelled by Blackburn as belonging to the species in the South Australian Museum, agreeing with the description, and also agreeing perfectly in sculpture with the type of *tepperi*. It is one of the dark species of the genus, but is distinct by its wide and rather flat head and prothorax, on fresh specimens these being slightly opalescent; the inter-antennary depression is faint and alike on the type of *tepperi* and on specimens labelled *ferox*. The species occurs also in New South Wales, Victoria, and Tasmania; island specimens are usually darker than mainland ones, on many of the latter the terminal joints of the antennae are pale. The species has a tarsal comb, but it is obscured by numerous long bristles, its teeth are also paler than usual (on most species having them they are blackish, or at least dark brown, on this one they are hardly darker than the bristles), are less than twenty in number, and are so placed that some manipulation is necessary to see them plainly. As the name *ferox* was already[11] in use in the genus Bernhauer and Schubert altered the name of the Australian species to *blackburni*, but their name is not now required.

QUEDIUS RUFICOLLIS, Grav.

Mr. Goudie took a specimen of this species, at Sea Lake, from the nest of a black species of *Camponotus*.

QUEDIUS LURIDIPENNIS, Macl.

Some Tasmanian examples of this species (taken in moss) have the elytra less conspicuously reddish than on mainland ones, and the abdomen is less brilliantly iridescent. Six (from Western Australia) have even darker elytra (although still obscurely reddish), and on two of them the abdomen is non-iridescent. Under the microscope the basal joint of the middle tarsi of the male is seen to be without a comb, but to have a short kind of fur amongst the bristles.

QUEDIUS IRIDIVENTRIS, Fvl.

The description of this species is but little more than a comparison with the European *Q. paradisianus*. Some specimens identified by Blackburn as belonging to it differ from the description in having the fourth joint of antennae

[11] Leconte, 1878.

shorter than the third, not, as in the description, "2-4 aequalibus," the eyes are large, in the description they are, compared with *paradisianus,* "multo minoribus." On the specimens before me the basal joints of the antennae are paler than the others, but these vary from moderately to deeply infuscated, apparently they are never quite black; they range in length 5·5-9·5 mm.

QUEDIUS SIDNEENSIS, Fvl.

A specimen of this species, from near Sydney, in Mr. Carter's collection, has the elytra, tips of abdomen, and tibiae darker than usual.

QUEDIUS BALDIENSIS, Blackb.

The type of this species is in the British Museum. Blackburn at first considered it was possibly an alpine form of *Q. cuprinus,* but afterwards considered it distinct; if a specimen from his collection, labelled by him as *baldiensis,* is correctly named the two species are certainly distinct; this specimen, however, does not agree with the description, as its elytra and most of the abdomen are pale, and it is also evidently apterous. Three specimens recently taken from tussocks by Mr. F. E. Wilson on Mount Donna Buang (Victoria) agree with the description except that at least five of the antennal joints (6th-10th) are transverse, whereas Blackburn described the antennae as having "articulis nullis transversis." In structure they agree perfectly with the specimen from the Blackburn Collection, differing only in the much darker elytra and abdomen.

QUEDIUS NELSONENSIS, Blackb.

Numerous specimens from Victoria, Tasmania, and King Island appear to belong to this species, which may be readily distinguished by its apterous body, narrow head, and bicoloured elytra. The main colour of the type was noted as "piceus," but most of the specimens before me are deep black, with the abdomen often brilliantly iridescent and with some of its segments tipped with red; the two apical joints of the antennae are usually, but not always, conspicuously paler than the preceding ones. The Tasmanian specimens were taken from moss, tussocks, and sods of grass.

QUEDIUS DIEMENENSIS, Blackb.

Two specimens from Brisbane, in the Queensland Museum, probably belong to this species, but differ from typical ones in being smaller, prothorax and elytra slightly more convex, and abdomen entirely dark; one specimen has the legs and antennae entirely pale, the other has (of the legs) only the tarsi and knees pale. On many Tasmanian specimens the prothorax is deep black, and three basal joints of antennae no darker than the following ones. Structurally the species is very close to *Q. ruficollis.* Its male has a tarsal comb much as on *Q. hybridus,* but the species being of larger size the teeth are more easily seen under a magnifying glass; on the reverse side of the joint the bristles are so dense that the comb is greatly obscured.

QUEDIUS INCONSPICUUS, Blackb.

The prothorax of this species was described as "rufo-piceo," and antennae as "piceis apicem versus ferrugineis"; possibly the type (now in the British Museum) was immature, as a specimen bearing Blackburn's name-label "*inconspicuus,* Blackb.," has the prothorax deep black, with a faint coppery tinge, its antennae are also black, except that the basal portion of several joints is reddish. The type was from Wallaroo, in South Australia, the specimen commented upon, and others before me, are from Tasmania.

QUEDIUS KOEBELEI, Blackb.

Two specimens, taken on seeds of *Pisonia brunoniana* in the Cairns district, probably belong to this species; they differ, however, from the description in having the sides and tips of the abdominal segments obscurely paler, the elytra were described as "obscure ferrugineis apicem versus infuscatis"; on these specimens the dark parts of the elytra are the outer apical angles (the dark parts scarcely extend to the suture) and the inverted sides.

QUEDIUS PICTIPENNIS, Blackb.

On the elytra, of this beautiful species, the black markings vary somewhat in size, but they usually leave a conspicuous red V. Specimens under examination are all from Victoria (Belgrave in February and August, Ferntree Gully in July, and Emerald in March); two of them were taken from moss.

QUEDIUS HYBRIDUS, Er.

The middle tarsi of the male, as seen from one side, has a very conspicuous comb of nearly thirty rather long, blackish teeth; under a magnifying glass the comb appears as a well-defined and not very narrow black edging, but from one side the teeth are less distinct. All that Erichson said of the middle tarsi was "articulo primo incrassato."

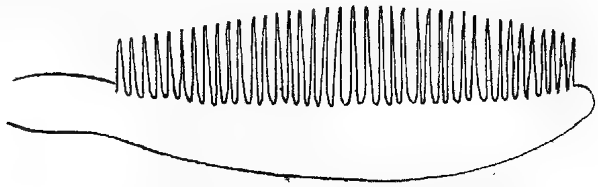
Quedius bellus, n. sp.

♂. Coppery-bronze; head and prothorax finely shagreened and of a different shade from elytra, muzzle, some mouth parts, basal joint of antennae and base of one or two others, and most of legs flavous, tarsi, knees, and hind coxae infuscated, antennae still darker; abdomen blackish and slightly iridescent, tips and sides of most of the segments, and most of the under surface obscurely reddish. Head, and sides of prothorax and of elytra, with a few blackish hairs, becoming numerous on sides of abdomen and dense on its tips; elytra, abdomen (both surfaces), and metasternum with rather dense, shining pubescence.

Head of moderate size, with a few setiferous punctures at sides of eyes and just before neck. Eyes rather large, about as long as the inter-antennary space. Antennae with first joint longer than second and third combined, third slightly longer than second and conspicuously longer than fourth, the others to tenth feebly decreasing in length and very feebly increasing in width, the tenth just perceptibly transverse, eleventh distinctly longer than tenth, feebly incurved on one side of apex. Apical joint of palpi about twice the length of preceding one and at base not much thinner. Prothorax with two punctures in the usual positions, with one towards each side, two towards base, and a few small ones about the front angles. Elytra with rather dense and small but sharply defined punctures, and with about eight to ten large ones on each elytron. Abdomen with rather dense punctures, tip of under surface gently incurved to middle. Basal joints of front tarsi somewhat dilated, basal joint of middle tarsi large, and with a conspicuous black comb. Length, 6-6·5 mm.

Hab.—Victoria: Belgrave in July (F. E. Wilson), Ferntree Gully in July (C. Oke), Beaconsfield in May (H. H. D. Griffith from E. Jarvis). Type, I. 12667.

A beautiful species, with a conspicuous satiny gloss on the head and prothorax, and to a certain extent on abdomen. The head and prothorax are apparently coloured as in *Q. luridus,* but the elytra are also bronzy and legs pale, size smaller, etc. Structurally it is fairly close to *Q. pectinatus,* but more metallic, elytra with large scattered punctures and comb of middle tarsi even larger. The comb is composed of nearly forty closely packed, blackish teeth, almost flat to the joint and slightly longer in the middle than on the sides, with its end projecting over the second joint; but there are numerous long bristles on the joint that somewhat obscure the comb under a weak power.



Tarsal comb of *Quedius bellus*, Lea.

Quedius inaequalipennis, n. sp.

♂. Piceous-brown; most of legs and of abdomen and base of antennae paler, head black. Head and sides of prothorax and of elytra with a few blackish hairs, becoming numerous on sides of abdomen and dense on its tips. Elytra, abdomen, and metasternum with rather dense pubescence.

Head of moderate size; two punctures touching each eye, a few behind them and a few just before neck. Eyes rather large, slightly longer than the inter-antennary space. Antennae with first joint as long as second and third combined, second the length of fourth and somewhat shorter than third, the others to tenth very feebly decreasing in length, but none transverse, eleventh longer than tenth, incurved on one side of apex. Apical joint of palpi considerably longer than subapical one, distinctly thinner at base, and acutely pointed. Elytra with suture distinctly elevated, a shallow depression on each side of it, and very feeble depressions elsewhere. Punctures fairly dense but small and shallow. Abdomen with irregularly distributed punctures, becoming dense in parts; tip of under surface slightly notched. Basal joints of front tarsi somewhat dilated, basal joint of middle tarsi large and with a distinct blackish comb. Length, 5·5-6·5 mm.

♀. Differs in having the head slightly smaller, antennae slightly shorter, with tenth joint just perceptibly transverse, abdomen wider, not notched at apex, front tarsi less dilated, and basal joints of middle tarsi shorter, thinner, and without a comb.

Hab.—Tasmania (Aug. Simson's No. 3613), Waratah in moss, Wilmot (H. J. Carter and A. M. Lea), Zeehan, Huon River (Lea). Victoria: Mount Donna Buang, near Warburton, in tussocks in March (F. E. Wilson). New South Wales: Blue Mountains (Dr. E. W. Ferguson). Type, I. 15250.

Allied to *Q. pectinatus*, but smaller, elytra more uneven, etc.; the inequalities of the elytra, other than the sutural elevation and subsutural depressions are fairly distinct on some specimens but very feeble on others. Of the thirteen specimens before me hardly any two are exactly alike in colour; on one of them the prothorax (except that the base and sides are narrowly and obscurely brownish) is quite as black as the head, on others although paler than the head it is darker than the elytra; on one the elytra are of a rather dingy red; the abdomen on some specimens is almost entirely blackish, on others most of it is no darker than the elytra; on one the prothorax is distinctly reddish, although not of the bright red of *Q. ruficollis*. On the specimen (probably immature) from the Blue Mountains, the prothorax is paler than the elytra, and the abdomen is almost flavous, but becomes darker posteriorly. The head and prothorax are highly polished and the latter is usually feebly iridescent, the abdomen is slightly iridescent. The pubescence on the abdomen (both surfaces), especially of the male, is somewhat undulated, and has an appearance on each side of most of the segments, as of radiating from a common base, with a slight golden gloss, faintly suggestive of Fauvel's figure of *Leucitus argyreus,*[12] a somewhat similar appearance but less pronounced, may be noticed on other species of the genus. There are two submedian punctures on the prothorax, in the usual positions, and near each of them is usually a semicircular row of three others, but of these the posterior one is sometimes ill-defined or absent; there are also a few about the front angles. The comb, on the middle tarsi of the male, extends almost the entire length of its supporting joint, but the teeth are only about fifteen in number, although stouter than usual.

Quedius cordatus, n. sp.

♂. Black; scutellum, elytra (a large blackish heart-shaped or triangular patch behind scutellum), sides and tips of upper surface of most of the abdominal segments, and most of their under surface, sterna, legs, muzzle, and two basal joints of antennae, flavous or somewhat reddish. Elytra, abdomen, and under surface with fairly dense, ashen pubescence.

Head moderately large; two punctures almost touching each eye, and a larger one between it and neck. Eyes rather large, scarcely longer than the inter-antennary space. Antennae with first joint longer than second and third combined, these subequal, fifth to tenth more or less feebly transverse, eleventh almost twice the length of tenth, incurved on one side of apex. Prothorax less narrowed in front than usual; two submedian punctures inconspicuous. Elytra with comparatively sparse and small, but sharply defined punctures. Abdomen with fairly numerous punctures, under surface of apparent sixth segment produced at apex into four acutely triangular lobes, of which the lateral ones are much shorter than the others. Front tarsi rather strongly dilated, basal joint of middle tarsi long and with a conspicuous blackish comb. Length, 4·75-5 mm.

♀. Differs in having the abdomen wider, apical segment on under surface evenly rounded, front tarsi less strongly (although distinctly) dilated, and basal joint of middle tarsi smaller and combless.

Hab.—Queensland: National Park (H. Hacker). Type in Queensland Museum; cotype, I. 15231, in South Australian Museum.

Mr. Hacker obtained four specimens, all of which have a conspicuous heart-shaped or subtriangular black mark behind the scutellum; there are no long hairs on the upper surface of the head, prothorax, or elytra of any of them. The comb on the middle tarsi of the male appears to consist of about seventeen teeth, and its end projects well over the second joint, the end teeth are small, rather rapidly increase in length to the middle, and then decrease to its base, which is about one-third from the base of the joint itself. The apical joint of the maxillary palpi is scarcely as long as the preceding joint, from one direction its base appears not much thinner than that joint, but from another direction it appears line-like, and so possibly the species should be referred to *Heterothops.*

Quedius hackeri, n. sp.

♂. Black; femora, basal joint of antennae and some of the mouth parts flavous, rest of legs and of antennae more or less deeply infuscated, but not black. Head, sides of prothorax and of elytra with a few long hairs, becoming more numerous on sides of abdomen, and especially on anal styles; elytra, abdomen, and sterna with rather dense, sooty pubescence.

Head rather large, distinctly transverse and gently convex; a few distinct punctures near eyes, behind them, and just before neck. Eyes rather large, about as long as the inter-antennary space. Antennae with first joint slightly longer

(12) Fauvel, Ann. Mus. Civ. Gen., xii., 1878, pl. ii., fig. 28.

than second and third combined, second slightly shorter than third, and longer than fourth, the others to tenth more or less feebly transverse, eleventh longer, its apex incurved on one side. Apical joint of palpi slightly longer than the preceding joint, its base not much thinner. Prothorax less narrowed in front than usual; with two submedian punctures in the usual positions, and three marginal ones on each side. Elytra with fairly dense but rather small and shallow punctures. Abdomen with fairly dense punctures, tip of under surface slightly notched. Front tarsi somewhat dilated, basal joint of middle tarsi long and with a distinct blackish comb. Length, 5-6 mm.

♀. Differs in having the head smaller, antennae somewhat thinner, abdomen not notched at tip, front tarsi less dilated, and the middle ones combless.

Hab.—Queensland: National Park (H. Hacker). Type, in Queensland Museum; cotype, I. 15252, in South Australian Museum.

Structurally rather close to *Q. tepperi*, but head rather more convex, elytral punctures smaller and less sharply defined, and antennae and legs conspicuously paler. The elytra have a faint coppery gloss, and on two females the tip of the suture is reddish; the abdomen has a distinct, but not brilliant, bluish iridescence. The tarsal comb of the male consists of about thirty close-set teeth, extending practically the whole length of its supporting joint.

Quedius nitidissimus, n. sp.

♂. Black and highly polished, femora flavous, tarsi, parts of mouth and of basal joints of antennae obscurely reddish, rest of antennae and tibiae darker but not black. Head and sides with a few blackish hairs, becoming numerous on tips of abdomen; elytra, abdomen, and sterna with sparse pubescence.

Head rather large, moderately transverse and rather convex; two punctures touching the side of each eye, a few behind them and just before neck. Eyes fairly large but scarcely as long as the inter-antennary space. Antennae with first joint slightly longer than second and third combined, these subequal, the others gradually decreasing in length till the ninth and tenth are moderately transverse, eleventh longer. Apical joint of palpi rather stout, slightly longer than the preceding one. Prothorax rather large, moderately narrowed in front; with two submedian punctures in the usual positions, and a few nearer the base, with a few marginal ones at apex and sides. Elytra with fairly numerous and moderately large, sharply defined punctures. Abdomen with sparse punctures, tip of under surface feebly incurved at middle. Front tarsi strongly dilated, basal joint of middle tarsi long and with a blackish comb. Length, 6 mm.

Hab.—Tasmania: Waratah (A. M. Lea). Type (unique), I. 12483.

At first glance close to the preceding species, but more highly polished, head considerably more convex, and elytral punctures much stronger, stronger than in *Q. tepperi;* from which it also differs in the convex head, and flavous femora. The upper surface is so highly polished that it has an oily appearance; the elytra have a faint coppery-green gloss. On the left side of the prothorax, at about one-fourth from the base, there are two conspicuous punctures, but on the left side there is but one. I have not mounted a middle leg to examine it more clearly under the microscope, and as the teeth of the comb are somewhat obscured by bristles, could not count them, but they are close-set, and extend almost the entire length of the supporting joint.

Quedius lateroflavus, n. sp.

♂. Flavo-castaneous; most of the head (both surfaces), a large patch on prothorax (the rest flavous), two spots on each elytron, a wide median stripe on upper surface of abdomen, and sides of metasternum black or blackish; legs, antennae, and palpi more or less flavous. Sides with some long dark hairs, becoming numerous on anal styles; elytra, abdomen, and under surface with pale pubescence.

Head large and moderately transverse; with a few large punctures near eyes and just before neck. Eyes very large, extending almost to neck, distinctly longer than the inter-antennary space. Antennae with first joint as long as second and third combined, the others gradually decreasing in length till the ninth and tenth are slightly transverse, eleventh longer, incurved on one side of apex. Apical joint of palpi rather thin, distinctly longer than the subapical one. Prothorax rather large; with two submedian punctures in the usual positions, and a few about apex and sides. Elytra rather wide, a feeble depression on each side of suture; punctures not very dense and rather small, but mostly sharply defined. Abdomen on upper surface with punctures near sides and sparse (or absent) elsewhere, the tips of most of the segments with numerous short, longitudinal impressions; under surface with more numerous punctures, the tips impressed as on upper surface, apical segment notched. Front tarsi with three basal joints moderately dilated; middle tarsi with first joint not very large and scarcely as long as second and third combined. Length, 4-6 mm.

♀. Differs in being somewhat wider, dark markings more extended, abdomen not notched and front tarsi less dilated.

Hab.—Queensland: Mount Tambourine (A. M. Lea). New South Wales: Blue Mountains (Dr. E. W. Ferguson), Sydney, Ourimbah (R. Helms). Type, I. 12687.

A beautifully marked and rather robust species. On the type the dark part of the prothorax occupies most of the apex, it is then slightly narrowed to near the middle, then suddenly dilated and then strongly narrowed to the base, where it occupies a space slightly less than the width of the scutellum; one spot on each elytron is rounded, apical, and slightly nearer the suture than side, the other is larger, less sharply defined, of irregular shape and medio-lateral; the abdominal stripe is almost one-third of the width of each of the segments to the subapical one, near the apex of which it terminates, the stripe is brightly iridescent. The female has the prothoracic mark somewhat larger, the medio-lateral spot on each elytron larger, and irregularly conjoined to a larger subscutellar blotch (the latter is scarcely indicated on the type), and the abdominal stripe is wider, with a blackish spot at the sides of each of four segments (faintly indicated on the type). Under the microscope the basal joint of the middle tarsi, of the male, appears bristly, but not combed.

Quedius erythroderes, n. sp.

Black; prothorax bright reddish, antennae, palpi and legs flavous, apical segment of abdomen, most of subapical one, and tips of the others, more or less reddish. With a few dark hairs on sides, and becoming numerous on anal styles. Elytra, abdomen, and under surface with dark pubescence.

Head rounded, distinctly transverse between antennae and neck; with a few punctures behind eyes and before neck. Eyes (for the genus) rather small, shorter than the inter-antennary space, and not extending half-way to neck. Antennae rather long, first joint as long as second and third combined, these subequal, the others gradually decreasing in length but none transverse, eleventh distinctly longer than tenth, one side of apex incurved. Apical joint of palpi rather stout at base, slightly longer than the subapical one. Prothorax moderately transverse, very little narrowed to apex; with two rather small submedian punctures in the usual positions, and a few on the apical and lateral margins. Elytra scarcely wider than prothorax, scarcely elevated at suture; punctures sharply defined and not very small or crowded. Abdomen with punctures quite as large as on elytra, but becoming smaller posteriorly. Three basal joints of front tarsi inflated. Length, 5-5·5 mm.

Hab.—South Australia: Mount Lofty (A. H. Elston), Wallaroo (A. M. Lea). Victoria: Forrest (H. W. Davey). Type, I. 12683.

A rather thin, parallel-sided species, at first glance resembling *Philonthus subcingulatus*, but head more rounded, prothorax shorter and with very different punctures; *Heterothops tibialis* is also similarly coloured but differs in the head, front legs, etc.; *Q. ruficollis* and *Q. thoracicus* are much wider, with much larger eyes, and are otherwise very different. It is apparently close to *Q. rubricollis*, but differs from the description in having the elytra not at all bluish, and the prothorax transverse. The elytra of the type, although black, are not of the intense polished black of the head, and on two specimens are more piceous-brown than black. I cannot be sure as to the sex or sexes of the four specimens before me, two have the tip of the under-surface of the abdomen straight in the middle, and two have it faintly incurved there, but the difference is so slight that it may not be indicative of sex; all of them have the basal joint of the middle tarsi combless, but in most species of the genus it is combless in both sexes.

Quedius apiciflavus, n. sp.

♂. Black; scutellum, elytra, margins of most of the abdominal segments, legs and antennae red, apical segment of abdomen and part of the subapical one flavous. Sides with a few dark hairs, becoming numerous on abdomen and dense on anal styles, a few hairs on tips of most of the abdominal segments and a distinct fringe on apex of elytra; elytra, abdomen, and under surface with pale (in some lights golden) pubescence.

Head somewhat rounded; with two punctures touching inner side of each eye, and a few near neck. Eyes very large, extending almost to neck, distinctly longer than the inter-antennary space. Antennae with basal joint as long as second and third combined, these subequal, eighth to tenth moderately transverse, eleventh considerably longer than tenth, incurved on one side of apex. Apical joint of palpi much longer than subapical one, its base not much thinner. Prothorax rather strongly narrowed to apex; with two strong submedian punctures in the usual positions, a few in the lateral and basal gutters, and two near apex. Elytra with rather sharply defined but small punctures. Abdomen with somewhat similar punctures to elytra, tips of most of the segments very finely serrated, the apex slightly notched on under surface. Front tarsi rather strongly dilated, basal joint of middle tarsi bristly but not combed. Length, 5·25-5·5 mm.

Hab.—Queensland: Mount Tambourine, two specimens from rotting leaves (A. M. Lea). Type, I. 12670.

A rather robust species, structurally fairly close to *Q. lateroflavus* but very differently coloured. In appearance it is fairly close to *Q. luridipennis* and *Q. metallicus*, but shorter and more robust, and tip of abdomen flavous. *Q. sidneensis* and *Q. fulgidus* are much larger species. Most of the abdomen (both surfaces) is brilliantly iridescent, the rest of the upper surface is highly polished but feebly iridescent; the middle of the antennae is slightly darker than the base and apex, but is not distinctly infuscated; in some lights the extreme tips of the elytra appear paler than the adjacent parts, but in other lights they appear darker.

Quedius subopacus, n. sp.

♀. Black; elytra and tarsi red, trochanters, parts of front legs, parts of anal styles and of antennae obscurely reddish. Sides with a few long dark hairs, becoming numerous about tips of abdomen; elytra, abdomen, and under surface with rather short, pale pubescence.

Head rather elongate; with a few punctures near eyes and before neck. Eyes large, distinctly longer than the inter-antennary space. Antennae with first joint as long as second and third combined, third distinctly longer than second, slightly longer than fourth and the length of fifth, the others to tenth slightly decreasing in length, but all longer than wide, eleventh scarcely one-fourth longer than tenth. Apical joint of palpi much longer than subapical. Prothorax strongly narrowed to apex, greatest width slightly more than greatest length; with two submedian punctures in the usual positions, and a few on all the margins. Elytra with small and not very sharply defined punctures, many resembling transverse scratches. Abdomen with larger punctures than elytra, five segments each with a row of setiferous ones at the tip. Front tarsi rather strongly inflated, basal joint of each of the others slightly longer than three following joints combined. Length, 9 mm.

Hab.—Tasmania: Launceston, in tussocks (A. M. Lea), unique.

Structurally and in general appearance close to *Q. luridipennis* and *Q. metallicus*, but head and prothorax very finely shagreened and subopaque; the anal styles are also thinner; the abdomen is shining, with a bluish, but not very brilliant iridescence.

Quedius duplopunctatus, n. sp.

♂. Black; elytra, antennae, palpi, legs, and tips of most of the abdominal segments, of a more or less dingy red. A few long dark hairs on sides, becoming more numerous on abdomen, and especially on the anal styles; elytra, abdomen, and under surface with dark pubescence.

Head moderately large and rounded, with a few large punctures close to eyes and before neck, and with numerous small ones scattered about. Eyes very large, distinctly longer than the inter-antennary space. Antennae with first joint as long as second and third combined, these subequal, the others to tenth gradually decreasing in length but none transverse, eleventh distinctly longer than tenth. Apical joint of palpi moderately thin, almost twice the length of the subapical one. Prothorax moderately transverse, strongly narrowed to apex; with two strong submedian punctures in the usual positions, and a few on the margins, with numerous small ones as on head. Elytra rather small; with fairly dense and rather small punctures, many of which are transversely subconfluent. Abdomen with punctures somewhat similar to those of elytra, but a setiferous row at the tip of each of five segments; tip of under surface notched. Three basal joints of front tarsi rather strongly inflated, basal joint of middle tarsi bristly but not combed. Length, 7·5-8·5 mm.

♀. Differs in having the abdomen somewhat wider, its tip evenly rounded and the front and middle tarsi thinner.

Hab.—Tasmania: Frankford, two specimens from moss (A. M. Lea).

The elytra are not conspicuously reddish as in *Q. metallicus, Q. luridipennis, Q. sulcicollis,* and others, but the species may be at once distinguished from these, and from all other Australian ones before me, by the numerous small but rather sharply defined punctures on the head and prothorax. The red of the elytra is fairly bright at the base, but it soon becomes obscured, till at the apex it is of a rather dark piceous-brown, the three basal joints of the antennae are paler than the others, parts of the legs are infuscated. In some lights the head and prothorax have a faint coppery gloss, the abdomen has a slight bluish iridescence; to the naked eye both specimens appear entirely black. The anal styles are unusually long, but as they are often partly withdrawn in specimens of the subfamily no reliance should be placed upon them.

Quedius pignerator, n. sp.

Black; elytra and tip of abdomen dull red, legs, antennae, and palpi somewhat paler, abdomen brilliantly iridescent. Sides with a few long dark hairs, becoming numerous on anal styles; elytra, abdomen, and under surface with somewhat ashen pubescence.

Head rounded and transverse, with a few distinct punctures near eyes and neck; with three shallow depressions in front: two between bases of antennae and the other forming a triangle with them. Eyes very large, extending almost to neck, much longer than the inter-antennary space. Antennae with first joint as long as second and third combined, these subequal, the following ones gradually becoming shorter, and two or three of them very feebly transverse, eleventh distinctly longer than tenth. Apical joint of palpi rather thin, twice the length of the subapical one. Prothorax moderately transverse, sides strongly narrowed to apex; with two conspicuous submedian punctures in the usual positions, and a few on the margins. Elytra with fairly dense and small punctures; suture moderately elevated. Abdomen with sparser but more sharply defined punctures than on elytra, each of four segments very finely serrated at apex. Three basal joints of front tarsi rather strongly dilated, basal joint of middle pair bristly but not combed. Length, 6-6·5 mm.

Hab.—New South Wales: National Park, two specimens from rotting leaves (A. M. Lea).

The head is smaller than on *Q. apiciflavus*, eyes larger, apical joint of palpi longer and body thinner; it is somewhat like *Q. luridipennis*, but is smaller and thinner than any specimen of that widely distributed species before me, eyes distinctly larger, and punctures of elytra and abdomen rather sparser; the abdomen is quite as brilliantly iridescent as on that species, but the iridescence is more golden, and varies from every point of view, and from one direction even disappears, from some the colours appear to be in narrow zones. It is apparently fairly close to *Q. nigrovirens*, but the head and prothorax are without a green tinge, and the abdomen is not a clear brown (as noted in Fauvel's table). The smaller specimen has the abdomen even more brilliantly iridescent than the other, and the glitter extends even to the legs, which are entirely pale; on the larger specimen the legs are partly black, and on the upper surface of its abdomen there are long bristles at the tips of two of the segments, as well as on their margins; but as each has the under surface of the abdomen slightly notched at the tip they are presumably males. There is a rather shallow puncture half-way between each of the submedian punctures on the prothorax, and the position of the rounded off hind angle.

Quedius nothus, n. sp.

Black; parts of elytra, tips of some of the abdominal segments, legs, two basal joints of antennae, and parts of the mouth and of the palpi more or less reddish. Sides with a few dark hairs, becoming numerous on tip of abdomen; elytra, abdomen, and under surface with dark pubescence.

Head rather large, convex, and slightly longer than wide; with a few distinct punctures near eyes and just before neck. Eyes (for the genus) rather small, not extending half-way to neck, and shorter than the inter-antennary space. Antennae with first joint as long as second and third combined, third slightly longer than second, seventh to tenth slightly transverse, the eleventh distinctly longer. Apical joint of palpi slightly longer than the subapical one. Prothorax moderately transverse, somewhat narrowed to apex; with two distinct submedian punctures in the usual positions, a few smaller ones in lateral and basal margins and near apex. Elytra with fairly dense and rather small punctures; suture not elevated. Abdomen with sparser punctures than on prothorax, the tips of four segments very finely serrated. Front and middle tarsi not at all dilated. Length, 4·5-5 mm.

Hab.—Queensland: National Park (H. Hacker), Brisbane (O. W. Tiegs). New South Wales: Illawarra (H. J. Carter). Type, I. 12671.

A rather dingy species, with a somewhat curious head and bicolorous elytra, the abdomen with a rather feeble bluish iridescence. The head is moderately narrow, but not as narrow as in *Q. nelsonensis, Q. baldiensis,* etc. The reddish parts of the elytra are not sharply limited, although quite distinct, they are the shoulders, about one-fifth of the tips (sometimes connected along the sides with the shoulders), and the suture (although this is sometimes very obscure, and on one specimen no darker than the adjacent parts). On the prothorax (which on some specimens is not as black as the head), immediately in line behind each of the strong submedian punctures, there are one or two more, but they are very small and invisible from most directions, although fairly distinct when viewed obliquely from behind; they are certainly far from being as distinct as the seriate punctures of *Philonthus*. The minute serrations at the tips of four of the abdominal segments of this, and of some other species, are due primarily to closely placed setiferous punctures. On some specimens the head is considerably larger and wider than on others, but I can find no distinctive male characters on the abdomen and legs of such specimens; the ones with smaller heads have also shorter antennae so they are probably females, the others probably being males; but the front tarsi on even the big-headed ones are thin, so they are possibly all females.

Quedius melas, n. sp.

♂. Deep polished black; tarsi, two or three basal joints of the antennae (the others infuscated but not black) and some of the mouth parts reddish. Sides with some dark hairs, becoming more numerous on abdomen and dense on its apex; elytra, abdomen, and under surface with black pubescence.

Head large, somewhat rounded and moderately convex; with two large punctures touching each eye, and a few near neck. Eyes large, extending more than half-way to neck, slightly longer than the inter-antennary space. Antennae with first joint scarcely as long as second and third combined, third distinctly longer than second and much longer than fourth, sixth to tenth somewhat transverse, eleventh distinctly longer than tenth, incurved on one side of apex. Apical joint of palpi somewhat thinner and slightly longer than the subapical one. Prothorax moderately transverse and narrowed to apex; with two conspicuous submedian punctures in the usual positions, and two slightly larger ones near the apex, with a few smaller ones in the basal and lateral margins. Elytra with fairly dense and not very large punctures, usually sharply defined, but many transversely confluent. Abdomen with sparser but larger punctures than on elytra, the tips of four segments (both surfaces) very finely serrated, apex of under surface slightly notched. Three basal joints of front tarsi dilated into a wide pad, basal joint of middle tarsi long and rather wide. Length, 7-8·5 mm.

♀. Differs in having the head slightly smaller, apex of abdomen not notched, front tarsi less strongly (although conspicuously) dilated, and basal joint of middle tarsi smaller.

Hab.—New South Wales: Blue Mountains (Dr. E. W. Ferguson). Victoria: Melbourne (Ejnar Fischer, No. 1634), Ringwood in July and Beaconsfield in December (F. E. Wilson). Type, I. 12871.

A deep black, shining species, in general appearance close to the one commented upon as possibly *Q. iridiventris,* but wider, antennae stouter, paler, at least five joints transverse, the third joint conspicuously longer than the second, and this slightly longer than the fourth. The antennae are practically identical with those of *Q. mesomelinus*, but the elytra are uniformly dark and with much denser punctures. It is apparently allied to *Q. hollandicus*, but the antennae are not black and the eyes are large. In some light the prothorax has a faint bluish gloss; the abdomen has a bluish or purplish iridescence, but it is not very brilliant. The basal joint of the middle tarsi of the male is furry rather than bristly, with the fur projecting over the second joint. Structurally and in general appearance it is very close to *Q. latifrons*, from New Zealand, but the male has a smaller head, the abdominal punctures are much sparser and the elytra are entirely black.

Quedius stenocephalus, n. sp.

Black; shoulders, antennae (some of the median joints infuscated), palpi, and legs more or less reddish. Sides with a few dark hairs becoming numerous on abdomen and dense on its tips; elytra, abdomen, and under surface with blackish pubescence.

Head rather long and thin, with a few distinct punctures near eyes and neck. Eyes rather small, scarcely as long as the inter-antennary space. Antennae with first joint about as long as second and third combined, third slightly longer than second, seventh to tenth transverse, eleventh moderately long. Apical joint of palpi rather thin, but slightly dilated near base, more than twice the length of the subapical joint. Prothorax not much wider than the greatest length, strongly narrowed to apex; with two distinct submedian punctures in the usual positions, and some smaller ones in the basal and lateral margins. Elytra not very small, suture slightly elevated throughout; with fairly dense and rather small, but sharply defined punctures. Abdomen with sparser but more distinct punctures than on prothorax, tips of four segments very finely serrated. Front and middle tarsi thin. Length, 4·75-5·25 mm.

Hab.—Queensland: Mount Tambourine, one specimen from rotting leaves in January (A. M. Lea). New South Wales: Kurrajong in July (H. J. Carter). Type, I. 12677.

The narrow head and general outlines are suggestive of some species of *Acylophorus*, but the basal joint of antennae is of normal length for *Quedius*, and the apical joint of the maxillary palpi is long and thin. The head is much as in *Q. nelsonensis*, but the elytra are larger and apparently cover wings, and less of their base is pale; the elytra are much larger than on the species commented upon as probably *Q. baldiensis;* the head is almost as small as in *Q. analis*, but the eyes are smaller, and the tips of the antennae are pale. The elytra at first appear to be entirely blackish, but on close examination are seen to be reddish about the shoulders; the palpi and front legs are almost flavous; the abdomen (both surfaces) is brilliantly iridescent, and the iridescence extends to some of the legs; in some lights the prothorax has a faint silken gloss. On both specimens the tip of the under surface of the abdomen is very feebly incurved, so, despite the thin front tarsi, they are probably males.

QUEDIOPSIS, Fvl., Cat., p. 437.

ABDOMINALIS, Fvl. V.

LUGUBRIS, Fvl. V.

ACYLOPHORUS, Nordm., Cat., p. 437.

ASPERATUS, Fvl. Q., V.

GLABERRIMUS, Herbst. N.S.W. Introduced.

INDIGNUS, Blackb. S.A.

RUFICOLLIS, Mots. Q., N.S.W., N.T. Introduced.

ACYLOPHORUS GLABERRIMUS, Herbst.

A specimen from Ebor, in the Queensland Museum, appears to belong to this species, which has not previously been recorded as Australian; six synonyms are noted in the Catalogue.

ACYLOPHORUS RUFICOLLIS, Motsch.

I have not seen the original description of this species, but a specimen sent by Mr. G. J. Arrow (from Adelaide River) was stated by him to agree "quite well with Ceylon examples considered by Kraatz and Fauvel to be *A. ruficollis.* Dr. Sjöstedt also sent two Queensland specimens identified by Dr. Bernhauer as belonging to the species. Other specimens before me are from Endeavour River, Cairns, Townsville, Rockhampton, and Bribie Island (in Queensland); and from near Sydney (in New South Wales). The species is very distinct by its bright red prothorax, reddish subapical segment of abdomen, and small head with long basal joint of antennae.

ATANYGNATHUS, Jacobson, Cat., p. 439.

TERMINALIS, Er. *(Tanygnathus).*
var. *australasiae,* Fvl. *(Tanygnathus).* Q., N.S.W., V.

ATANYGNATHUS TERMINALIS, Er.

Two specimens from New South Wales (Nepean River and Sydney) appear to belong to the variety *australasiae.*

Two others, from Queensland, possibly represent another variety; their elytra are entirely black, three apical joints of antennae whitish-flavous, and abdomen more brilliantly opalescent than in the preceding specimens, but with the tips of the segments less conspicuously reddish.

CRYPTOMMATUS,[13] Matth., Cat., p. 440.

JANSONI, Matth. *(Amblyopinus).* V., Tas.

CRYPTOMMATUS JANSONI, Matth.

The nine specimens of this species that I have seen were all taken clinging to the anal hairs of bush rats, in Tasmania, by Messrs. Aug. Simson and H. M. Nicholls, and in Victoria by Mr. E. Jarvis. The male only, on the basal joint of the middle tarsi, has a comb with a dense fringe of setae as on the males of many species of *Quedius;* in Matthews' figure of the middle leg[14] only the teeth of the comb are shown.

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(13) Matthews, Cist. Ent., iii., p. 87, considered that *Myotyphlus* was a catalogue name only, and unsuitable for the present genus.

(14) Matthews, *L.c.,* ii., pl. 6, fig. 7.

CONTRIBUTIONS TO THE ORCHIDOLOGY OF PAPUA AND NEW GUINEA.

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

[Read September 10, 1925.]

Through the kindness of Mr. C. T. White, Government Botanist of Queensland, two small collections of orchids from Papua (Owen Stanley Ranges) and adjacent Mandated Territory were submitted to me for determination.

The larger of these collections was made by Mr. C. E. Lane-Poole, Forestry Adviser to the Commonwealth Government. Mr. Lane-Poole writes as follows:—"The object of my exploration of Papua and the Territory of New Guinea, was to ascertain the forestry possibilities of these two colonies of Australia. The collection of botanical material of woody plants, of necessity occupied most of my time, and I was obliged to pass by many interesting herbs, and even shrubs, which for lack of space and time could not be collected.

"At high altitudes and in parts not previously visited by white people, and where the possibility of a collector visiting the region again seemed remote, I collected everything that I found in flower. That is how I came to collect the few orchids that you have examined and determined.

"After spending 15 months in the forests of Papua, I went on to New Guinea, and spent a little over a year exploring that Territory."

The balance of the material was collected by the Rev. R. Lister Turner, a London Mission Society officer, in the Rigo District, on the south coast of Papua, a few miles east of Port Moresby. It contains a new *Habenaria*, which I have named after him, and two orchidaceous plants of interest not hitherto recorded from Papua.

Habenaria (§ Peristyloideae) Turneri, Rogers, n. sp. Terrestris, circa 54 cm. alta. Folia 4 vel 5, basilaria v. sub-basilaria, elliptico-lanceolata, erecto-patentia, basi in petiolum brevem amplectantem sensim attenuata, acuta, conspicue 3-nervia, ad 18 cm. longa, 3 cm. lata, in bracteas amplectantes acuminatas decrescentes sensim transeuntia. Spica laxe multiflora, circa 22·5 cm. longa; bracteae ovato-lanceolatae, 1·0-2·0 cm. longae. Flores parviusculi. Sepalum dorsale erectum, cucullatum, ovatum, acutum, circa 4·25 mm. longum. Sepala lateralia oblique ovata, deflexa, subacuta, conspicue 3-nervia, 4·25 mm longa, 3 mm. lata. Petala sub sepalo dorsali abscondita, simplicia, erecta, anguste linearia, 1-nervia, obtusissima, 4·25 mm. longa, 0·5 mm. lata. Labellum breviter unguiculatum, ungue convexo, paulo supra basin alte tripartitum, circa 5·75 mm. longum; partitiones laterales ellipticae, 2-nerviae, obtusiusculae, marginibus minutissime serrulatis, 4·25 mm. longae, 1·6 mm. latae, divaricatae (explanatae), inter apices 9 mm. latae; partitio intermedia paulo brevior, circa 4·0 mm. longa, 0·75 mm. lata, lineari-elliptica, obtusiuscula, 3-nervia, marginibus minutissime serrulatis. Calcar lineari-filiforme, tortum, ovario multo brevius, circa 1·0 cm. longum. Gynostemium circa 2 mm. longum, staminodiis ovalibus verrucosis; canales antherae mediocres, porrecti, caudiculis breviores. Processus stigmatiferi mediocres, carnosi, obtusi, depressi, canalibus antherae multo excedentes. Ovarium circa 1·7 cm. longum.

Plant about 54 cm. high. Leaves 4 or 5, basal or sub-basal, elliptic-lanceolate, narrowing at the base into a short clasping petiole, erecto-patent, acute, with 3 conspicuous veins and several subsidiary ones, reaching 18 cm. long, 3 cm. wide, passing into stem-bracts diminishing upwards. Bracts about 6, sheathing at the base, acuminate. Inflorescence a loose multiflowered spike, about 22·5 cm. long, subtending bracts ovate-lanceolate, 1·0-2·0 cm. long. Flowers somewhat small. Dorsal sepal erect, cucullate, ovate, acute, 4·25 mm. long. Lateral sepals obliquely ovate, deflexed, subacute, conspicuously 3-nerved, 4·25 mm. long, 3 mm. wide. Petals hidden beneath the dorsal sepal, erect, simple, narrow-linear, 1-nerved, very obtuse, 4·25 mm. long, 0·5 mm. wide. Labellum deeply 3-partite from a little above the base, about 5·75 mm. long; lateral divisions elliptical, 2-nerved, divaricate (when spread out), rather blunt, margins very minutely serrulate, 4·25 mm. long from point of junction with middle division, 1·6 mm. wide, 9 mm. between the apices; middle division slightly shorter, about 4·0 mm. long, 0·75 mm. wide, linear-elliptical, rather blunt, 3-nerved, margins very minutely serrulate. Spur linear-filiform, twisted, much shorter than the ovary, about 1·0 cm. long. Stigmatic processes of medium length, stretching forwards and slightly deflexed, fleshy, obtuse, exceeding the anther-canals. Anther-canals of medium length, rather slender, porrect, shorter than the caudicles. Glandular discs naked. Ovary about 1·7 cm. long.

Papua. Rigo District. Rev. R. Lister Turner. This plant is very closely related to *H. Bauerleni*, F. v. M. et Krnzl., but differs in its much longer and wider leaf, in the shape of the lateral lobes of the labellum and in other details.

Oberonia (§ Otoglossum) oblonga, Rogers, n. sp. Epiphytica, dependens, ad 24 alta. Radices filiformes, elongatae, flexuosae. Caulis circa 7·5 cm. longus, compressiusculus, subgracilis, flexuosus, basibus foliorum omnino obtectus. Folia erecto-patentia, equitantia, basin versus conduplicata, acuminata, falcata, submembranacea, multinervia, summa longissima, ad 15 cm. longa, circa 5·5 mm. lata. Inflorescentia gracilis, circa 13 cm. longa, foliis supremis longior, multiflora. Bracteae anguste lanceolatae, acuminatae, circa 2 mm. longae, marginibus serrulatis, ovario paulo longiores. Flores minuti, brunnei, verticillati, glabri, patentes, circa 2·5 mm. diametro. Segmenta perianthii marginibus integris. Sepalum dorsale ovatum, obtusum, circiter 1·0 mm. longum, 0·6 mm. latum. Sepala lateralia sepalo dorsali aequalia sed paulo latiora. Petala aequilonga, subtruncata, circiter, 0·25 lata. Labellum ambitu late oblongum, circiter 1·5 mm. longum, 1·0 mm. latum, basi cordato-auriculatum, auriculis parvulis columnam amplectantibus, prope medium leviter constrictum, antice paulo latius alte bilobulatum, lobulis oblongis truncatis subdivergentibus; lamina puncticulosa, basi leviter concava, 2 lineis parallelis usque medium instructa. Columna crassiuscula, perbrevis. Ovarium cum pedicello circiter 1·75 mm. longum.

A dependent plant about 24 cm. high with filiform roots. Stem about 7·5 cm. long, rather flattened, flexuose, entirely covered by the bases of the leaves. Leaves erecto-patent, equitant, conduplicate towards the base, falcate, acuminate, rather thin, multinerved, increasing in length from below upwards, uppermost one 15 cm. long, 5·5 mm. wide near the middle, covered by many glandular dots. Inflorescence slender, about 13 cm. long, exceeding the leaves, multiflowered. Bracts narrow-lanceolate, acuminate, about 2·0 mm. long, margins minutely serrulate, slightly exceeding the ovary. Flowers minute, brown, verticillate, pedicel at right angles to rhachis, about 2·5 mm. in diameter. Margins of the perianth segments entire. Dorsal sepal ovate, obtuse, about 1 mm. long, 0·6 mm. wide. Lateral sepals similar and equal to the dorsal sepal, but a little wider. Petals oblong, almost truncate, equal in length to the dorsal sepal, about 0·25 mm. wide. Labellum broadly oblong, about 1·5 mm. long, 1·0 mm. wide, cordate-auriculate at the base, its small auricles clasping the column, slightly narrower near the middle, widening a little towards the apex; deeply bilobed in front, the lobes slightly divergent, truncately oblong. Lamina slightly concave at the base, minutely dotted, 2 parallel longitudinal lines extending to the middle. Column fleshy, very short. Ovary with pedicel rather stout, about 1·75 mm. long.

Papua. Owen Stanley Range, between Adai and Naro Rivers, at elevation of 6,000 feet. "Epiphyte, with pendent spikes of minute brown flowers, very scarce, only one plant seen." C. E. Lane-Poole, No. 414. Feb., 1923.

This species approaches rather closely to *O. biloba*, Schltr., a plant from the Bismarck Mountains, but in the Papuan species the flowers are smaller, the labellum relatively narrower and the inflorescence is not dense.

Epiblastus tuberculatus, Rogers, n. sp. Pseudobulbi ad 9 cm. longi, subteretes vel compressi, sulcati, basin versus paulo dilatati, superpositi, apice unifolii, vaginis magnis acutis vulgo omnino obtecti. Folium unicum terminale, erectum, glabrum, lineari-lanceolatum, subacutum, multinervium, costa intermedia subtus carinata, apice inaequale bidentatum, basin versus conduplicatum, 30-47·5 cm. longum, 2·0-2·5 cm. latum. Inflorescentiae terminales, fasciculatae, 15-24 florae; pedunculis gracillimis, 1-floris, 1-seriatis, 12-14 cm. longis. Bractea florea subulata, circa 3 mm. longa. Ovarium cum pedicello gracillimum, glabrum, tuberculatum, circa 1·5-2·0 cm. longum. Flores badii, subquadrati, illis *Eriae* similes, tuberculis multis resinaceis obtecti, glabri, circa 8 mm. longi, 6 mm. lati. Sepalum dorsale ovali-oblongum, obtusissimum, 5-nervium, erectum, 7 mm. longum, 3 mm. latum. Sepala lateralia oblique triangula, 5-nervia, subacuta, erecta, marginibus anticis liberis, circiter 8·5 mm. longa, basi pede columnae adnata mentum breve obtusum formantia. Petala elliptica, subacuta, erecta, 5-nervia, circiter 6 mm. longa, 2·75 mm. lata. Labellum unguiculatum, antheram bene excedens, sepalis breviusculum, erecto-recurvum, pluri-nervium, circiter 9 mm. longum, 7 mm. latum, quasi 3-lobum; unguis oblongus, carnosus, circiter 2·5 mm. longus, more generis pede columnae adnatus; lobi laterales obtuse trianguli, marginibus integris, columnam amplectantes; lobus intermedius recurvus, longior et multo angustior, marginibus crenulatis; lamina (expansa) trapezioidea, flexu inter lobos laterales callo transverso magno arcuato carnosiusculo. Columna circiter 3·5 mm. longa; clinandrium profunde excavatum, lobis lateribus latis obtusis, lobo dorsali angustiore et paulo longiore. Pollinia 8. Stigma maximum, profunde concavum. Pes columnae circiter 3 mm. longa; in medio crista longitudinali anguste triangularia, basi columnae et ungue labelli adnata.

Pseudobulbs 9 cm. or less long, subterete or flattened, sulcate, slightly swollen towards the base; covered in the lower part or entirely with large acute sheaths. Leaf single, terminal, erect, glabrous, linear-lanceolate, subacute, unequally bilobed at the apex, multinerved, midrib very prominent below, 30-47·5 cm. long, 2·0-2·5 cm. wide, conduplicate towards the base. Inflorescence terminal, fasciculate, 15-24-flowered. Peduncles 1-flowered, very slender, 1-seriate, 12-14 cm. long. Flower bract subulate. Flowers reddish-brown, beset with numerous resinous tubercles, erioid, glabrous, circiter 8 mm. long, 6 mm. wide, subquadrate. Dorsal sepal oblong-oval, quite blunt, 5-nerved, subacute, erect, 7 mm. long, 3 mm. wide. Lateral sepals obliquely triangular, 5-nerved, subacute, erect, anterior margins free, about 8·5 mm. long, adnate by their base to the foot of the column forming a short blunt mentum. Petals elliptical, subacute, erect, 5-nerved, about 6 mm. long, 2·75 mm. wide. Labellum clawed, well exceeding the anther and shorter than the sepals, erecto-recurved, concave, pluri-nerved, quasi 3-lobed, about 9 mm. long, 7 mm. wide; the claw oblong, fleshy, about 2·5 cm. long, adnate for its whole length along the middle line to a knife-edged crest on the apical part of the column foot; the lamina (spread out) trapezioid, the lateral lobes bluntly triangular with entire margins clasping the column, the middle lobe much narrower bluntly triangular recurved with crenulate margins; at the bend between the lateral lobes a large transverse somewhat fleshy arcuate callus. Column about 3·5 mm. long, clinandrium deeply excavated, the dorsal lobe narrower and slightly longer than the broad blunt lateral ones. Pollinia 8. Stigma very large, deeply concave. Foot of column more or less at right angles to the ovary, about 3 mm.

long, a narrow triangular crest extending along its centre from the base of the column to the claw of the labellum. Ovary and pedicel slender, about 1·5-2·0 cm. long, tuberculate.

Papua. Hamlet of Laruni; Owen Stanley Range, at elevation of about 4,000 feet. C. E. Lane-Poole, No. 373. Feb., 1923.

This plant occupies a near relationship to *E. cuneatus*, J. J. Sm., from which, however, it is to be distinguished by the peculiar tuberculate condition of the flowers. The flowers in the inflorescence of the new species are very numerous, but very few (only 6) in the other plant.

It appears to be the first record of a member of the remarkable genus *Epiblastus*, Schltr., from Papua. Two species have been described by J. J. Smith from the Dutch territory of New Guinea, and eight by Schlechter from the Mandated Territory; another has been recorded from the Celebes and two more from Samoa, so that the total number of known species, including *E. tuberculatus*, Rogers, now stands at 14.

The flowers are apparently always some shade of red in colour, and on casual inspection are very similar to those of *Eria*, Lindl. From members of the latter genus, however, they differ in the singular mode of attachment of the labellum to the foot of the column and also by the presence of a peculiar transverse callus on the lamina. The inflorescence is likewise very remarkable and its fasciculate character is in itself sufficient to remove these plants from *Eria*, Lindl.

This interesting genus has been placed by Dr. Schlechter in the large Group *Glomerinae*, with the members of which its inflorescence establishes a relationship.

Ceratostylis calceiformis, Rogers, n. sp. Epiphytica, caespitosa, erecta. Rhizoma abbreviatissimum. Radices filiformes, flexuosae, hirsutissimae. Caules (pseudobulbi ?) teretes, gracillimi, glabri, facie sulcati, 20-30 cm. longi, basi vaginis pluribus lanceolatis membranaceis obtecti. Folium unicum, terminale, erectum, caule continuum, facie sulcatum, teres, acutum, glabrum, 10-15 cm. longum. Flos unicus (?), terminalis, minutus, albus, circiter 7 mm. longus, vaginis plurimis cinctus. Bracteae parvulae, truncatae, breves, hyalinae, prope basin ovarii. Sepalum dorsale erectum, ellipticum vel oblongo-ellipticum, subacutum, 3-nervium, fere 3 mm. longum, 1 mm. latum. Sepala lateralia subobtusa, parte libera falcata, deorsum longe oblongo-ligulata, cum pede elongato columnae oblique decurrentia; marginibus anticis conspicue productis et connatis, calcar longum curvulum pilosum apice dilatatum circiter 4·5 mm. longum formantibus. Petala sepalo dorsali brevia angustiaque, lanceolata, acuta, 1-nervia, circiter 2 mm. longa, 0·5 mm. lata. Labellum breve unguiculatum, erectum, spathulatum, glabrum, 3-nervium, circiter 6 mm. longum; basi elongato-ligulatum; apicem versus dilatatum, ovate calceiforme, incrassatum. Columna brevis, alte bipartitum, cum brachiis rotundato-oblongis dimidium laminae labelli attingens. Ovarium cum pedicello dense pilosum, gracile, calcar multo excedens, circiter 6 mm. longum.

Epiphytic, caespitose, erect. Rhizome very much shortened. Roots filiform, flexuose, very hairy. Stems (pseudobulbs ?) terete, rush-like, very slender, longitudinally sulcate, glabrous, 20-30 cm. long, covered at the base with many long, lanceolate, membraneous sheaths. Leaf single, terminal, continuous with the stem, erect or erecto-patent, terete, glabrous, acute, sulcate, 10-15 cm. long. Flowers minute, white, single (?), terminal, about 7 mm. long (including spur), surrounded by numerous acute membraneous sheaths. Bracts small, blunt, short, truncate, hyaline, near the base of the ovary. Dorsal sepal erect, elliptical or oblong-elliptical, subacute, 3-nerved, hardly 3 mm. long, about 1 mm. wide. Lateral sepals rather blunt, falcate, 3-nerved above, longly oblong-ligulate below, obliquely decurrent with the elongated foot of the column; their anterior margins free above for 2 mm., conspicuously produced and connate below, forming a long curved hairy spur bluntly dilated at the apex about 4·5 mm. long. Petals shorter and narrower than the dorsal sepal, lanceolate, acute, 1-nerved, about 2 mm. long, 0·5 mm. wide. Labellum shortly clawed, erect, spathulate, about 6 mm. long, 3-nerved, the base elongated, ligulate; the apex ovate-elliptically dilated, concave, slipper-shaped, fleshy, glabrous. Column short, deeply bipartite; the brachia oblong-obtuse, about 4 mm. long, reaching to about the middle of the dilated part of the lamina of the labellum. Ovary with pedicel slender, about 6 mm. long, much exceeding the spur.

Papua. Owen Stanley Range; Mount Obree, at 8,000-10,300 feet elevation. Epiphytic on trunks of trees. C. E. Lane-Poole, No. 361. Feb., 1923.

This species has affinity with *C. clavata*, J. J. Sm., but its flowers are smaller, the labellum is quite glabrous, the spur is curved, but not sigmoid, and it differs in other floral details.

Calanthe (§ Calothyrsus) latissimifolia, Rogers, n. sp. Planta robustissima, glabra, acaulis, habitu *C. veratrifolia,* R. Br. Folia ovato-lanceolata, in petiolum basi sensim angustata; lamina prominente 9-nervosa, usque ad 75 cm. longa, circiter 18 cm. lata; petiolus circiter 32 cm. longus. Scapus teres, usque ad 120 cm. altus. Racemus subdense multiflorus, 22-33 cm. longus. Bracteae laxae, persistentes, elliptico-lanceolatae, 2·5-3·0 cm. longae. Segmenta perianthii reflexa (?) vel patentia. Sepalum dorsale ellipticum, 5-nervium, subacutum, circiter, 2·3 cm. longum, 9 mm. latum. Sepala lateralia elliptica, 7-nervia subacuta, sepalo dorsali paulo breviora. Petala basi in petiolum breve contracta, sepalo dorsali aequilonga, lamina elliptica obtusiuscula. Lamina labelli trifida, segmenta perianthii paulo excedens; lobus intermedius alte bifidus, segmenta divergentia linerai-falcata apice dilatata et oblique truncata; lobi laterales multo latiores, latiuscule trapezoidei; basi verrucosa, cirrhis luteis seriatis apicibus simplicibus bifidis vel trifidis instructa. Calcar gracillime, subfiliforme, prope apicem genuflexum, circiter 5·8 cm. longum. Ovarium subcylindraceum, pedicello multo longiore et gracillimi; ovarium cum pedicello clavatum, circiter 8 cm. longum.

A very robust, glabrous, stemless plant, with the habit of *C. veratrifolia,* R. Br. Leaves ovate-lanceolate, gradually narrowing at the base into a petiole; lamina with 9 prominent nerves, up to 75 cm. long, 18 cm. wide; petiole about 32 cm. long. Scape terete up to 120 cm. high. Raceme moderately dense, many-flowered, 22-33 cm. long. Bracts loose, persistent, elliptic-lanceolate, 2·5-3·0 cm. long. Perianth reflexed (?) or spreading. Dorsal sepal elliptical, 5-nerved, subacute, about 2·3 cm. long, 9 mm. wide. Lateral sepals elliptical, subacute, 7-nerved, a little shorter than the dorsal sepal. Petals about as long as the dorsal sepal, contracted at the base into a short petiole, the lamina elliptical rather blunt. Lamina of labellum trifid, slightly exceeding the perianth segments; the middle lobe deeply bifid, the segments divergent linear-falcate dilated and obliquely truncate at the apex; the lateral lobes much wider, rather broadly trapezoidal; verrucose at the base, with yellow cirrhi in rows with simple bifid or trifid apices. Spur very slender, subfiliform, genuflexed near the apex, about 5·8 cm. long. Ovary subcylindrical, pedicel much longer and very slender; ovary with pedicel clavate, about 8·0 cm. long.

Papua. Owen Stanley Range, between Mount Obree and Kargi. C. E. Lane-Poole, No. 426A.

This handsome plant is evidently a near relative of *C. Engleriana*, Krzl., a species which has been recorded from Dutch New Guinea and the Mandated Territory. It also has close affinities with the well-known *C. veratrifolia,* R. Br., a very widely distributed plant which has been reported from the Deccan Peninsula, through the Malay Archipelago, Philippines, New Guinea, Australia, and certain of the South Sea Islands. From both these species, it chiefly differs in its enormously wide leaf as well as in the relative lengths of the spur and pedicelled ovary.

The condition of the material did not admit of a critical examination of the flowers, and some slight amendments may be necessary, when more satisfactory material is available. This species is well worthy of cultivation.

Calanthe (§ Styloglossum) flabelliformis, Rogers, n. sp. Herba epiphytica, acaulis. Folia circa 4, glabra, anguste lanceolata, acuminatissima, 56-65 cm. longa; lamina 41-50 cm. longa, 1·75-2·50 cm. lata, nervis 3 validis prominentibus et pluribus tenuibus, basi in petiolum gracile sublongatum canaliculatum sensim attenuata. Scapi in speciminibus meis imperfecti, sed manifeste breves, circiter 15-20 cm. longi; vaginae 2·0-2·5 cm. longae, subacutae, amplectantes. Bracteae caducae, majusculae. Flores subparvi, flavi, 4-5, racemosi, subpatuli, calcarati; pedicellus gracilis, circiter 3 mm. longus; ovarium longius, subgracile. Segmenta perianthii subaequalia, 10-11 mm. longa, 3-nervia, erecto-patentia, elliptica vel elliptico-lanceolata, subacuta. Labellum alis totis columnae adnatum calcar scrotiforme 3-4 mm. longum formante; 3-lobum; lobus intermedius flabelliformis, marginibus integris, 5-6 mm. longus, 3·5 mm. latus; lobi laterales prope basi, minutissimi, anguste auriculati; lamina nervis 7 longitudinalibus inter lobos laterales confertissimis instructa. Columna semiteres, erecta, labello adnata, apice dilatata, circa 3 mm. longa (antheram includens), auriculis brevibus. Anthera apice breviter 2-dentata. Pollinia 8, cerea.

Stemless, epiphytic. Roots not available. Leaves about 4, glabrous, 56-65 cm. long, 1·7-2·5 cm. in widest part, traversed by 3 conspicuously prominent longitudinal nerves, gradually attenuating at the base into a rather slender channelled petiole about 15 cm. long. Scape incomplete in my specimens, but evidently short, about 15-20 cm. long; vaginae about 3. Flowers 4-5, yellow, distant, racemose, spurred, about 1·4 cm. long (including spur), subpatulous; pedicel slender, about 3 mm. long; ovary rather longer and somewhat slender. Bracts deciduous. Perianth segments subequal in length, about 10-11 mm. long, 3-nerved, subacute, erecto-patent, elliptic-lanceolate. Labellum adnate by its claw to the wings of the column throughout their whole length, forming a short blunt scrotiform spur 3-4 mm. long; 3-lobed; the lateral lobes near the base, very minute, narrowly auriculate; middle lobe flabelliform, margins entire, about 5-6 mm. long, 3·5 mm. wide; lamina with about 7 longitudinal nerves rather conspicuously crowded between the lateral lobes. Column semiterete, erect, adnate to labellum, dilated at apex, about 3 mm. long (including anther), auricles short. Anther shortly 2-dentate at apex. Pollinia 8, waxy.

Papua. Owen Stanley Range, between Adai and Naro Rivers, at elevation of 7,000-8,000 feet. C. E. Lane-Poole, No. 411. Feb., 1923. Epiphyte of the mossy forests.

The section represented by this plant is distributed from the Himalayas through Malay-Papuan territory to the Samoan Islands. It has no representatives in Australia, but two, *C. Langei*, F. v. M., and *C. Balansae*, Finet, have been recorded from New Caledonia. About 8 or 9 species have been reported from New Guinea, almost all of which are inhabitants of the moist forest and all are terrestrial with the exception of *C. chrysantha*, Schltr.

The total number of *Calanthe* species recorded from New Guinea now number 35 or 36.

Spathoglottis Lane-Poolei, Rogers, n. sp. Erecta, valida, 130 cm. alta excedens. Radices filiformes. Pseudobulbi ovoidei, circiter 2·0-2·5 cm. diametro, vaginis omnino absconditis. Folia circa 4, erecto vel erecto-patentia, ad 130 cm. longa; lamina anguste elliptico-lanceolata, acuminata, glabra, valide multinervia, circiter 85 cm. longa, in medio circiter 5·5 cm. lata, in petiolum basi sensim angustata; petiolus gracilis, canaliculatus, ad 45 cm. longus. Scapus teres, glaber, folia multo excedens. Racemus pubescens dense multiflorus. Flores extus velutini, circiter 2·6 cm. diametro. Segmenta perianthii patentia. Sepalum dorsale ellipticum, concavum, obtusiusculum, 11-nervium, 1·5 cm. longum, circiter 7 mm. latum. Sepala lateralia ovato-oblonga, obtusiuscula, 11-nervia, 1·5 cm. longa, 7·75 mm. lata. Petala breve et late pedicellata, ovato-elliptica, sepalis longiora latioraque, 1·7 cm. longa, 8·5 mm. lata, 15-nervia. Labellum basi columnae subsessile, circiter 1·4 cm. longum, 3-lobatum; lobi laterales oblongo-trapezoidales, apicibus paululo dilatati et oblique truncati, erecti columnam amplectantes, circiter 7·8 mm. longi, 2·25 mm. lati, inter apices (explanati) 1·5 cm. lati; lobus intermedius longe unguiculatus, antice late obcordatus, prope apicem circiter 6 mm. latus, basi unguis vel "isthmi" callo magno carnoso glabro bilobato, ultra medium isthmi callo parvo conico pubescenti; discus inter lobos laterales tricarinatus. Columna erecta, elongata, incurva, circiter 1·3 cm. longa, alata, versus apicem dilatata. Anthera ovato-cucullata. Rostellum longe amplum, obtusum, triangulum. Pollinia 8, plano-convexa, cerea. Ovarium cum pedicello gracile, pubescens, circiter 2·7-3·7 cm. longum.

Erect, tall, exceeding 130 cm. high. Roots filiform. Pseudobulbs somewhat ovoid, 2·0-2·5 cm. in diameter, entirely hidden by sheaths. Leaves about 4, erect or erecto-patent, up to 130 cm. long; lamina narrowly elliptic-lanceolate, acuminate, glabrous, multi-nerved, 5-nerves very conspicuous, about 85 cm. long, about 5·5 cm. wide in the middle, gradually passing at the base into the petiole; petiole slender, chanelled, up to 45 cm. long. Scape incomplete in my specimen, much exceeding the leaves. Raceme pubescent, multiflowered. Flowers velutinous on the outside, about 2·6 cm. in diameter, segments spreading. Dorsal sepal elliptical, concave, rather blunt, 11-nerved, 1·5 cm. long, 7·75 cm. wide. Petals shortly and widely pedicellated, ovate-elliptical, obtuse, longer and wider than sepals, 1·7 cm. long, 8·5 mm. wide, 15-nerved. Labellum subsessile at the base of the column, about 1·4 cm. long, 3-lobed; lateral lobes oblong, trapezoidal, erect, clasping the column, about 7-8 mm. long, 2·5 mm. wide, slightly dilated and obliquely truncate at apex, 1·5 cm. wide between the apices (spread out), between the bases 3 longitudinal raised lines; middle lobe on long narrow claw or "isthmus," widely obcordate in front, about 6 mm. wide near apex, a large bilobed fleshy glabrous callus at base of isthmus, a small conical pubescent callus beyond the middle. Column erect, elongated, incurved, about 1·3 cm. long, narrowly winged below, widely winged above. Anther ovate-cucullate. Rostellum large, elongated, blunt. Pollinia 8, waxy, ovate, plano-convex. Ovary with pedicel slender, puberulous, about 2·7-3·7 long.

Papua. Owen Stanley Range; at Embi Lake, 200 feet, between Mount Obree and Kargi. C. E. Lane-Poole, No. 249.

This plant approaches *S. plicata*, Bl., so closely that I have hesitated to separate it. It differs, however, in the absence of hair from the large bilobed callus, in the raised oval non-dentate anterior small callus, and in the much slighter degree of curvature in the column. Dr. Schlechter,[1] who has studied the question on the spot, regards the distribution of hairiness on the labellum as one of the few constant features of this closely related group of species, and one on which we must rely for specific determinations.

Blume's species has been recorded from Dutch New Guinea by J. J. Smith and Kränzlin, but Schlechter evidently doubts its occurrence, and thinks that the determination requires confirmation.

Two species, *S. stenophylla*, Ridl., and *S. papuana*, Bail., as well as a variety of the latter, *puberiflora*, Rogers and White, have been previously reported from Papua.

(1) Schlechter, "Die Orchidaceen Deutsch Neu-Guinea," p. 393.

The colour of the flowers is not mentioned by the collector and cannot be surmised from the two or three flowers which remain on my fruiting specimen.

Geodorum pictum, Lindl.

Papua. Rigo District. Rev. R. Lister Turner (L.M.S.).

This species, which is a native of Australia, does not appear to have been previously reported from Papua, although it has been recorded from Dutch New Guinea by J. J. Smith, and from the Mandated Territory by Schlechter.

Dendrobium (§ Pedilonum) caliculi-mentum, Rogers, n. sp. Herba epiphytica. Caules gracillimi, teretes, penduli, elongati, 90-120 cm. longi, ramosi, vaginis foliorum omnino obtecti. Internodia ad 2·2 cm. longa. Vaginae foliorum tubulosae, truncatae, internodiis longiores. Folia lanceolata, rigida, subpatentia, acutissima, multi-nervia, 1·1-3·7 cm. longa, 2·5-4·0 mm. lata, glabra, versus apicem minute serrata. Racemi brevissimi, terminales vel subterminales, vulgo 4-6-flori. Flores rosei, 1·4-1·5 cm. longi, cornucopiodei. Sepalum dorsale erectum, ovatum, acutissimum, 3-nervium, leviter concavum, circiter 5-6 mm. longum, 2·75 mm. latum. Sepala lateralia oblique obcuneata, parte libera acutissima sepalum dorsale aequante, cum pede elongato columnae decurrentia; marginibus anticis 1·4-1·5 cm. longis, basi connatis, superne contiguus; cum pede gynostemii mentum obtusum curvulum circiter 8 mm. longum formantia. Petala erecta anguste oblonga, sepalo dorsali angustiora, acuta, 3-nervia, circiter 5·5 mm. longa, versus apicem minute serrata. Labellum erectum, gynostemium multo superans; lamina ovali-lanceolata, integra, 8 mm. longa, 3·5 mm. lata, 7-nervia, marginibus lateralibus incurvulis, margine posteriori elevato crassiusculo semilunato, versus apicem minute serrata; unguis canaliculatus, circiter 5 mm. longus, 3 mm. latus, 5-nervius, a basi marginibus lateralibus lateribus pedis columnae adnatis caliculum formantibus. Columna brevissima, circiter 3-4 mm. longa, pedi gracillimi 9-10 mm. longa. Clinandrium profunde excavatum, lobis lateralibus latis obtusis leviter emarginatis, dorsali leviter longiori lineari. Ovarium cum pedicello gracile, mentum excedens, circiter 1·4 cm. longum; pedicello 7 mm. longo.

Epiphytic. Stems very slender, terete, pendent, much elongated, entirely covered by the leaf-sheaths. Internodes 2·2 cm., or less. Leaf-sheaths tubular, truncate, longer than the internodes. Leaves lanceolate, rather rigid, multi-nerved, very acute, 1·1-3·7 cm. long, 2·5-4·0 mm. wide, glabrous, minutely serrated at the apex. Inflorescences very short, terminal or subterminal, usually 4-6-flowered. Flowers rose coloured, cornucopioidal, about 1·4-1·5 cm. long. Dorsal sepal erect, ovate, very acute, 3-nerved, 5-6 mm. long, 2·75 mm. wide, slightly concave, narrowing at the base. Lateral sepals obliquely obcuneate, free part apparently erect, as long as the dorsal sepal, very acute; decurrent with the elongated foot of the column; anterior margins 1·4-1·5 cm. long, connate at the base for about 4 mm., contiguous above, forming a blunt curved spur about 8 mm. long. Petals erect, narrowly oblong, acute, about 5·5 mm. long, much narrower than the dorsal sepal, 3-nerved, minutely serrate near the apex. Labellum erect, lamina oval-lanceolate, 8 mm. long, 3·5 mm. wide, 7-nerved, acute, lateral margins incurved, basal margin elevated into a transverse semilunar lamella, undivided, plain, minutely serrate near the apex; the claw semi-cylindrical, about 5 mm. long, 3 mm. wide, 5-nerved, the lateral margins adnate at the base to the sides of the column-foot for 2 mm. forming a small cup. Column very short, about 3-4 mm. long, the foot very slender and elongated, about 9-10 mm. long. Clinandrium deeply excavated, the lateral appendages broad, blunt and slightly emarginate; the dorsal appendage slightly higher, conspicuously 1-nerved, linear. Ovary with pedicel slender, about 14 mm. long; pedicel above about 7 mm. long.

Papua. Owen Stanley Range; trail between Kakoda and the Gap, at elevation of 6,000 feet. C. E. Lane-Poole, No. 265. August, 1923.

"Epiphytic on trees, stems 3-4 feet long, pendent; flowers ornamental, dark rose at the base, pale rose at tips, reminding one of the Cape Heaths."

This species appears to approach most nearly in its flowers to *D. dichaeoides*, Schltr., and *D. constrictum*, J. J. Sm., but differs from both of these in important details.

Dendrobium (§ Calyptrochilum) Delphinioides, Rogers, n. sp. Herba epiphytica. Caules graciles, teretes, elongati, simplices, costati, vaginis foliorum omnino obtecti, ad 30 cm. longi. Internodia circa 1·5 cm. longa. Folia erecto-patentia, basibus semitortis, ovato-lanceolata vel oblongo-lanceolata, multi-nervia, circa 4·0-6·5 cm. longa, 1·5-2·0 cm. lata, glabra, tenuia, papyracea. Vaginae foliorum tubulosae, truncatae, internodiis longiores, nervis prominentibus, semi-pellucidae. Racemi brevissimi, laterales, pauciflori. Bracteae angustiuscule ovato-lanceolatae, acuminatae, circiter 5 mm. longae. Ovarium cum pedicello gracillimum, calcar excedens. Flores rubri, majusculi, 2·7-3·25 cm. longi, 7 mm. lati illis *Delphinii* similes. Sepalum dorsale ovatum, obtusum, erectum, 5-nervium, 8 mm. longum, 4 mm. latum. Sepala lateralia oblique oblongo-cuneata, cum pede elongato columnae decurrentia, marginibus anticis dimidio inferiore connatis superne contiguis, mentum acutum curvulum anguste conicum 2·0 cm. longum formantia. Petala parva, erecta, oblonga, subacuta, 3-nervia, 7·5 mm. longa, 2·5 mm. lata, sepalo dorsali breviora. Labellum simplex, erectum, obcuneato-cochleare, circiter 1·8 cm. longum, basin columnae non attingens; marginibus lateralibus pede columnae adnatis, calcar invaginatum intra sepala formantibus; margine apicali cucullato-infracto, convexo, pectinato-dentato, circiter 8·5 mm. lato; lamina 7-nervia, prope basin lamella transversa. Columna brevis, carnosiuscula, circiter 4 mm. longa; clinandrii lobis lateralibus integris obtusis late falcatis erectis, lobo dorsali subulato dentiforme incurvulo. Pollinia 4, inaequalia. Ovarium cum pedicello gracillimum, 2·7-3·0 cm. longum.

Epiphytic. Stems slender, elongated, ribbed, to about 30 cm. high, entirely hidden by leaf-sheaths; internodes about 1·5 cm. long. Leaves semitwisted at the base, erecto-patent, ovate-lanceolate to oblong-lanceolate, acute, multi-nerved (7 conspicuous, rest subsidiary), about 4·0-6·5 cm. long, 1·5-2·0 cm. wide near the middle, thin, papery when dry; leaf-sheaths tubular, truncate exceeding the internodes, semitransparent, with prominent nerves. Racemes lateral, few-flowered, very short, bracts rather narrowly ovate-lanceolate, acuminate, about 5 mm. long. Flowers red; ovary and pedicel exceeding the spur; 2·7-3·25 cm. long (*i.e.*, from top of dorsal sepal to apex of spur), about 7 mm. wide, cornucopioidal. Dorsal sepal bluntly ovate, erect, 5-nerved, about 8 mm. long, 4 mm. wide. Lateral sepals oblong-cuneate, decurrent with the elongated foot of the column; anterior margins about 2·1-2·9 cm. long connate in lower half, above contiguous, forming a very long acute conical curved spur; upper border reaching the level of the anther. Petals small, erect, oblong, subacute, 3-nerved, much narrower than the dorsal sepal, about 7·5 mm. long, 2·5 mm. wide. Labellum obcuneate-cochlear, erect, simple, about 1·8 cm. long, lower than the column; lateral margins in their lower half adnate within the sepals to the foot of the column so as to form a secondary or invaginated spur; lamina about 1·0 cm. long, a small transverse lamella at the cuneate base, otherwise plain, 7-nerved; apical margin convex, pectinate-dentate, cucullate, inflexed, about 8·5 mm. wide. Column short and rather fleshy, about 4 mm. long; foot slender, elongated; clinandrium deeply excavated, its lateral lobes entire blunt broadly falcate erect, dorsal lobe subulate dentiform incurved. Pollinia 4, in two unequal pairs.

Papua. Owen Stanley Range, near Laruni, at elevation of 5,000 feet. C. E. Lane-Poole, No. 394. Feb., 1923. "Epiphytes on tree-trunks."

The flowers of this species are very similar to those of *D. cuculliferum*, J. J. Sm., but the stems are simple in the former and branched in the latter.

Dendrobium (§ Calyptrochilum) Lane-Poolei, Rogers, n. sp. Herba epiphytica. Caules graciles, elongati, ramosi, longitudinaliter costati, vaginis foliorum omnino obtecti, 30 cm. longi excedentes. Internodia circiter 1·0-2·0 cm. longa. Vaginae foliorum tubulosae, internodiis paulo longiores, longitudinaliter costatae, truncatae, punctate papilliferae. Folia erecto-patentia, lanceolatâ, acuta, glabra, rigidiuscula, papyracea, multi-nervia, apice minute serrata, circiter 2·5-5·0 cm. longa, 5·5-9·0 mm. lata. Racemi laterales brevissimi, vulgo 5-6-flori; bracteis circiter 7-8 mm. longis, 4 mm. latis, ovatis, acuminatis. Flores lutei, cornucopioidales, 2·1-2·3 longi. Sepalum dorsale, erectum, ovatum, obtusum, 8-9 mm. longum, 5·5 mm. latum, 5-nervium. Sepala lateralia oblique obcuneata, cum pede elongato columnae decurrentia; marginibus anticis 1·6-1·7 cm. longis, basi connatis, superne contiguis; cum pede gynostemii mentum latiusculum obtusum curvulum 1·2 cm. longum formantia; parte libera obtusa antheram superante. Petala erecta vel erecto-patentia, oblongo-ovalia, obtusa, 3-nervia, 7-8 mm. longa, circiter 3 mm. lata. Labellum simplex, obcuneato-calyptratum, erectum, planum, basin columnae paulo superans, 1·3 cm. longum inexpansum; margine apicali calyptrato-infracto, convexo, lacerato-pectinato; marginibus lateralibus inferne longitudinaliter circiter 9 mm. pedi columnae adnatis, calcar conicum invaginatum intra sepala formantibus. Columna brevis, circiter 3·5 mm. longa. Clinandrium profunde excavatum; lobis lateralibus triangulusculis, apice obtuse emarginatus; lobo dorsali multo longiore, subulato, incurvo. Anthera reniformis, dorso compressa. Pollinia 4, inaequalia. Ovarium cum pedicello circiter 2·1 longum, calcar multo excedens.

Epiphytic. Stems elongated, branched, longitudinally ribbed, slender, entirely hidden by the leaf-sheaths, exceeding 30 cm. long. Internodes about 1·0-2·0 cm. long. Leaf-sheaths tubular, slightly longer than the internodes, punctately papillose, longitudinally ribbed, truncate. Leaves erecto-patent, lanceolate, acute, glabrous, rather rigid, papery, multi-nerved, minutely serrate towards the tip, about 2·5-5·0 cm. long, 5·5-9·0 mm. wide. Racemes very short, lateral, about 5-6-flowered; bracts about 7-8 mm. long, 4 mm. wide, ovate, acuminate. Flowers orange-yellow, about 2·1 cm. long, cornucopioidal. Dorsal sepal erect, ovate, quite blunt, about 8-9 mm. long, 5·5 mm. wide, 5-nerved. Lateral sepals obliquely obcuneate, decurrent with the elongated foot of the column; anterior margins 1·6-1·7 cm. long, connate only at the extreme base, contiguous above, forming a rather blunt broad curved mentum, about 1·25 cm. long; free part very blunt, exceeding the anther. Petals erect or erecto-patent, oblong-oval or oval, quite blunt, 3-nerved, about 7-8 mm. long, 3 mm. wide. Labellum plain obcuneate-calyptrate, erect, the top of the hood slightly exceeding the base of the column, about 1·3 cm. long unexpanded, the apical margin lacero-denticulate, the lateral margins adnate below for 9 mm. to the foot of the column forming a "secondary" or invaginated spur. Column short, about 3·5 mm. long. Clinandrium deeply excavated, lateral lobes somewhat triangular with bluntly emarginate apex; dorsal lobe much longer, subulate, incurved, attached at its apex to the dorsum of the anther. Anther somewhat reniform, flattened on the top and slightly depressed in middle. Pollinia 4, in 2 unequal pairs. Ovary together with pedicel slender, about 2·1 cm. long, greatly exceeding the mentum.

Papua. Owen Stanley Range, between Adai and Naro, at elevation of 6,000-7,000 feet. C. E. Lane-Poole, No. 406. Feb., 1923.

"Epiphytic on moss-covered tree-trunks. Flowers orange-yellow, pendent. A common conspicuous orchid of the lower elevations of the mossy forests."

The flowers come very close to those of *D. infractum,* J. J. Sm., but they differ in colour and are smaller in size. Likewise in the latter species the stems are simple, but branched in the new species.

Dendrobium (§ Oxyglossum) bilamellatum, Rogers, n. sp. Herba epiphytica. Caules in speciminibus meis incompleti, circiter 15 cm. ?, graciles, elongati, vaginis foliorum fere obtecti. Internodia 2-3 cm. longa. Vaginae foliorum tubulosae, truncatae, longitudinaliter striatae, internodiis paulo breviores. Folia erecto-patentia, elliptico-lanceolata, multi-nervia, subrigida, crassiuscula, circiter 2·5-7 cm. longa, 1-1·5 cm. lata. Racemi brevissimi, laterales, pauciflori (semper ?). Bracteae ovato-lanceolatae, acuminatae, circiter 5-7 mm. longae. Flores in sectione inter majores, circiter 2·8 cm. longi. Sepalum dorsale ovatum, erectum, subacutum, 5-nervium, 1·0 cm. longum, 4·5 mm. latum. Sepala lateralia oblique triangularia, cum pede elongato columnae decurrentia; marginibus anticis 2·6 cm. longis, in parte libera profunde bilamellatis, basi connatis, superne contiguis, cum dimidio inferiore labelli adnatis; cum pede columnae mentum angustiusculum, conicum, acutum, curvulum, circiter 1·6 cm. longum, apice bifidum formantia. Petala erecta, elliptico-lanceolata, acutiuscula, 3-nervia, apice minute serrulata, circiter 9 mm. longa, 3·5 mm. lata. Labellum erectum, basi ligulatum, sursum sensim dilatatum, deinde ad apicem acutum recurvum abrupte contractum, 2·35 cm. longum; marginibus lateralibus dimidio inferiore cum pede columnae et sepalis lateralibus adnatis; lamina obcuneata, margine apicali minute serrulata, obscure 3-lobata, 7-nervia, superne 4·75 mm. lata. Columna brevis. Clinandrium profunde excavatum; lobis lateralibus latis semiquadratis minute denticulatis, lobo dorsali multo longiore subulato incurvo. Anthera ovato-quadrata, margine antica minute serrata. Ovarium cum pedicello gracile, circiter 2·4 cm. longum, late 3-alatum. Pollinia 4, inaequalia.

Stems incomplete in my specimens, probably about 15 cm. long, thin, elongated, almost entirely covered by the leaf-sheaths. Internodes 2-3 cm. long. Leaf-sheaths slightly shorter than the internodes, tubular, truncate, longitudinally striated. Leaves erecto-patent, elliptic-lanceolate, multi-nerved, rather rigid, moderately thick, about 2·5-7·0 cm. long, 1·0-1·4 cm. wide. Racemes very short, lateral, few-flowered (apparently 3). Bracts ovate-lanceolate, acuminate, about 5-7 mm. long. Flowers fairly large for the section, about 2·8 cm. long (including spur), dark mauve with orange tip to labellum. Dorsal sepal ovate, erect, subacute, 5-nerved, about 1·0 cm. long, 4·5 mm. wide. Lateral sepals obliquely triangular; decurrent with the elongated foot of the column; the anterior margins 2·6 cm. long, deeply bilamellate in their free part, connate near the base for a distance of about 5 mm., and adnate to the labellum for 11 mm., forming a rather narrow conical curved acute spur about 1·6 cm. long with a slightly bifid apex. Petals erect, elliptical-lanceolate, rather acute, 3-nerved, minutely serrulate at the apex, 9 mm. long, 3·5 mm. wide. Labellum erect, ligulate at the base, gradually dilating towards the apex, 2·35 cm. long, spread out, 4·75 mm. wide; lamina obcuneate, apex minutely serrate, obscurely 3-lobed, suddenly contracting to a short acute recurved point, 7-nerved; lateral margins adnate in their lower part to the foot of the column and also to the lateral sepals for a distance of 1·1 cm. Column short. Clinandrium deeply excavated; lateral lobes broad, somewhat rounded, minutely denticulate; dorsal lobe much longer, incurved. Anther ovate-quadrate, margin minutely serrate. Ovary with its slender pedicel 3-winged, 2·4 cm. long.

Papua. Owen Stanley Range, between Adai and Naro, at elevation of 7,800 feet. C. E. Lane-Poole, No. 408. Feb., 1923.

"Epiphytes on tree trunks in mossy forests. Flowers dark mauve. Labellum mauve with orange tip."

In the dried plant, the "lamella" appears to lie in the same plane and in close apposition with the surface of the lateral sepal, so as to form a double fold. Whether it occupies the same position in the living plant, or one perhaps at right angles to the surface of the sepal, it is impossible to decide. It is noteworthy, however, that J. J. Smith in the description of his species *D. discrepans* (a member of the same section), refers to the lateral sepal as "*carinate*."

Dipodium elatum, J. J. Sm.

Papua. Rigo district; Rev. R. Lister Turner (L.M.S.). I believe this to be J. J. Smith's species, although it is apparently a much more slender plant than that examined by him. The scape in my specimen is 70 cm. high and the basal sheaths comparatively few in number (about 6 or 7). It is evidently a very near relation to the Australian representative of the genus, *D. punctatum,* R. Br.

It has only been reported previously from the Dutch portion of New Guinea.

Phalaenopsis amabilis, Bl., var. **papuana,** Schlchtr., in Orch. Deutsch-Neu-Guinea, p. 968 (1914).

Mandated Territory of New Guinea. Kundam. C. E. Lane-Poole, 26/8/24, No. 807. "Epiphyte on Pometia. Flowers white, 3½ inches in diameter."

"P. amabilis" has been recorded from Papua by F. M. Bailey and from Dutch New Guinea by J. J. Smith. These may possibly be identical with Schlechter's variety, which only appears to differ from the type form, in that the large bilobed callus near the base of the labellum is wider and not so high in the variety and the gland of the pollinarium is larger and cordate-incised.

CRYSTAL FORMS OF TOURMALINE, AZURITE, AND LINARITE.

By Iris E. Robertson.
(Communicated by C. T. Madigan.)

[Read October 8, 1925.]

The purpose of this contribution is to place on record the forms assumed by certain well-crystallised minerals of local occurrence.

The nomenclature of faces is that employed in Dana's "System of Mineralogy." The angular measurements were obtained by means of Goldschmidt's two-circle goniometer, which admits of determinations to within an accuracy of 30″.

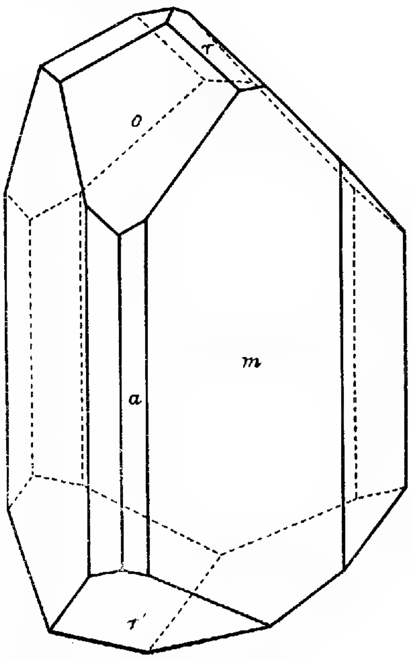


Fig. 1.

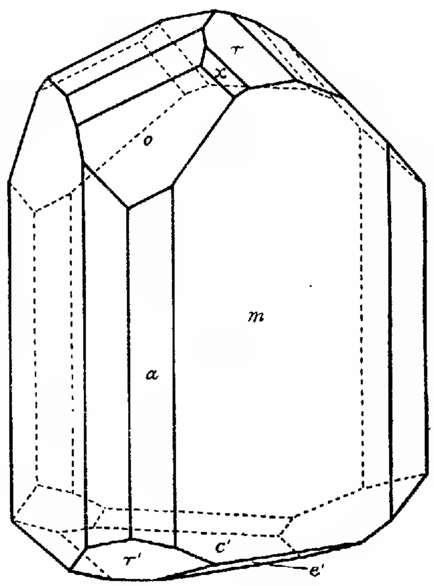


Fig. 2.

Tourmaline from Tourmaline Hill.

Well-developed crystals of tourmaline occur abundantly weathered out of a pegmatite intrusion at Tourmaline Hill, which is situated intermediate between Umberatana and Yudanamutana, in the North Flinders Range, in this State. The crystals which are now in the University Museum were collected by Professor Sir Douglas Mawson, who reports that the pegmatite principally consists of soda felspar and quartz. It intrudes pebble-bearing beds which appear to be the equivalent of the tillite of the Adelaide Series. The tourmaline crystals are generally large, frequently attaining a length of several inches, and a number exhibit end faces. Though not remarkable in form, the type appears to be specific for the locality, certain constant features of crystalline habit recurring with very little variation in the crystals examined. All specimens examined were of a deep black colour in hand specimens, but a few fragmentary crystals of a beryl-green colour were also reported from the pegmatite. Tourmaline belongs to the trigonal (rhombohedral) system. The axis *c*, calculated from the average angular measurement $0001 \wedge 01\bar{1}1$ of four crystals from Tourmaline Hill is 0·44763.

Observed forms are:—

a $(11\bar{2}0)$	*h* $(41\bar{5}0)$	*o* $(02\bar{2}1)$
m $(10\bar{1}0)$ (pos. & neg.)	*l* $(52\bar{7}0)$	*e* $(01\bar{1}2)$
c (0001)	*r* $(10\bar{1}1)$	*x* $(12\bar{3}2)$

Angular measurements, ascertained from average readings of 4 crystals, are as follows:—

c m	=	90° 0′	*c e*	=	14° 29′
m m	=	60° 0′	*c x*	=	34° 23½′
m a	=	30° 0′	*a h*	=	10° 48′
c r	=	27° 20½′	*h l*	=	5° 47′
c o	=	45° 41′	*m l*	=	13° 25′

The crystals are of prismatic habit, elongated in the direction of the *c* axis. The faces in the prism zone are frequently striated parallel to their intersections,

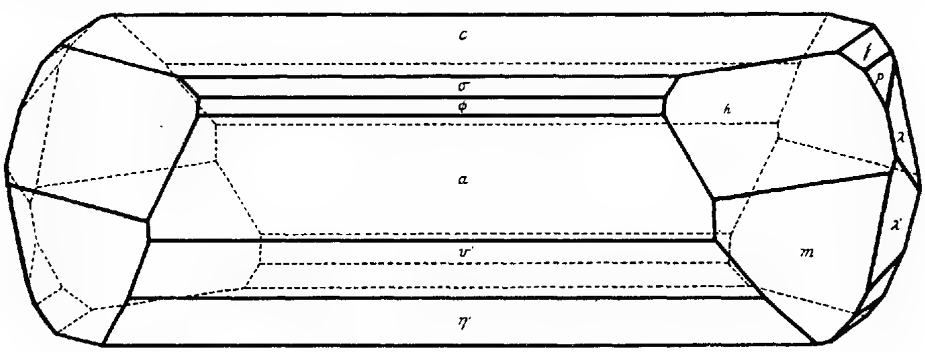


Fig. 3.

particularly *a*, *h*, and *l*. In such cases imperfect reflections were obtained and accurate measurement was difficult. The forms most prominently developed include *m* (negative and positive forms sometimes combined to produce a hexagonal cross section), *r* (positive and negative forms sometimes combined to produce a hexagonal hemipyramid), *a*, *o*, *e*, and *c*; *x* is not so common and *h* and *l* are not infrequently absent. The two most common combinations are *m*, *a*, *r*, *o* (fig. 1), and *m*, *a*, *r*, *o*, *x*, *c*, *e* (fig. 2).

Azurite from the Broken Hill Lode.

The South Australian Museum possesses an unusually fine collection of minerals from Broken Hill, N.S.W. Amongst these azurite is represented in many magnificent crystals and clusters, in which perfectly formed individuals range up to several inches in length. These are in the form of oblique prisms much elongated on the *b* axis. Azurite crystallises in the monoclinic system. $\beta = 87°\ 35\frac{1}{2}'$ (average measurement of six of these Broken Hill crystals). $a : b : c = 0{\cdot}8516 : 1 : 0{\cdot}8837$ (calculated).

Observed forms are:—

a (100)	m (110)	p (021)
c (001)	s (111)	f (011)
σ (101)	w (120)	l (023)
ϕ (201)	h (221)	k ($\bar{2}21$)
μ ($\bar{1}05$)	δ (243)	n ($\bar{2}23$)
θ ($\bar{1}01$)	Q (223)	o ($\bar{2}41$)
η ($\bar{3}02$)	γ (121)	λ ($\bar{2}\cdot18\cdot3$)
v ($\bar{2}01$)		

Angular measurements, ascertained from average readings of six crystals, are as follows:—

$a\ \phi = 25^\circ\ 16\tfrac{1}{2}'$	$b\ s = 58^\circ\ 49\tfrac{1}{2}'$
$\phi\ \sigma = 17^\circ\ 19'$	$b\ l = 59^\circ\ 24'$
$\sigma\ c = 44^\circ\ 57'$	$b\ k = 51^\circ\ 57'$
$c\ \mu = 11^\circ\ 44\tfrac{1}{2}'$	$b\ p = 29^\circ\ 32'$
$\mu\ \theta = 35^\circ\ 25'$	$b\ o = 32^\circ\ 36'$
$\theta\ \eta = 11^\circ\ 42'$	$b\ h = 52^\circ\ 48'$
$\eta\ v = 7^\circ\ 11'$	$b\ Q = 64^\circ\ 31'$
$v\ a = 26^\circ\ 22'$	$b\ n = 63^\circ\ 39'$ (2 readings only obtained)
$b\ m = 49^\circ\ 37'$	$b\ \gamma = 39^\circ\ 40'$ (2 readings only obtained)
$b\ w = 30^\circ\ 29'$	$b\ \delta = 42^\circ\ 13'$ (1 reading only obtained)
$b\ f = 48^\circ\ 32'$	$b\ \lambda = 12^\circ\ 37'$ (1 reading only obtained)

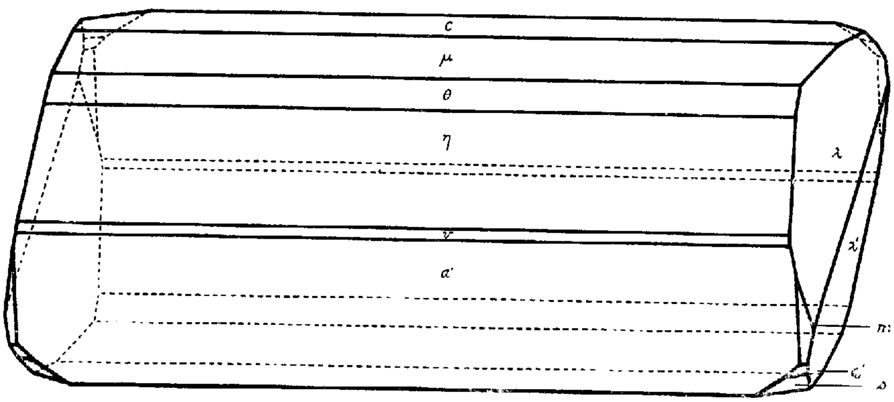


Fig. 4.

The forms a, c, μ, θ, η, λ, p, f, l, m, h are generally well developed. A very common habit occurs in which the elongated prism is terminated by the flat hemipyramidal form λ. Common combinations include forms a, σ, ϕ, c, v, η, h, m, p, f, λ (fig. 3), and a, c, μ, θ, η, v, m, s, Q λ (fig. 4). Most of these yielded brilliant reflections except those in the a, c zone, where images were frequently blurred or multiple, *e.g.*, those of μ, ϕ, and σ, μ is almost invariably striated parallel to the b axis. Etching is of frequent occurrence on the faces c, h, m, λ. Many faces appear rarely, *e.g.*, g, δ, γ, μ, Q, or are poorly developed, *e.g.*, σ, ϕ, w, g, s, k, o.

Linarite from the Broken Hill Lode.

Linarite occurs not infrequently in the Broken Hill lode, though it is seldom recorded, for it is usually mistaken for azurite by the miners. It is, however, of a lighter shade of blue than azurite and is usually restricted to crystals of very small size. The specimens examined are of the collection of the South Australian Museum, which, like the azurites, were made available by the Museum Board through the Honorary Curator, Sir Douglas Mawson.

The associated minerals in the specimens examined were cerussite and azurite. The crystals for the most part are twinned forms exhibiting re-entrant angles. They are prismatic in habit, rarely exceeding a few millimetres in length.

Linarite crystallises in the monoclinic system:—$\beta = 77° \ 19'$ (average of four crystals measured). $a : b : c = 1 \cdot 7216 : 1 : 0 \cdot 8297$ (calculated).

Observed forms are:—

a (100)	*e* ($\bar{1}$11)
b (010)	*u* ($\bar{1}$01)
c (001)	*s* ($\bar{2}$01)
m (110)	

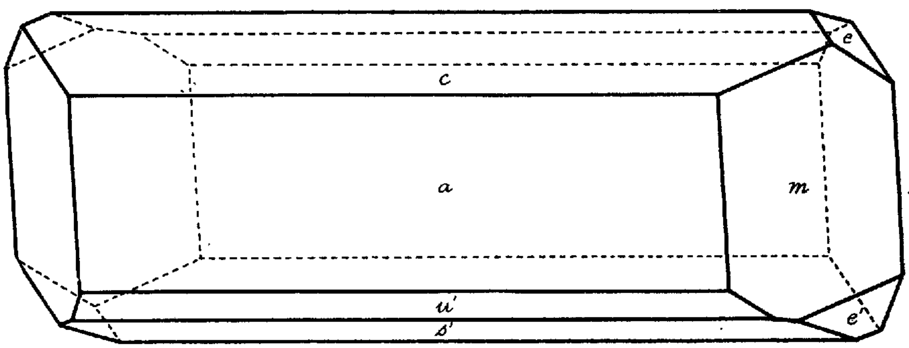


Fig. 5.

Angular measurements, ascertained from average readings of four crystals, are as follows:—

a c	=	77° 19′	*u a*	=	52° 34′
b c	=	90° 0′	*m a*	=	30° 31½′
c s	=	27° 50′	*e e′*	=	77° 22′
s u	=	22° 17½′			

The common habit appears to be a combination of the forms *a, u, s, c, m* with *e* occasionally, and *b* rarely present (fig. 5). The prismatic habit is due to elongation on the *b* axis. Untwinned specimens occur rarely. The twin axis is the *b* axis, with both twin and composition planes parallel to the *a* face.

Geological Laboratory,
University, Adelaide.

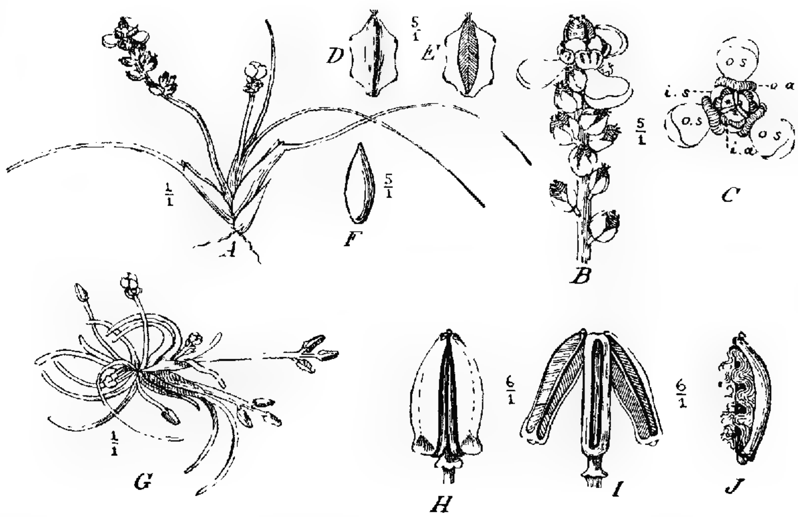
ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA.
No. 23.

By J. M. Black.

[Read October 8, 1925.]

Scheuchzeriaceae.

Triglochin hexagona, n. sp. Herba annua, scapis 2-5 cm. longis plerumque quam folia filiformia brevioribus, floribus brevissime pedicellatis racemosis circiter 20, flore terminali solo bisexuali ceteris femineis, perianthii segmentis floris terminalis obovatis exterioribus majoribus albis patentibus, eis florum femineorum acutis inaequalibus, fructûs ambitu ovoideo fere 2 mm. longo, carpidiis 3 fertilibus subhexagonis lateraliter bialatis 1 mm. latis dorso subplanis apice et basi repente angustatis.



Triglochin hexagona, A—E. A, plant, natural size; B, flowering part of scape; C, terminal bisexual flower viewed from above; *o.s*, outer perianth-segments; *i.s*, inner perianth-segments; *o.a*, outer anthers; *i.a*, inner anthers; D, back of fruitlet; E, inner face of fruitlet; F, fruitlet of *T. Muelleri*. *T. trichophora*, G—J. G, plant, natural size, viewed from above; H, fruit; I, fruit showing 2 fruitlets hanging from the summit of the carpophore; the groove in the carpophore indicates the line of attachment of the third fruitlet, which has fallen; J, fruitlet viewed from the side, showing the inner face of the pericarp disintegrating into hair-like fibres.

Near Lake Bonney, River Murray. Coll. H. W. Andrew. Seems nearest to *T. turrifera*, (Luehm.) Ewart, but the latter has much longer and narrower fruitlets very shortly spurred at base. The present species cannot be described as spurred, although it is possible that the 2 lower angles of the rather square fruitlet represent incipient or obsolescent spurs. The fruitlet of *S. hexagona* is more than half as broad as it is long, this result being due to the 2 stiff flat wings which spread outward on either side of the fusiform pericarp.

It is worthy of note, that in the 3 species of *Triglochin* here dealt with, the terminal flower of the raceme is alone bisexual; all the lower ones, whether few or numerous, are female. The 3 outer anthers of the bisexual flower are much larger than the 3 inner ones and are sheltered in bud by the 3 outer and larger obovate white membraneous perianth-segments. These large and very broad outer anthers burst open much earlier than the inner, and shower a mass of pollen on to the few or many female flowers below. Their extrorse dehiscence enables them to do this most effectively. The question naturally arises whether all the Australian annual *Triglochins* have this strongly polygamous arrangement of the flowers. This seems probable, but the question can only be decided by careful examination of the young living plant. Buchenau, who has revised the genus more than once, says "flowers hermaphrodite"; Bentham is nearer to reality when he says "flowers hermaphrodite or rarely polygamous." No doubt many *Triglochins,* like our large perennial *T. procera,* have all the flowers bisexual. As regards the 3 annual species here mentioned I had the good fortune to grow 2 of them in my garden at North Adelaide, and the third was cultivated by Professor Osborn at the University.

T. Muelleri, Buchenau. This is a rather large species, the scapes mostly 4-8 cm. long, and the leaves are usually longer; the fruits are very shortly pedicellate, ovoid or elliptical, $1\frac{1}{2}$ mm. long, the fruitlets almost fusiform, without any basal spurs (fig. F). Lake Bonney, River Murray. First record for South Australia; only known previously from the Vasse River and Busselton, Western Australia.

T. trichophora, Nees. This is a much-debated species. Buchenau, in Engler's Pflanzenreich, iv., 14:12 (1903), makes it a synonym of *T. nana,* F. v. M., while Ostenfeld, Contrib. W. Austr. Bot., part 2:36 (1918), reduces *T. nana* to a variety of *T. centrocarpa,* Hook., and, after examining Preiss's specimen No. 2411, from which Nees described *T. trichophora,* he considers it should be retained as a species. Our specimen was grown by Professor Osborn from seed which he brought back from the Pearson Islands, off the west coast of Eyre Peninsula, in 1923. It is illustrated by the fig. G—J on the plate. The scapes have no more than 3 flowers each and one of them only ripened 1 terminal fruit. In this paucity of flowers it agrees exactly with the original description, but Ostenfeld collected at Busselton specimens with up to 17 fruits on the scape. The type came from Rottnest Island, and hitherto the species has only been recorded from Western Australia. Our fruits are ovoid-oblong, nearly $2\frac{1}{2}$ mm. long, on short pedicels, the fruitlets oblong, tapering upwards, dilated obtusely at base, but they can scarcely be called "spurred." The outer layer of the pericarp on the back of each fruitlet is somewhat spongy when fresh; on the inner face of each fruitlet is a membraneous outer layer. This layer splits readily into 2 wings along the angle which runs down the middle of the inner face. When the fruitlet is moistened, these appressed wings become free from the inner face, but remain attached to the sides of the fruitlet; they quickly assume an undulate shape along the margin as the fibres of which they are constructed expand, and finally they disintegrate into the hair-like fibres. It was owing to this evolution that Nees gave the plant its specific name (fig. I—J). These hair-like developments are not, however, confined to *T. trichophora,* although they may be peculiarly prominent in that species, as they occur more or less in the fruits of some other small annual species of this genus. Another peculiarity of the single specimen available for examination was that while the terminal bisexual flower had 6 perianth-segments and 6 stamens, the 2 lower female flowers had only 3 very loose unequal segments each. This reduced number may have been abnormal.

GRAMINEAE.

**Sphenopus divaricatus,* (Gouan) Reichb. This little Mediterranean grass has been found well established near Port Adelaide; coll. H. W. Andrew. Apparently the first record for Australia.

CHENOPODIACEAE.

Chenopodium desertorum, n. sp. Suffrutex dense farinosus 15-30 cm. altus, foliis crassis ovatis vel rhomboideis 5-15 mm. longis petiolatis supra saepius concavis, floribus in spicas saepius interruptas vel subramosas 1-3 cm. longas folia paulo superantes dispositis, staminibus 5, semine depresso horizontali nigro margine obtuso.—*Ch. microphyllum*, F. v. M., var. *desertorum*, J. M. Black (1922).

Murray lands; Port Augusta westward to Ooldea.—Victoria Desert, Western Australia. Almost papillose from the prominent mealy scales.

**Ch. anthelminticum*, L. Near the Semaphore. First record for South Australia.—A native of America, now introduced in many other parts of the world.

AMARANTHACEAE.

**Amarantus albus*, L. This weed, a native of North America, now naturalised in the Mediterranean region, has established itself at Beaumont, Fulham, and on the North Park lands.

PORTULACACEAE.

Calandrinia volubilis, Benth., var. *parvula*, n. var. Variat foliis obovoideis vel fere globosis 3-6 mm. longis, pedicellis 3-5 mm. longis, staminibus saepius 6, seminibus circiter 15. Plantula tantum 8-25 mm. alta.—Port Lincoln district (without exact locality). Has the seeds and reflexed pedicels of the type, but differs in its dwarfed proportions and very short pedicels.

CARYOPHYLLACEAE.

**Tunica prolifera*, (L.) Scop. (*Dianthus prolifer*, L.), Kingscote and Rocky River, K.I.; coll. J. B. Cleland. This European weed has been known for many years in Victoria and New South Wales, but has not previously been recorded for South Australia.

RANUNCULACEAE.

Ranunculus pentandrus, n. sp. Herba annua nana glabra, foliis longe petiolatis praecipue radicalibus, 5-8 mm. longis, infimis ovatis integris cito marcescentibus, ceteris ambitu rotundato-cordatis palmatipartitis, lobis 3 obovatis saepius trifidis vel incisis, floribus minutis, sepalis 3-5 ovatis albis membranaceis 1½-2 mm. longis, petalis 1-2 albis calyce brevioribus et angustioribus supra unguem nectariferis, staminibus 5, achaeniis 6-12, ovatis laevibus 2-3 mm. longis breviter recurvo-rostratis, receptaculo ovoideo glabro.

Flooded land on Minnie Downs, near Warburton River. A curious and distinct desert species. Coll. L. Reese. Nearest to *R. parviflorus*, L.

CRUCIFERAE.

Blennodia pterosperma, n. sp. Herba annua stellato-pubescens, foliis praecipue radicalibus parce lobulatis vel dentatis superioribus saepe integris et lineari-lanceolatis, sepalis 5-7 mm. longis, petalis 10-15 mm. longis albis vel roseis longe unguiculatis, pedicellis fructiferis 5-8 mm. longis denum reflexis; siliquis compresso-linearibus 3-6 cm. longis 2-2½ mm. latis pubescentibus, stigmate fere sessili, valvis uninervibus, seminibus numerosis alâ angustâ membranaceâ cinctis fere uniserialibus haud mucosis.—*B. canescens*, R. Br., var. *pterosperma*, J. M. Black (1917).

Northern part of Flinders Range to Lake Blanche.—North-western New South Wales.

A stouter plant than *B. canescens*, with a less prominent style and flat winged seeds.

**Myagrum perfoliatum,* L. Cultivated land, Wudinna, E.P. First record for South Australia.—Mediterranean region.

LEGUMINOSAE.

**Trifolium stellatum,* L. Penola. First record.—Mediterranean region.

RUTACEAE

Correa calycina, n. sp. Frutex, ramis laxe tomentosis, foliis oblongis vel ovato-oblongis crassiusculis obtusis 2-3 cm. longis supra glabrescentibus infra stellato-pilosis, pedunculis brevissimis, calyce fere campanulato circiter 12 mm. longo extus sparsim stellato-piloso intus stellato-tomentoso, lobis latis acuminatis tubum subaequantibus, petalis subviridibus primum cohaerentibus 20-25 mm. longis, staminibus exsertis, quatuor filamentis alternis basin versus valde dilatatis, ovario sericeo.

Waterfall in Hindmarsh Valley. Collected by Professor J. B. Cleland. Differs from *C. reflexa,* Labill., in the narrower leaves greenish and not white beneath and the calyx twice as long, with 4 broad lobes or teeth.

Pomaderris halmaturina, n. sp. Frutex 2-3 m. altus; foliis ovato-lanceolatis denticulatis 3-7 cm. longis supra minute scabro-pilosis infra stellato-tomentosis prominenter nervatis, floribus in racemos axillares breviores aut longiores quam folium dispositis, receptaculo 1 mm. longo, sepalis 2-2½ mm. longis, styli ramis fere liberis clavatis, stigmatibus subcapitatis, coccis valvulâ eis dimidio breviore dehiscentibus.

Cygnet River and Hog Bay River, K.I. Differs from *P. apetala,* Labill., in the leaves being hairy above, the flowers racemose, not paniculate, and the style-branches almost free.

Spyridium halmaturinum, F. v. M., var. *integrifolium,* n. var. Variat foliis integris, oblongo-linearibus 1½-2 mm. latis obtusis vel apice rotundatis margine recurvis, tomento paginae superioris densiore, foliis floralibus ovato-oblongis integris.—Kangaroo Island.

Spyridium bifidum, F. v. M., var. *integrifolium,* n. var. Variat foliis omnibus integris 5-10 mm. longis circiter 1 mm. latis linearibus obtusis, foliis floralibus oblongis obtusis 2-3 mm. latis.—Port Lincoln to Marble Range, E.P.

Spyridium subochreatum, F. v. M., var. *laxiusculum,* n. var. Variat foliis minoribus supra glabrescentibus, stipulis minus conspicuis citiusque deciduis, floribus in capitula composita laxiora nonnunquam majora dispositis.—Keith; Wirrega. A variety showing a tendency towards *Trymalium* in the inflorescence.

TILIACEAE.

Hymenocapsa, n. gen. (Ex verbis, graecis *hymên,* membrana et *kapsa,* capsula). Calyx campanulatus 5-lobus, lobis tubum aequantibus; petala 5; stamina 5 hypogyna petalis opposita; antherae lineares basifixae, thecis acuminatis in longitudinem dehiscentibus; ovarium 5-loculare, ovulis pluribus amphitropis horizontalibus biserialibus in quoque loculo; fructus capsularis, valvis 5 crustaceis vel membranaceis loculicide dehiscens, loculis pleiospermis; semina albuminosa subreniformia, testâ coriaceâ, embryone curvato, cotyledonibus plano-convexis conjunctim teretibus diametro radiculam aequantibus.

Differs from *Corchorus,* L., in the sepals united for half their length, the stamens equalling the petals and sepals in number, the linear anthers with pointed cells and the embryo with narrow not leafy cotyledons. It appears to be an anomalous genus occupying a position between the tribes *Brownlowieae* and *Tilieae.*

Hymenocapsa longipes, (Tate) n. comb. Herbula glanduloso-pilosa perennis, caulibus prostratis rigidulis, foliis alternis oblonga-lanceolatis breviter petiolatis grosse serratis 10-15 mm. longis subglabris vel infra parce stellato-puberulis deltoideis, pedunculis axillaribus 1-2-floris 8-15 mm. longis, pedicello 2-5 mm. longo bracteâ emarginatâ vel bifidâ suffulto, petalis oblanceolatis 5 mm. longis, stylo brevi apice minute 5-lobo, capsulâ ovoideo-oblongâ 6 mm. longâ stellato-puberulâ, seminibus 10-14 in quaque valvâ.—*Corchorus longipes,* Tate.

Near Farina (Flinders Range).

MALVACEAE.

Plagianthus incanus, n. sp. Fruticulus rigidus stellato-incanus, foliis sessilibus ambitu obovato-truncatis apice obtuse trilobis basin versus breviter cuneatis supra concavis circiter 3 mm. longis et $4\frac{1}{2}$ mm. latis, floribus dioicis sessilibus saepius ternis in axillis trium foliorum glomeratorum, glomerulis alternis approximatisque, calyce masculo 3 mm. longo 5-lobo, floribus femineis non visis.

Gawler Ranges, E.P. Near *P. microphyllus,* F. v. M., differing in the stellate not scaly clothing, the leaves broader than long and the floral leaves in clusters of 3.

Abutilon malvifolium, (Benth.) n. comb. Suffrutex humilis tomentosus pilis longis simplicibus inter stellatos vestitus, foliis cordatis orbicularibus vel ovatis crenatis 1-4 cm. longis obtusissimis glabrescentibus saepius leviter 3-5-lobis, floribus flavis solitariis, pedunculis petiolos subaequantibus, calyce circiter 6 mm. longo, lobis tubo longioribus, carpellis maturis aristatis ut in *A. oxycarpo* sed non nisi paulo calycem superantibus, seminibus glabris aut puberulis.—*A. oxycarpum,* F. v. M., var. (?) *malvaefolium,* Benth.

North of Cooper's Creek.—Western New South Wales.

Hibiscus intraterraneus, n. sp. Frutex stellato-tomentosus scabriusculus, foliis profunde 3-5-partitis, 2-5 cm. longis, lobis oblongo-cuneatis dentatis vel obtuse lobulatis medio plerumque longiore quam laterales, supremis interdum indivisis lineari-oblongis, pedunculis solitariis crassis petiolo longioribus, alabastris aureo-pubescentibus laevibus acutis, calyce 12-15 mm. longo, lobis lanceolatis tubum subaequantibus nervis sub denso tomento occultis, bracteolis 7-10 linearibus, petalis 4-5 cm. longis lilacinis vel purpureis ad marginem exteriorem unidentatis, styli rami liberis, stigmatibus capitatis saepius penicillatis, capsulâ calycem subaequante acuminatâ, seminibus multis lanatis.

Everard Range.—Central and Western Australia. Differs from *H. Pinonianus,* Gaudich., in the smooth acute (not acuminate) bud, the leaves not reticulate below, the leaf-lobes longer and narrower and the style-branches free.

DILLENIACEAE.

Hibbertia stricta, R. Br., var. *oblonga,* n. var. Variat foliis satis confertis lineari-oblongis 4-8 mm. longis $1\frac{1}{2}$-$2\frac{1}{2}$ mm. latis pilis brevibus simplicibus vel bisectis supra scaberrimis infra stellato-pilosis, nervo medio latissimo, pedunculis circiter 5 mm. longis, carpellis 4-ovulatis.—Ravine Creek, K.I.

H. sericea, (R. Br.) Benth., var. *major,* n. var. Variat omnibus partibus majoribus, foliis lineari-oblongis 15-20 mm. longis, sepalis valde sericeis 10-15 mm. longis, staminibus 10-20; carpellis 6-8-ovulatis.—Kangaroo Island; near Port Lincoln.

Hibbertia sericea, (R. Br.) Benth., var. *scabrifolia,* n. var. Variat foliis pilis longiusculis simplicibus rigidis supra scabris magis cuneatis basin versus quam in typo, margine saepe tantum revolutis ut folia linearia videantur, floribus arcte sessilibus, sepalis exterioribus villosis sed vix sericeis 6-9 mm. longis, staminibus 8-14, carpellis 4-6 ovulatis.—Encounter Bay; Kangaroo Island; Murray scrub and 90-Mile Desert, near Millicent and Lake Bonney, S.E.; Streaky Bay.

Hibbertia paeninsularis, n. sp. Fruticulus nanus, ramis villosis, foliis confertis subteretibus 5-8 mm. longis vix 1 mm. latis pilis longis albis simplicibus patentibus villosis, marginibus revolutis paginam inferiorem occulentibus; floribus sessilibus intra folia floralia, sepalis acuminatis dorso villosis, petalis parum emarginatis vix sepala superantibus, staminibus 4-7 unilateralibus, carpellis 2 tomentosis 3-5-ovulatis.

Coomunga, E.P. Differs from *H. sericea,* (R. Br.) Benth., in the much narrower leaves, the petals shorter and very slightly notched, and the stamens much reduced in number.

THYMELAEACEAE.

Pimelea macrostegia, (Benth.) n. comb. Frutex glaber absque inflorescentiâ, foliis oppositis oblongo-lanceolatis 2-3 cm. longis planis vel margine subrecurvatis petiolo circiter 2 mm. longo, bracteis involucrantibus 4 ovatis glabris tenuibus 2-2½ cm. longis capitula cernua aequantibus, receptaculo pilis caducis extus sericeo intus puberulo, basi persistente glabrescente, sepalis glabris, antheris exsertis, connectivo lato, basi florali pubescente, nuce ovoideâ, testâ nigrâ punctulatâ.—*P. ligustrina,* Labill., var. ? *macrostegia,* Benth.

Kangaroo Island. Differs from *P. ligustrina,* Labill., by the bracts glabrous inside; from this species and from *P. spathulata,* Labill., by the much larger bracts and the broad connective of the anthers.

MYRTACEAE.

Melaleuca decussata, R. Br., var. *ovoidea,* n. var. Receptaculo ad basin rotundato non plano 1½-3 mm. longo, sepalis brevibus deltoideo-obtusis herbaceis absque margine scarioso, foliis oblanceolatis vel paene obovatis 3-8 mm. longis 2-3½ mm. latis.—Kangaroo Island; Encounter Bay; Goolwa; southern Yorke Peninsula; South-East.

HALORRHAGIDACEAE.

Halorrhagis ciliata, n. sp. Herba perennis, ramulis pilis brevibus scabris, foliis alternis anguste lanceolatis superne remote serratis sessilibus 1-2 cm. longis scabro-ciliatis rigidis, supremis fere integris, floribus saepius binis vel ternis axillaribus brevioribus quam bracteae foliosae ciliatae, bracteolis receptaculum subaequantibus lineari-lanceolatis herbaceis ciliolatis, fructu depresso-globoso 2½ mm. longo 4 mm. lato (alis 4 latis ciliolatis comprehensis) 4-loculari inter alas tuberculato vel transverse rugoso.

Murray lands. Differs from *H. acutangula* in the hairy clothing and the winged rugose fruits.

Halorrhagis semi-angulata, n. sp. Herba perennis fere glabra, foliis alternis anguste lanceolatis rigidis sessilibus remote serratis 15-25 mm. longis glabris absque margine ciliolato, floribus plerumque 3-4 axillaribus, bracteis foliosis serrulatis, bracteolis lineari-lanceolatis herbaceis flores subaequantibus, receptaculo tetragono glabro, petalis 4 glabris, fructu depresso-subgloboso 2¼ mm. longo 4 mm. lato 4-loculari laevi, dimidio superiore prominenter et rigide 4-angulato quam dimidium inferius basi rotundatum latiore atque huic imminente.

Yalata (near Fowler's Bay). Differs from *H. acutangula,* F. v. M., in the depressed fruit with 4 prominent obtuse and sloping angles or ribs on the upper half only, the lower half being without angles, narrower and overhung by the upper portion.

PLUMBAGINACEAE.

**Statice occidentalis,* Lloyd. Flats on north side of Patawalonga Creek, Glenelg. First record.—Western Europe.

THE FLORA AND FAUNA OF NUYTS ARCHIPELAGO AND THE INVESTIGATOR GROUP.

No. 18.—NOTES ON THE VEGETATION OF FLINDERS ISLAND.

By T. G. B. Osborn, D.Sc.,

Professor of Botany in the University of Adelaide.

[Read October 8, 1925.]

Plates XXI. to XXIII.

The following notes on the vegetation of Flinders Island are based upon observations made during a visit to the island from January 5 to 10 last year. I desire to express thanks to Professor F. Wood Jones, F.R.S., leader of the party, for assistance in various ways.

Flinders Island is the largest and central island of the Investigator Group. It lies in 134° 30′ E. longitude and 33° 42′ S. latitude, at a minimum distance of 18 miles from the nearest mainland, Cape Finnis, near Elliston. It was named by Captain Matthew Flinders in 1802 and was visited by him and his party. Robert Brown, who was naturalist on board the "Investigator," landed upon the island and collected there. *Casuarina bicuspidata,* Benth., is only known in South Australia by the type specimen collected by Brown upon the island. The specimens of *Casuarina* collected by me on the island unfortunately all belong to the common species *Casuarina stricta,* Ait.

In 1907 some members of the Australian Association landed on Flinders Island from the s.s. "Governor Musgrave." Maiden, who (1907) wrote an account of the botanical collections, only listed 12 species from the island. The present paper in an Appendix records 108 species collected. The number is probably fairly complete except for annuals most of which were dead in January.

Physiographic Features.

The physiographic features call for little note here. The area of the island, estimated by the Lands Department at 9,000 acres, was too large to attempt, in the limited time of our visit, such a survey as was made on Pearson Islands (Osborn, 1923). According to the Australian Directory,[1] the island is of limestone formation, but as in the case of Franklin Islands (Osborn, 1922) there is a platform of granite rock upon which the softer limestone rests (pl. xxi., fig. 1). Granite boulders appear on the shore at various points, and the highest land on the island, a hill of 215 feet, on the south-eastern side, is an outcrop of igneous rock. The north-eastern coast has some remarkably bold cliffs, ranging up to 200 feet, but elsewhere the coast consists of low cliffs, granite boulders, or sandy beaches. In parts of the western coast typical dunes develop, a plant habitat entirely absent from the more rugged Pearson Islands and only developed at two points on the lower and more exposed Franklins.

The general surface of Flinders Island is a gently undulating plain. There are no watercourses, but two centres of inland seepage at the northern end are developed as saline flats.

(1) Australian Directory, 10th Edition, p. 167, 1907.

Environmental Factors.

Rainfall and temperature data have been given in the earlier paper on the Franklin Islands for the two nearest meterological stations on the mainland. The rainfall is a winter one and averages 15·02 inches at Streaky Bay. The area under consideration being an island, the conditions are probably less severe than on the mainland. The influence of the strong south-westerly winds is chiefly marked by the production of areas of unstable soil upon exposed headlands. The south-westerly end of the island is a low-lying wind-swept plain from which the land rises gradually to the higher north-eastern corner. Extreme examples of wind-shearing were not a feature of this island, as they were on the exposed Pearson Islands.

The soils of Flinders Island are very diverse for such a comparatively small area. They vary from drifting sand or fine shell-grit to a good red loam. Most of this latter soil has been cleared and some hundred acres or so are ploughed and under wheat. In addition to the loamy soils there is much soil of a lighter sandy type. This is derived from the consolidated calcified sands that form the greater part of the island and which, by weathering, produce its most rugged cliff scenery. Below these soils a travertine limestone crust commonly develops, and is often found at no great depth below the surface. As noted above, there are two distinct saline swamps, the soil of which contains much gypsum. Where this is pure it forms a typical kopi of cheesy consistency, but is often more or less intermixed with sand.

The indigenous mammal upon the island, the wallaby, *Thylogale flindersi*, now plays a negligible part as a biotic factor. The most important influences are due to man and his domestic animals, particularly sheep. These, by their grazing, tend to keep the succession depressed, but the primary disturbing element is undoubtedly the human agency. Flinders Island has been the site, on a small scale, of the struggle that has gone on over so much of Australia, that of the effort to produce grass land upon areas naturally carrying scrub or woodland. So far as could be seen the bulk of the open country on the island directly owes its existence to human interference. It is only by repeated fires that the tendency to revert to scrub woodland, dominated by *Melaleuca parviflora*, is kept in check.

Vegetation.

Five main vegetation types are to be seen on Flinders Island to-day. They are (1) woodland and scrub with a climax of dense woodlands of *Melaleuca parviflora*, (2) cliffs, (3) sand dunes, (4) ruderals and communities on the pasture land, and (5) the gypsum salt swamps. The first and last of these are most clearly defined. Cliff and dune vegetation tends to develop into scrub at its highest stages, while the grass land areas are obviously artificial.

(1) *Woodland and Scrub Series.*

Thick woodlands of *Melaleuca parviflora* occur in a belt of varying width around the northern portions of the island, as well as in dense isolated groves elsewhere. The trees grow close together and range up to about 10 metres high. The crown is very dense and umbrageous (pl. xxi., fig. 2), so that there is little or no ground flora, the surface of the soil being covered with a litter of fallen twigs and leaves. In the thickest parts of the woods the only other plants observed were a few straggling bushes of *Rhagodia baccata* or *Threlkeldia diffusa*.

In more open places, and on small sandy rises (pl. xxii., fig. 1), the trees stand further apart, and such shrubs as *Myoporum insulare* (up to 3 metres), *Leucopogon Richei*, and *Exocarpus aphylla* appear. Several undershrubs occur in these open places, also such climbers as *Clematis microphylla* and *Comesperma volubile*. The undershrub flora includes the following:—

Rhagodia baccata, R. crassifolia, Correa rubra, Geijera linearifolia, Beyera Leschenaultii, Calythrix tetragona, Westringia rigida, var. *dolichophylla, Olearia axillaris.*

This community has obvious affinities with the highest form of cliff scrub, a resemblance which is increased by the occurrence of occasional trees of *Pittosporum phillyraeoides* and *Casuarina stricta.*

No eucalypt was found on either the Franklin or Pearson Islands. It was, then, of some interest to find the mallee, *Eucalyptus gracilis,* upon Flinders Island.

This now only occurs in a few obviously degenerate groups upon the heavier loamy soil. Probably it was formerly much more extensive, for it would be freely felled to provide timber and posts for building. The groups were surrounded by the remains of *Melaleuca parviflora* woodland, but it was not possible to determine the relationship between the two.

(2) *Cliffs and Coastal Rocks.*

While it is convenient to speak of a cliff flora, a rather miscellaneous grouping of habitats is included here.

Some high cliffs are to be seen on the Flinders Island ranging up to 200 feet. These are composed of a friable calcified sandstone which, if the cliff face be nearly vertical, is devoid of plant life. Where the slope is more gradual and covered by a jumbled mass of sandstone or travertine fragments (pl. xxi., fig. 1) a considerable flora may develop which has obvious relationships with the dune shrub. The most exposed places have the following:—

Bassia uniflora, Enchylaena tomentosa, Threlkeldia diffusa, Mesembryanthemum australe, Tetragonia implexicoma, Hemichroa diandra, Frankenia pauciflora, Nitraria Schoeberi, Zygophyllum Billardieri.

Of these only *Tetragonia* and *Nitraria* cover considerable areas; the former often hanging in festoons over ledges, the latter forming dense thickets even to the level of high spring tides.

This open, unstable, and essentially chamaephytic community is replaced by a mixed scrub community in the less exposed places. The following occur:—

Acacia armata, Templetonia retrusa, Correa rubra, Geijera linearifolia, Beyeria Leschenaultii, Dodonaea Baueri, Pomaderris racemosa, Spyridium eriocephalum, Calythrix tetragona, Leucopogon Richei, Alyxia buxifolia, Westringia rigida, var. *dolichophylla, Myoporum deserti.*

With these occur such lower growing plants as:—

Poa caespitosa, Enchylaena tomentosa, Atriplex paludosum, Rhagodia crassifolia, Mesembryanthemum aequilatrale, Tetragonia implexicoma, Danthonia setacea, Goodenia varia.

Trees are rare, but occasional specimens of *Casuarina stricta, Pittosporum phillyraeoides,* or *Melaleuca parviflora,* indicate the essentially woodland type.

The tops of some of the higher cliffs are very exposed and large areas of unstable wind-eroded soil occur. The vegetation here is very open. Nearest to the cliff edge, which is often a sharp and overhanging platform of harder sandstone, *Frankenia pauciflora* is to be found. In almost equally exposed situations the following were noted:—

Hemichroa diandra, Mesembryanthemum australe, Samolus repens, Calocephalus Brownii.

On these cliff-edge platforms the problem is to fix the light sandy soil upon the underlying rock. *Frankenia pauciflora* and *Goodenia varia* are able to do this and so to form low mounds. Small bushes of *Calocephalus Brownii* hold sand among the exceedingly divaricate branches. The most efficient plant to stabilize soil, because of its great size, is *Nitraria Schoeberi* (Cannon, Osborn, 1923). Dense thickets, over 7 metres in diameter, may be found holding masses of sand heaped up against the prostrate branches. These mounds may become centres for the formation of a thicket in which other plants occur such as:—

Enchylaena tomentosa, Rhagodia baccata, Threlkeldia diffusa, Olearia axillaris.

When an old Nitraria mound becomes eroded the great lateral spread of its roots is apparent. These were followed for as much as 8 metres from the trunk, running horizontally. They then appeared to turn vertically, making a right angle. Close inspection, however, showed that this was not so, but that the vertical portion was a lateral to the main root, remains of which continuing in the horizontal plane could generally be observed.

Calocephalus Brownii may also form large mounds up to 3 metres in diameter, but it has not a similar spreading root habit, nor does it form adventitious root buds, as does *Nitraria;* moreover, it often becomes killed on the side of the prevailing wind.

The only place in which *Callitris robusta* was found upon the island was in this unstable cliff-top area. There it formed a dense thicket of semi-prostrate shrubs. It is possible, however, that, in clearing the island, groves of *Callitris* were burnt or cut out for fence posts.

There are no actual cliffs of granite rocks but, in places, steep, boulder-strewn slopes rise from the shore. A scrub flora develops upon them having a different constitution from that on the sandstone or travertine cliffs. Near the sea the following occur:—

Suaeda australis, Threlkeldia diffusa, Salicornia australis, Mesembryanthemum australe.

Higher up the slope, these more salt-tolerant plants are replaced by such shrubby species as:—

Atriplex cinereum, Frankenia pauciflora, Enchylaena tomentosa, Rhagodia baccata, Lycium australe, Myoporum insulare, Calocephalus Brownii, Olearia ramulosa.

(3) *Dunes.*

The succession of the vegetation upon the sand dunes follows the usual sequence to be observed along the South Australian coast (Osborn, 1914). Briefly [2]**Cakile maritima* and *Atriplex cinereum* are the two littorals, the latter often forming a small fore-dune thicket.

Spinifex hirsutus is the pioneer dune plant. With this there becomes associated as the face is stabilized and on the dune crest, *Olearia axillaris, Salsola kali,* and *Calocephalus Brownii.* The transition is thus rapid towards an open shrub community in which the *Olearia* is dominant and associated with the following:—

Rhagodia baccata, Threlkeldia diffusa, Enchylaena tomentosa, Leucopogon Richei, Alyxia buxifolia, Myoporum insulare, Scirpus nodosus, Dianella revoluta, Tetragonia implexicoma, Mesembryanthemum aequilaterale, Senecio lautus.

The annual element in the flora is low, only *Bromus arenarius, Swainsonia lessertiifolia,* and *Helichrysum Baxteri* being noted. The prostrate shrub *Myoporum humile* occasionally forms extensive mats on the bare sand between the larger bushes.

Generally, behind the first dune with its shrub-clad crest and hinder face there is a scrub-covered flat followed by a second dune. The conditions here are more stable, the shrubs often being of large size and with great spread of branches.

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(2) An asterisk (*) preceding a generic name denotes that the plant is not indigenous to Australia.

Occasionally trees of *Melaleuca parviflora* appear, so that the final stage in the dense succession is a scrub woodland, much like the earlier phases of the *M. parviflora* woodland described above.

On the stable dunes two twining climbers appear, *Clematis microphylla* and *Comesperma volubile*. *Tetragonia implexicoma* often assumes a scrambling habit. *Exocarpus aphylla* is an occasional root parasite in these areas.

The foreshore, in places, consists of a coarse granitic sand. On this one notices the absence of *Spinifex hirsutus* and *Olearia axillaris*. It may be recalled that neither of these common coastal plants was found on the essentially granitic Pearson Islands.

The first colonists of these granitic sands are shrubs or mat plants, and a shrub community develops immediately. Plants noted were:—

Threlkeldia diffusa, Enchylaena tomentosa, Rhagodia baccata, Myoporum insulare, Calocephalus Brownii, Olearia ramulosa.

(4) *Ruderals and Communities on Pasture Land.*

A very diverse assemblage of plants is to be noticed here. Most of the ruderals are aliens, weeds that have been introduced, not merely to the island following its occupation, but to Australia itself.

On land that has been cropped and now abandoned the growth of annual grasses is often very rank. Dead haulms and leaves of **Avena fatua* or **Bromus* spp. covered acres with a continuous mat, through which other plants were unable to grow.

More interesting was the land that had been roughly cleared for pasture by burning and left to develop what flora it would (pl. xxii., fig. 2). The chief grasses were:—**Avena fatua*, **Festuca bromoides*, **F. myuros*, and **Bromus* sp. The indigenous annual grass *Stipa pubescens* was less abundant, as was the perennial *Danthonia penicillata*. Other herbaceous plants were:—

**Lolium subulatum*, **Hordeum murinum*, *Bulbine semibarbata*, *Trichinium spathulatum*, **Silene Gallica*, *Crassula Sieberiana*, **Melilotus indica*, **Medicago denticulata*, **Anagallis caerulea*, *Convolvulus erubescens*, *Vittadinia australis*, *Podotheca angustifolia*, **Centaurea militensis*, **Hypochoeris glabra*, **Sonchus arvensis*.

The above list represents a census taken in the area shown (pl. xxii., fig. 2) which was burnt two years previously. It will be noticed that of the 20 herbaceous plants recorded, 13 are aliens.

Immediately following a fire one notices large plants of *Cassinia spectabilis*, which is a common fire weed on the sandy soils upon the mainland and Kangaroo Island as well.

In addition to the annuals, seedlings of indigenous shrubs also appear. The most prominent is *Myoporum insulare*. It is widely disseminated by birds which eat its succulent fruits. This plant is a most successful colonist of these secondary bare areas, and is now dominant over large parts of the southern end of the island. Its only competitors are the species of *Olearia*, *O. axillaris*, and *O. ramulosa*. The former, like the Myoporum, is naturally a member of the dune series and becomes most prominent on light, sandy soils. *Olearia ramulosa* appears on the coarser soils of granitic origin. Over these bushes *Enchylaena tomentosa* scrambles and, not infrequently, *Clematis microphylla* or *Comesperma volubile* occur as true climbing plants.

Open shrublands, of the type just described, are clearly secondary successions to the scrub-woodland typical of the vegetation in its undisturbed state. They now cover more than half the island (pl. xxiii., fig. 3). No good purpose could be served by listing here the various species observed. The time available was quite insufficient to investigate these secondary successions in detail. It was obvious that, as noted above, certain differences exist between the stages on sandy soils and those of granitic origin.

In the list of plants given in the Appendix these open shrublands are referred to as "secondary" areas in the habitat column. Rather more than forty species are so placed.

(5) *Gypsum Salt Swamps.*

Two fairly extensive areas of gypsum salt swamps occur—one near the landing, and the other on the opposite, north-western, side of the island. They are level plains of white kopi soil more or less mixed with sand.

The dominant vegetation over most of the area is *Arthrocnemum halocnemoides,* var. *pergranulatum* (pl. xxiii., fig. 1), the low bushes of which form a more or less complete covering. The individual plants grow outwards from a centre, forming a tussock of increasing circumference. As this becomes older the centre dies away, forming a ring, which, with age, breaks up into separate clumps. These repeat the process, meanwhile the bare centre of the original clump may become colonized by seedlings again. In one of the swamps the lowest portion was definitely wetter. This wet portion was colonized at the margin by a dense growth of *Arthrocnemum* sp.(3) (pl. xxiii., fig. 2). The roots of this plant only penetrate 7-8 cms. into the water-logged soil and then run horizontally. Evidently, as can be seen from the photograph, the centre of this patch was too wet and salt even for this species of *Arthrocnemum,* for the plants there are much more open. It would seem that the edaphic requirements of *A.* sp. differ from those of *A. halocnemoides,* var. *pergranulatum,* for there is a well-defined, open zone between the two societies. Nearing the margins of the swamps the following occur:—

Arthrocnemum arbuscula, Kochia oppositifolia, Salicornia australis, Frankenia pauciflora, Mesembryanthemum australe.

A. arbuscula is an unusual colonist of an inland swamp. It usually is dominant in the coastal salt swamps of the mainland, immediately behind the mangroves (Osborn and Wood, 1923), and follows the drainage channels into the drier portions. Osborn and Wood found that at Port Wakefield it had a much higher salt toleration than *A. halocnemoides.*

The highest community developed around swamps is a thicket of *Melaleuca halmaturorum,* a "paper-bark tea-tree." With this, other salt-tolerant plants occur, the following being a list:—

Lepturus incurvatus, Threlkeldia diffusa, Enchylaena tomentosa, Rhagodia baccata, Tetragonia implexicoma, Mesembryanthemum australe, Nitraria Schoeberi, Lycium australe.

Evidently, as the swamps dry up a number of ephemerals make their appearance around the margins. These were generally too dry for determination, but *Skirrophorus strictus* and *Hydrocotyle medicaginoides* were recognised. The transition from a saline swamp community to one typical of the sandy soil is usually very abrupt. In a pace or two one passes from one to the other.

Vegetation.

From the foregoing notes it is apparent that the natural vegetation of Flinders Island is of a uniform type. Dune and cliff communities in their highest states tend to develop into a scrub woodland with *Melaleuca parviflora.* Over the greater part of the area now left in its original state, this is the dominant plant. Indeed, at times, it almost forms a mono-specific community.

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(3) Unfortunately, owing to the absence of ripe fruits, it is impossible to identify this. It is a stout low-growing plant, in its robustness suggesting *A. leiostachyum,* but does not appear to be this species. I am grateful to Mr. J. M. Black, who kindly examined my material of this plant.

On Pearson Islands two chief scrub-woodland consocies were recognised, one dominated by *Casuarina stricta* and the other by *Melaleuca parviflora*. The former was only developed at the higher altitudes and was replaced by *Melaleuca* in more exposed places, or at lower levels.

On Flinders Island, *Casuarina stricta* is chiefly found upon outcrops of granite rocks. In the Mount Lofty Ranges, Adamson and Osborn (1924) refer to the development of *Casuarina stricta* on rocky outcrops in the Eucalyptus forests. They note *(l.c.*, p. 129) that approaching the River Murray Basin, where, with increasing aridity, rocky soils alone can support a forest type, this community must be regarded as a climax. Upon these exposed islands of the Investigator Group, which have a rainfall of about 15 inches, *Casuarina stricta* again forms a "forest," or woodland, wherever the water relations are sufficiently good. The "forest" is relatively well developed on the more hilly Pearson Islands, where the altitude ranges up to 781 feet, and cloud effects produce a more humid influence. Upon the less hilly Flinders Island only small patches of *Casuarina stricta* woodland can develop, but it is very striking to notice the way that the granite outcrops are marked by their occurrence (pl. xxiii., fig. 3). In the light of our knowledge of the extent and distribution of this Casuarina woodland on Pearson Islands, as well as on the mainland, it seems justifiable to regard these as vestigial outliers of a forest type that has reached its climatic limit.

It is otherwise with the Melaleuca parviflora woodland. In discussing this on Pearson Islands it was said *(l.c.*, p. 109): "The Melaleuca parviflora consocies is a scrub woodland of a more xerophytic type than the Casuarina woodland. *M. parviflora* forms dense thickets of considerable extent on some of the neighbouring islands, *e.g.*, Flinders Island, and also on the mainland. On the mainland, however, it is certainly a stage in the sere culminating in mallee *(Eucalyptus* spp.")*.* The observations since made upon Flinders Island confirm this opinion. Though it was not possible to study the relations of *Eucalyptus gracilis* to the Melaleuca woodland, owing to the extent of human interference around the only known station for the mallee upon the island, it is clear that they are related. On these islands M. parviflora woodland appears to be a subclimax, but whether the climatic or edaphic factors inhibit further development towards the Mallee consociation, typical of most of the mainland areas with similar rainfall, it is not possible to say.

Sufficient has been said in the earlier section on "Ruderal and Pasture Land Communties" to show the profound modifications of the natural vegetation that follow human interference. The island, and, indeed, South Australia as a whole, has not a grassland climate. The exigencies of a sheep-grazing industry demand that there should be pasture. The problems that are raised by this attempted change in the vegetation type are of great interest. Under agricultural conditions the change is effected with great success. Huge acreages of primitive forest are replaced by herbaceous communities. But when large areas are only lightly grazed the change is much less successful. There develops merely a poor pasture composed largely of a heterogeneous collection of weeds. With the possible exception of *Melilotus indica*, it is unlikely that there are any intentional introductions among the alien plants recorded for the island. The community that results after clearing is an unstable one, and, only by constant burning, is the scrub prevented from recolonizing the area.

Flora.

A list of the vascular plants collected is given in the Appendix. It comprises 108 species, but, as the island was visited in the dry summer season, it is probably incomplete so far as small herbaceous plants are concerned. The same remark had to be made in connection with the investigation of Franklin and Pearson Islands. This difficulty is unfortunately inevitable, for the islands are comparatively inaccessible.

Of the total number of plants listed, however, no less than 26 (24 per cent.) are recognised as aliens to Australia. This is a much larger percentage than on the other islands visited. On Pearson Islands, which show but little result of human interference, only 2 alien species (3·7 per cent.) occurred, one of which was **Sonchus asper*, var. *littoralis*, now widely distributed around the South Australian coast. Even on the Franklins, which until a few years ago had been used as a sheep run, there were only 3 introduced species (8·8 per cent.), one of which was again the Sonchus. Excluding the Sonchus, only one grass on each island group had become generally established, **Hordum* sp. on the Franklins and **Festuca bromoides*, the widespread "silver grass" of the mainland, upon Pearson Islands.

Considering the length of time during which there has been human settlement on Flinders Island, and also that farming operations are now carried on, the number of aliens is not remarkable. Of those that occur, two, **Cakile* and **Sonchus asper*, are now general elements in the littoral flora of South Australia. The remainder may be divided into two groups, ruderals and widely spread plants, containing, respectively, 10 and 14 species. Were human interference removed it is quite legitimate to assume that after a few years most of these widely spread plants would almost, if not quite, disappear, except, perhaps, **Erodium*, **Melilotus*, and **Hypochoeris*; also such grasses as **Festuca*, **Lolium*, and **Hordeum*. As has been remarked previously, it is only by fires and grazing that the natural scrub is kept in check.

As was the case in the florula of Pearson Islands, the most important families upon Flinders Island are the *Chenopodiaceae*, *Compositae*, and *Gramineae*, each with 15 species. However, some of these are aliens. Excluding these introduced plants, the numbers become: *Chenopodiaceae*, 14 species; Compositae, 11 species; and *Gramineae*, 7 species.

On neither of the island groups previously visited was a member of the Leguminosae collected. Six species were found on Franklin Island, three of them indigenous to Australia. Two of these, the Templetonia and *Swainsonia lessertiifolia*, take a prominent place in some of the communities. *Acacia armata* was the only wattle observed, and, though a considerable number of dunes were examined, the common dune Acacias of the mainland, *Acacia ligulata* and *Acacia longifolia*, were not seen.

A eucalypt, the mallee *Euc. gracilis*, was found; none occurred on the Pearsons and Franklins. The small part played by eucalypts in these florulas is remarkable. At the western end of Kangaroo Island, where very similar conditions of soil and exposure exist, such a species as *Eucalyptus santalifolia* comes close to the sea. Flinders Island has certainly a lower rainfall than Kangaroo Island, but, to judge from the vegetation around Streaky Bay and Elliston, the nearest harbours on the mainland, the annual precipitation (15·10 inches) is sufficient for a typical mallee eucalypt flora. At present we have too little knowledge of the ecological requirements of the eucalypts to do more than draw attention to the minor part they play in these insular florulas.

In the list given below the occurrence of the various species upon the other two island groups is given. There are few important species occurring on one or other of the two groups that are not recorded for Flinders Island. The apparent absence of *Scaevola crassifolia* and *Pimelia serpyllifolia* from the dunes or dune scrub is the most surprising omission.

The life forms, according to Raunkaier's system, are also noted, and from these a biological spectrum is constructed (Table I.). The percentages have been calculated, first on the total flora, and secondly on the indigenous species only. The effect of cultivation and, especially, the partial clearing by fires in order to produce grazing land, in the statistics is very marked. The percentage of Therophytes is practically halved when the alien species are neglected. The spectrum constructed for the indigenous florula agrees well with that of Pearson Islands. The Nanophanaerophyte percentages are almost identical (36 and 37 per cent.) and much in excess of the normal. The Chamaephyte percentage is also very high in each case. Though the Therophyte number is high, it is appreciably lower than that of Ooldea, which is situated on the mainland to the north-west of Flinders Island (Adamson and Osborn, 1922). On the other hand, the spectrum for the full florula, including aliens, is very like that of Ooldea. A high percentage of Therophytes, according to Raunkaier, is to be expected in a region of high cultivation or in a desert. Flinders Island is far from being a region of high cultivation. It is interesting, then, to notice that the effect of partial exploitation of the flora on this small semi-arid island is to develop a more arid type of succession. Similar changes can be seen commonly in the arid or semi-arid districts of the mainland. There again, whenever the biological factor operates severely upon the vegetation, the naturally high percentage of Nanophanaerophytes and Chamaephytes is reduced with a consequent raising of the Therophyte number.

TABLE I.

District.	Total No. of spp. considered.	M.M.	M.	N.	Ch.	H.	G.	H.H.	Th.	E.	S.
				Percentage of species in each life form.							
Flinders Island (all) ..	109	—	9	28	17	6	1	—	39	—	—
Flin. Isd. (excluding aliens)	83	—	12	37	22	7	1	—	20	—	—
Pearson Islands	53	—	6	36	28	2	—	—	28	—	—
Franklin Islands	34	—	—	15	38	—	—	—	47	—	—
Ooldea	188	1	19	23	14	4	1	—	35	—	—
Mt. Lofty Scleroph. ..	244	1	9	34	13	23	13	—	4	—	—
Mt. Lofty Savannah ..	229	1	8	14	12.	26	23	—	14	—	—
Normal	400	6	17	20	9	27	3	1	13	3	1

Reference was made to the importance of the Chamaephytic element in these florulas of the semi-arid type in the paper on Pearson Islands. The observations on Flinders Island are in agreement. In the vegetation of those portions of South Australia that verge on the arid type, life forms, in which the renewal buds are on the surface of the ground or just above it (*i.e.*, Chamaephytes), appear to be far more successful than those in which the buds are buried. Neither Hemicryptophytes nor Geophytes are common in the South Australian arid or semi-arid regions. In the flora of the Mount Lofty region (Adamson and Osborn, 1924) these two life forms show a marked increase, and the Geophytic element is much above normal. The vegetation of Flinders Island is of a distinctly more arid type than that of either of the eucalyptus forests on the South Australian mainland. In spite of this difference one cannot but be struck by the very low Hemicrytophyte percentages in the few Australian arid florulas to which Raunkaier's methods have been applied.

In the typical biological spectra given by Smith (1923) the far more arid regions of the Death Valley, Aden, and Lybian Desert, the Hemicryptophyte percentage is 18, 19, and 20 respectively. At Ooldea it was 4 per cent. and 7 per cent. on Flinders Island. Clearly this is a point upon which further work is needed.

APPENDIX.

The following list contains the names of all the vascular plants collected upon Franklin Island.

In addition to the name of the plant, the record of its occurrence upon Franklin or Pearson Islands is indicated by the initial letter F or P. The following column shows the life form according to Raunkaier's system. The last two columns refer to habit and habitat upon Flinders Island. Any measurements refer to Flinders Island specimens.

Name.	Other Islands.	Life Forms.	Habit.	Habitat.
POLYPODIACEAE.				
Cheilanthes tenuifolia, Swartz.	P.	H.	Small tufted fern	Occasional near granite outcrops
CUPRESSACEAE.				
Callitris robusta, R. Br.	—	M.	Semi-prostrate up to 2·5 cm.	Dunes
GRAMINEAE.				
Spinifex hirsutus, Labill.	Fr.	Ch.	Creeping stout stems forming tussocks	Dunes
Stipa pubescens, R. Br.	—	Th. (& Ch.?)	Small tussocks	General on secondary areas
**Avena fatua*, L.	—	Th.	Tall erect grass	Ruderal, occasional secondary areas
**A. barbata*, Brot.	—	Th.	Tall erect grass	Ruderal, occasional secondary areas
Danthonia penicillata, (Labill.) F. v. M.	Fr.	Ch.	Low tussock grass	Secondary areas
D. setacea, R. Br.	Fr.	Ch.	Dwarf tussock grass	Cliff scrub
**Koeleria phleoides*, Pers.	—	Th.	Erect annual	Secondary areas, occasional settled dunes
Poa caespitosa, Forst., var. *Billardieri*, Hook. f.	P.	Ch.	Tussock grass, leaves pungent, 30 cms.	Cliffs, dune scrub
**Festuca Myuros*, L.	—	Th.	Small annual grass	Secondary areas
**F. bromoides*, L.	P.	Th.	Small annual grass	Secondary areas
**Bromus Madritensis*	—	Th.	(Seed only)	Secondary areas
B. arenarius, Labill.	Fr.	Th.	Erect annual	Dunes
**Lolium subulatum*, Vis.	—	Th.	Erect annual	Secondary areas, occasional settled dunes
Lepturus incurvatus, Trin.	—	Th.	Small annual	Swamp margins
**Hordeum murinum*, L.	(Fr.)	Th.	Annual grass	Secondary areas and ruderal
CYPERACEAE.				
Scirpus nodosus, Rottb.	—	H.	Tussocks from short rhizomes	Dunes
LILIACEAE.				
Dianella revoluta, R. Br.	Fr., P.	Ch.	Tussocks, leaves up to 50 cms.	Settled dunes, cliff scrub
Thysanotis Baueri, R. Br.	—	G.	Leafless in flower, root tubers	Settled dunes
Bulbine semibarbata, (R. Br.) Haw.	P.	Th.	Dwarf herb	Settled dunes, secondary areas
CASUARINACEAE.				
Casuarina stricta, Ait.	P.	M.	Tree to 10 m.	Granite outcrops, occasional open places Melaleuca woodland
URTICACEAE.				
Urtica urens, L.	—	Th.	Erect annual	Ruderal
SANTALACEAE.				
Exocarpus aphylla, R. Br.	—	M.	Stiff branched leafless shrub to 3 m.	Occasional cliff, dune, and Melaleuca woodland
CHENOPODIACEAE.				
Rhagodia baccata, (Labill.) Moq.	P.	N.	Shrub to 2 m., often scrambling	Cliffs, settled dunes, occasional open places Melaleuca woodland
Rh. crassifolia, R. Br.	Fr., P.	N.	Dwarf shrub, erect	Cliff scrub, open places Melaleuca woodland
Chenopodium microphyllum, F. v. M.	—	Ch.	Mat plant	Cliffs, secondary areas
**Ch. album*, L.	—	Th.	Erect herb, 30 cms.	Ruderal
Atriplex paludosum, R. Br.	P.	N.	Erect shrub, 30 cms.	Occasional cliffs, coastal scrub
A. cinereum, Poir.	P.	N.	Erect half shrub, 1 m.	Littoral, dune face
Bassia uniflora, (R. Br.) F. v. M.	—	Ch.	Dwarf diffuse shrub	Cliffs

Name.	Other Islands.	Life Forms.	Habit.	Habitat.
Kochia oppositifolia, F. v. M.	—	N.	Erect shrub, leaves 3-4 m., succulent	Margins of saline swamps
Salsola kali, L.	Fr.	Th.	Dense bushy herb, spiny leaves	Dunes
Suaeda australis, (R. Br.) Moq.	P.	Ch.	Succulent mat plant, base woody	Rocks near sea
Enchylaena tomentosa, R. Br.	Fr., P.	N.	Semi-prostrate or scrambling shrub, leaves succulent	Cliffs, dunes, occasionally in Melaleuca woodland and secondary areas
Threlkeldia diffusa, R. Br.	Fr., P.	Ch.	Succulent-leaved mat plant	Cliffs, dunes, open places Melaleuca woodland
Arthrocnemum halocnemoides, Nees, var. *pergranulatum*, J. M. B.	—	N.	Succulent shrub, 50 cms.	Saline swamps
A. arbuscula, (R. Br.) Moq.	—	N.	Succulent shrub, 1 m.	Margins saline swamp
A. sp.	—	N.	Succulent shrub, 30 cms.	Wettest parts gypsum salt swamp
Salicornia australis, Banks and Sol.	P.	Ch.	Prostrate, half shrubby	Coastal rocks, saline swamps
AMARANTHACEAE.				
Hemichroa diandra, R. Br.	—	Ch.	Low cushion plant, herbaceous	Damp soil near springs, cliffs near sea
Trichinium spathulatum, R. Br.	—	H.	Prostrate, herbaceous stems from perennial root stock	Secondary areas
AIZOACEAE.				
Mesembryanthemum aequilaterale, Haw.	Fr., P.	Ch.	Mat plant, leaves erect, succulent	Cliffs, dunes
M. australe, Sol.	Fr., P.	Ch.	As above but leaves smaller	Coastal rocks, saline swamps
Tetragonia implexicoma, (Moq.) Hook. f.	Fr., P.	N.	Scrambling weak shrub	Cliffs, stable dunes, and occasional secondary areas
CARYOPHYLLACEAE.				
**Cerastium glomeratum*, Thuill.	—	Th.	Small annual	Ruderal
Spergularia marginata, (DC.) Vitt.	—	Ch.	Perennial, leaves glabrous, succulent	Coastal and saline swamps
**Silene gallica*, L.	—	Th.	Erect hairy annual	Ruderal, secondary areas
Scleranthus pungens, R. Br.	P.	Ch.	Cushion plant	Cliffs, occasional secondary areas
RANUNCULACEAE.				
Clematis microphylla, DC.	—	N.	Half woody climber	Stable dunes open places Melaleuca woodland, and secondary areas
PAPAVERACEAE.				
**Papaver dubium*, L.	—	Th.	Erect annual herb	Ruderal, secondary areas
CRUCIFERAE.				
**Sisymbrium orientale*, L.	—	Th.	Erect annual herb to 1 m	Ruderal
**Cakile maritima*, Scop.	—	Th.	Glabrous procumbent annual	Littoral
CRASSULACEAE.				
Crassula Sieberiana, (Schultes) Ostenf.	—	Th.	Minute annual	Secondary areas, dunes
PITTOSPORACEAE.				
Pittosporum phillyraeoides, DC.	—	M.	Small tree, drooping, leaves 5 cm.	Cliff scrub, occasional open spaces Melaleuca woodland
LEGUMINOSAE.				
Acacia armata, R. Br.	—	N.	Erect shrub, 1·5 m., spinescent stipules	Cliff scrub, secondary areas
Templetonia retrusa, (Vent.) R. Br.	—	N.	Spreading shrub, 2 m., leaves glaucous, 3 x 1 cm.	Cliff scrub, secondary scrub around outcrops
**Melilotus indica*, All.	—	Th.	Erect annual, 1 m.	Ruderal
**Medicago denticulata*, Willd.	—	Th.	Prostrate annual	Ruderal, occasional secondary areas
**M. sativa*, L.		H.	Herbaceous erect perennial	Ruderal
Swainsonia lessertiifolia, DC.	—	Th.	Prostrate, inflorescence erect	Stable dunes, secondary areas

Name.	Other Islands.	Life Forms.	Habit.	Habitat.
GERANIACEAE.				
**Erodium cicutarium*, L'H.	—	Th.	Low spreading herb	Granitic sand near sea, occasional secondary areas
OXALIDACEAE.				
Oxalis corniculata, L.	—	H.	Prostrate herbaceous perennial	Open places in Melaleuca woodland and among granitic rocks
ZYGOPHYLLACEAE.				
Zygophyllum Billardieri, DC.	—	N.	Half shrubby	Cliffs
Z. ammophilum, F. v. M.	—	Th.	Small succulent herb	Cliff scrub, open places Melaleuca woodland
Nitraria Schoeberi, L.	Fr., P.	N.	Fleshy-leaved shrub, under 1·5 m.	Cliffs, unstable soil
RUTACEAE.				
Correa rubra, Sm.	P.	N.	Shrub to 60 cms., leaves tough, tomentose below	Cliff scrub, open places Melaleuca woodland
Geijera linearifolia, (DC.) J. M. B.	—	N.	Rounded shrub, leaves 4 x ·5 cm.	Cliffs, dune scrub, open places Melaleuca woodland
POLYGALACEAE.				
Comesperma volubile, Labill.	—	M.	Almost leafless, half-woody climber	Secondary areas
EUPHORBIACEAE.				
Beyeria Leschenaultii, (DC.) Baill.	—	N.	Rounded shrub, leaves viscid, 2 x ·2 cms.	Cliffs, dune scrub, open places Melaleuca woodland
SAPINDACEAE.				
Dodonaea Baueri, Endl.	—	N.	Small shrub, leaves 10-15 x 6-10 mm., viscid	Cliff scrub
RHAMNACEAE.				
Pomaderris racemosa, Hook. f.	—	N.	Small-leaved straggling shrub	Cliff scrub
Spyridium eriocephalum, Fenzl.	—	N.	Low freely branching shrub, leaves narrow, revolute	Cliff scrub
MALVACEAE.				
**Malva parviflora*, L.	—	Th.	Erect spreading annual	Ruderal
FRANKENIACEAE.				
Frankenia pauciflora, DC.	Fr., P.	Ch.	Semi-prostrate dwarf shrub	Cliffs, edges saline swamps
MYRTACEAE.				
Melaleuca parviflora, Lindl.	P.	M.	Tree to 8 m., dense canopy	Dominant in sandy soils
M. halmaturorum, F. v. M.	P.	M.	Tree to 5 m., dense canopy	Margins saline swamps
Eucalyptus gracilis, F. v. M.	—	M.	Mallee to 8 m.	Occasional Melaleuca woodland on loamy soil
Calythrix teragona, Labill.	P.	N.	Erect shrub	Coastal scrub, open places in Melaleuca woodland
UMBELLIFERAE.				
Apium prostratum, Labill.	P.	Th.	Prostrate herb	Cliffs near sea
Hydrocotyle medicaginoides, Turcz.	—	Th.	Minute annual	Margins of saline swamps
EPACRIDACEAE.				
Leucopogon Richei, Labill.	P.	M.	Bushy shrub to 3 m.	Dune scrub, open places in Melaleuca woodland, secondary areas
PRIMULACEAE.				
Samolus repens, Pers.	—	H.	Dwarf stoloniferous herb	Near spring
**Anagallis coerulea*, Schreb.	—	Th.	Diffuse herb	Secondary areas, ruderal

Name.	Other Islands.	Life Forms.	Habit.	Habitat.
GENTIANACEAE.				
Sebaea ovata, R. Br.	—	Th.	Erect herb, 15 cms.	Secondary areas
APOCYNACEAE.				
Alyxia buxifolia, R. Br.	—	N.	Erect bushy shrub to 2 m.	Dunes, cliff scrub
CONVOLVULACEAE.				
Convolvulus erubescens, Sims.	—	H.	Slender twining herb	Secondary areas
LABIATAE.				
Westringia rigida, R. Br., var. *dolichophylla*, Ostenf.	P.	N.	Shrub ·5 m., leaves linear, 2 cms., root buds	Cliffs and dune scrub, open places Melaleuca woodland, secondary areas
SOLANACEAE.				
**Solanum nigrum*, L.	—	Th. (N. ?)	Diffuse half shrub	Ruderal
S. aviculare, Forst.	—	N.	Shrub to 1·5 m., leaves to 18 cm., lobes thin	Secondary areas, dunes, inland
Lycium australe, F. v. M.	P.	N.	Erect shrub, spinescent branches, leaves fleshy, 1 cm.	Coastal rocks, edges saline swamps, occasional secondary areas
MYOPORACEAE.				
Myoporum insulare, R. Br.	Fr., P.	M.	Spreading shrub to 3 m.	Coastal, dunes, secondary areas
M. deserti, A. Cunn.	P.	N.	Erect shrub to 1·5 m., leaves with large glands	Cliff scrub
M. humile, R. Br.	—	N.	Prostrate mat shrub	Stable dunes
GOODENIACEAE.				
Goodenia varians, R. Br.	—	Ch.	Prostrate, half shrubby	Cliffs
COMPOSITAE.				
Olearia axillaris, F. v. M.	Fr.	N.	Dense growing rounded shrub to 2 m.	Dunes, secondary areas
O. ramulosa, Labill.	P.	N.	Erect bushy shrub to 1 m.	Cliffs, secondary areas
Vittadinia australis, A. Rich.	Fr.	Th.	Erect free branching herb, 30 cm.	Secondary areas
Podotheca angustifolium, Labill.	—	Th.	Small prostrate annual	Dune scrub, secondary areas
Cassinia spectabilis, R. Br.	P.	Ch.	Erect robust herb to 1·5 cm., leaves almost woolly, to 20 x 5 cms.	Secondary areas after fire
Gnaphalium indutum, Hook. f.	—	Th.	Prostrate herb	Among granitic boulders
Helichrysum Baxteri, F. v. M.	Fr., P.	N.	Erect herb	Dune scrub
Senecio lautus, Soland.	Fr., P.	Th.	Free branching herb	Dunes
Skirrophorus strictus, A. Gray	—	Th.	Erect ephemeral, 3 cms.	Margins saline areas
Calocephalus Brownii, F. v. M.	Fr., P.	N.	Divaricating shrub, white tomentum, leaves 5 mm. erect, forming mounds to 3 m. diam.	Dunes, granitic boulders on coast, cliffs
**Centaurea militensis*, L.	—	Th.	Erect annual	Ruderal
**Sonchus oleraceous*, L.	—	Th.	Erect herb	Ruderal, occasional secondary areas
**S. asper*, All., var. *littoralis*, J. M. B.	Fr., P.	Th.	Erect fleshy-leaved herb	Littoral, dunes
**Hypochoeris glabra*, L.	—	Th.	Rosette plant	Secondary areas

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DESCRIPTION OF PLATES XXI. to XXIII.

Plate XXI.

Fig. 1. Headland of consolidated sands and travertine resting on granitic platform. Flora of dwarf bushy type described in the text, p. 278.

Fig. 2. Pure woodland of *Melaleuca parviflora* taken from the edge of an invading sand dune to show the monospecific type of community-developed and the density of the foliage.

Plate XXII.

Fig. 1. View from sandy rise in *Melaleuca parviflora* woodland. The open places in the middle distance are secondary areas, clearings due to fire. The undershrubs in the foreground are *Correa rubra, Westringia rigida* var., and *Olearia axillaris.*

Fig. 2. Clearing in *Melaleuca parviflora* woodland showing effect of recent burning. The dead bushes are *Myoporum insulare* and the scorched trees *Melaleuca.* Undershrub of *Correa* in foreground. The flora of annuals on page 280 was listed near this spot.

Plate XXIII.

Fig. 1. Gypsum salt-swamp colonized by *Arthrocnemum halocnemoides,* var. *pergranulatum.* The swamp is fringed by *Melaleuca halmaturorum* thickets. In the foreground is a sand-dune recently fired.

Fig. 2. Gypsum salt-swamp mainly colonized by *Arthrocnemum halocnemoides* var., but with wetter central area occupied by *Arthrocnemum* sp. Fringing thicket of *Melaleuca halmaturorum* as before. The foreground has recently been burnt. Across the swamp is secondary thicket of *Myoporum insulare.*

Fig. 3. View from highest point on island, a granite outcrop, looking north, and showing extent of secondary shrubland, chiefly of *Myoporum insulare* and *Olearia axillans.* In foreground shrub community with *Olearia ramulosa* dominant. Note trees of *Casuarina stricta* to right and few trees of same on granite outcrop in the middle distance.

ON THE ECOLOGY OF THE VEGETATION OF ARID AUSTRALIA,
No. 1.
INTRODUCTION AND GENERAL DESCRIPTION OF THE KOONAMORE RESERVE FOR THE STUDY OF THE SALTBUSH FLORA.

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[Read October 8, 1925.]

Plate XXIV.

It is proposed in the present paper, and in others of the same series that will appear from time to time, to give some account of the vegetation of arid Australia. If an arid climate be defined as one receiving 10 inches of rain, or less, each year, then about 37 per cent. of the area of Australia is arid; 1,105,452 square miles out of a total area of 2,974,581 square miles. In South Australia alone, 317,600 square miles out of the 380,070 square miles included in the State, or, roughly, five-sixths of the area, has 10 inches of rain or less *per annum*. It thus follows that not only is a botanist resident in South Australia very favourably situated for the study of an arid flora, but also that the problems connected with arid vegetation are, or should be, of considerable importance to the State as a whole.

During the past few years the ecology of the arid portions of Australia has been a subject of study by several workers. Mention may be made of the work of Cannon, Adamson and Osborn (1922), Osborn and Wood in South Australia, as well as that of Miss Collins in the district of New South Wales immediately adjacent to the South Australian border. As a result our knowledge of the major plant communities has become more precise, though much remains to be done in the way of elucidating the inter-relationships of these communities and on the trend of succession as a whole. We are, however, in a position to make certain broad generalizations.

The first is that as we approach the arid regions, the eucalypt, typical of so much of the wetter portions of Australia, becomes a less and less important element in the vegetation. Adamson and Osborn (1924) have shown how the sclerophyll forest, dominated by such an eucalypt as *E. obliqua*, which is developed near Adelaide in regions of more than 30 inches annual rainfall with a winter maximum, is replaced by the savannah forest in the drier areas. This more open forest type has its climatic range between the 30- and 15-inch isohyets in South Australia. At its more arid limit the forest is replaced by scrub and the mallee formation is developed. Mallee is a scrub composed of various species of eucalypts growing to a height of from 2 to 10 metres, or, exceptionally, more. Several stems, bearing a canopy top of foliage, arise from a large root stock and develop a most characteristic habit. It is clear that the term mallee must pass into ecological usage as one descriptive of a definite vegetation type. As yet the ecology of the mallee formation has been little investigated. Certain purely descriptive accounts have been given (Hardy, 1914), while Adamson and Osborn (1922) examined a mallee community at Ooldea. The mallee vegetation is so important in parts of Victoria and South Australia that it merits more detailed study.

The climatic limit of mallee appears to lie between 10 and 8 inches of annual rainfall. In New South Wales it reaches the limit about Broken Hill (Collins, 1923), and in South Australia about Koonamore (Osborn and Wood, 1923b).

Proceeding northwards towards the more arid and even desert regions (areas with under 5 inches annual rainfall) the eucalypts disappear except as "fringing forests" along the intermittent rivers. These are usually bordered by *Eucalyptus rostrata,* the river red gum, which has a very wide range over the continent, or *Eucalyptus microtheca,* the Box or Coolabah. This last is distinctly xerophytic. It is the riverside tree of the desert area and also colonizes flats liable to occasional flooding within the arid zone.

Except for these species the eucalypt has disappeared as an important element in the flora. With increasing rainfall it reappears within the Tropic, but this region is outside that to be considered in these studies.

Secondly, and concurrently with the decreasing importance of the eucalypt, one notices the appearance of new vegetation types. Shrubby and low-growing species of Acacia become increasingly prominent. Of these the mulga *(Ac. aneura),* a canopy-topped tree rarely exceeding 5 metres in height, is probably the most important. Collins (1923) uses the term "mulga scrub association" for the various scrub communities developed on rocky slopes about the Broken Hill area. Used in this sense it covers several communities, some of which are dominated by other genera, *e.g., Eremophila* spp. Describing a somewhat similar habitat at Copley, Cannon (1921, p. 73) notes the great importance of *Cassia* spp. and *Eremophila* spp., referring indeed to a Cassia-Eremophila community.

However, in addition to the various scrub communities of the hill slopes, which for the present may conveniently be grouped under the "mulga scrub association," there is a second vegetation type, that of the plains. Arid Australia is, as a whole, not a country of sharp relief. Though the altitude may be about 1,000 feet over large areas, and though it falls to —39 feet around Lake Eyre, the transitions are gradual; there are vast plains and peneplains. Except for the Flinders Range itself there are few abrupt changes in level. Even the MacDonnell Ranges, situated near the Tropic of Capricorn and within the Northern Territory, though they attain 4,000 feet, appear much lower than their true height above sea level because they arise from a plateau of 2,000 feet altitude. The principal vegetation type over the southern portion of these plains is the saltbush.

Saltbush is a general descriptive term for the low shrubby annual or perennial species of such genera as *Atriplex* and *Rhagodia.* Osborn and Wood were chiefly concerned with this vegetation type, or with the nearly allied bluebush (white tomentose species of *Kochia),* in their paper (1923B) on the Halophytic and Non-Halophytic Communities of Arid South Australia.

These low shrublands, dominated by various species of Chenopodiaceae, form a distinct vegetation type. Climatologically it appears limited to regions of 10 inches annual rainfall or less. A most interesting application of ecology, before ecology was a recognised branch of Botany, was the use made by a former Surveyor-General (Goyder) of the occurrence of saltbush to delimit the droughty areas in 1865. Goyder's Line coincides wonderfully with the 15-inch isohyet over much of its length. In determining the northern and eastern distribution of saltbush vegetation the season of maximum rainfall appears to be significant. With the increasing importance of the summer rainfalls, grasses become a more prominent feature of the permanent flora. Miss Collins (1924) has described an area in New South Wales to the north of Broken Hill which must be nearing the limit of the saltbush owing to summer rainfall control. We have, however, insufficient data, as yet, to define the climatic control of saltbush. It extends as an important vegetation type far into the Northern Territory above the South Australian border.

At the southern limit, however, the saltbush and mallee formations overlap to some extent. In those countries where physiographic relief is great, sharply defined formations may be seen. This is not so in arid Australia. Consequently there may be a broad zone in which the two formations overlap—the mallee, typical of arid-semi-arid conditions, and the saltbush, a distinctly more arid type. In such a zone the two vegetation types do not merely dovetail into each other, but are, as it were, superposed. This is the condition of saltbush with mallee described by Osborn and Wood at Dilkera (1923B). Where, however, an abrupt change in edaphic conditions occurs, leading to the contiguity of two habitats with differing degrees of aridity, then the two formations may be sharply delimited. This is the state of affairs at the edge of the Nullarbor Plain at Ooldea, described by Adamson and Osborn (1922). At such a junction the essentially more arid nature of the saltbush-bluebush type can be seen.

In the course of their work on the arid vegetation it was shown by Osborn and Wood (1923A and B) that these low shrubby chenopodiaceous plants are not halophytic, but that they grow in soils of relatively low salt content. Nevertheless, their leaves do contain a high percentage of sodium chloride. As Wood has shown (1925) this is concerned with the direct absorption of water by the leaves, thus enabling the plants to utilise light falls of rain.

Slight falls of rain occurring in an arid region at a time when the soil is dry and dusty do not penetrate the ground to a depth sufficient to reach the roots of the plants. Falls of this "ineffective" type are a feature of much of arid Australia (Cannon, 1921). They render the figures for the annual rainfall, even the monthly totals, unreliable as a true indication of the value of the precipitation to permanent vegetation. Cannon estimated that a fall of ·15 inches and under was "ineffective" if it fell during a dry period. Osborn and Wood (1923B) and Wood (1925) discuss the same feature of rainfall. Yet, as Wood has shown, the dominant plants of the arid region are in a remarkable state of equilibrium so far as their water relations with the environment is concerned (1923 and 1924). The transpiration rate is not only absolutely low, but it is relatively independent of the diurnal variations in the climatic factors influencing transpiration rates.

It seems possible that this capacity on the part of saltbushes to utilise directly light falls of rain may account, in part, at any rate, for the richness of the Australian arid flora. This contains not merely a very diverse assemblage of species, but also a surprisingly large number of individuals per unit of area. Were it only that the number of *annual* species was great, that would merely be an application of the Therophyte test to indicate arid or desert climate. The surprising feature is the number of perennial individuals (Nanophanaerophytes or Chamaephytes) that form an almost closed community over large areas. When it is remembered that many of these (*Atriplex* spp., and *Kochia*, *Bassia*, and *Rhagodia* to a lesser extent) can utilise light rainfalls directly, this richness in the flora becomes more comprehensible.

In studying the vegetation of an area the three groups of factors—climatic, edaphic, and biologic—must all be considered. Farrow (1925) has very pertinently emphasized the importance of the biologic factor in his studies at Breckland and has shown how misleading conclusions as to distribution may be, if drawn from such data, as, *e.g.*, soil analyses alone.

The importance of the biologic factor in determining the vegetation type in arid Australia to-day is very great. Until the advent of white settlers with their flocks and vermin (rabbits) the flora had evolved without the incidence of close grazing animals, for the native marsupials are not close feeders, though they once existed in great herds.[1] Yet there is no evidence that such regressive changes in the permanent vegetation were produced by these animals as have been produced by the grazing of sheep or rabbits.

(1) The killing on several occasions of close on 1,000 kangaroos in one day is on record, as is the slaughter of 1,400 animals in a single day. These figures refer to that part of arid South Australia adjacent to the Great Australian Bight.

The result of the work so far conducted upon the arid vegetation has been to show that the dominant plants are in a state of equilibrium with their environmental factors. The balance is a delicate one, and the incidence of an additional adverse factor correspondingly severe. Profound changes result from human interference. As examples, on a small scale, may be cited, the condition of the vegetation on Pearson Islands (Osborn, 1923), uninhabited islands almost in their virgin state, when compared with Flinders Island (Osborn, 1925). There the effect of only a slight degree of exploitation has been to modify profoundly the vegetation.

Any worker on the vegetation of arid Australia to-day must immediately be struck by two features, namely, the failure of the woody plants to regenerate and the regressive state of many of the communities.

First, in regard to the regeneration of woody plants. Much more work is needed upon this subject. We know that in some species reproduction from adventitious root buds is important. *Pittosporum phillyraeoides* is such a species, as is also *Casuarina lepidophloia*. In the case of *Acacia Carnei*, which forms dense thickets in places, seed pods are very rare; root regeneration seems to be the rule and seed production the exception. Obviously, seed must form in these species, as well as in the case of other species such as the mulga *(A. aneura)* which have no means of vegetative propagation. We know nothing as to the existence of seed years among the trees and shrubs. Certainly heavy seeding is not an annual occurrence. There also appears to be a high degree of sterility among many species.

Adamson and Osborn refer to this in connection with the plants of the Mount Lofty forests (1924). Not only are seeds not set in proportion to the abundant promise of the flowering, but insect pests take a heavy toll of those that are ripening. Each year in the Mount Lofty Ranges *Acacia pycnantha* shows a wealth of bloom. It is rare to find trees with a proportionate crop of seed. This may be connected with the weather conditions at the time of flowering. Acacias have very exposed pollen, yet in the Mount Lofty Ranges most species flower before the close of the wet season. In the arid region it is improbable that the trees in full bloom are ever drenched by rain, but we do not know what the effect a period of hot, dry wind may be if it come when the plants are in flower. In short, if we know little as to the conditions determining seed production in the more settled districts, it is safe to say we know less about those affecting the species of the arid areas.

The widespread mulga is rarely found in fruit. There is some suggestion that this plant has had seed cycles in the past. The trees over considerable areas are often remarkably uniform as to size and apparent age. Reliable observers state that they have seen seedling mulgas in numbers occasionally, and that they are eaten out. Assuming that there may be a cycle of seed production, then there is also to be considered the effect of climatic and biologic conditions on germination and the establishment of the seedling. The work of Watt (1919 and 1923) on the causes of the failure of regeneration in the oak and beech woods in Britain, has shown how difficult it is to evaluate the complex of factors that operates upon woodland regeneration. Whatever the cause may be, it is clear that the mulga is not regenerating, and that it is doomed, if not to extinction, at least to relegation to a position of minor importance over large areas in which it at present is a dominant in the vegetation. Miss Collins (1924) has stressed this point, and my own observations, made over a wide extent of the arid interior, are in agreement with her conclusions.

Secondly, as to the regressive state of many of the communities. The white man, through the operation of his grazing animals and vermin, has been directly, if unconsciously, the cause of this. The Therophyte flora of the arid district is a varied assemblage of grasses and dicotyledonous herbs. Following a winter rainfall dicotyledons are most prominent, particularly composites, also *Erodium* and *Tetragonia expansa*, as well as many others. A summer rain leads to an increase in the importance of the grass element among the annuals that spring up. While these plants may provide most of the food for the stock when they are abundant, there is always a certain amount of browsing upon the shrubby perennials. In drought years these shrubs are the only fodder plants. The effect of this browsing is seen in varying degrees, ranging from a mere pruning to complete extinction (pl. xxiv.). Thus secondary bare areas are produced. These are colonized by plants of two types. One is the immigrant. An extensive scrub community in many places is composed of *Nicotiana glauca*, an alien plant that has spread remarkably in the arid areas. It is not eaten by stock and rarely suffers from rabbit attack. The second type of colonist is the plant from lower phases in the succession.

The operation of an additional adverse factor is to depress succession. This has been well shown by Bews in his study of fire effects on the Natal grass veldt (1918, p. 142), or by Potts on the veldt near Bloemfontein (1923). Observations on the trend of succession in the arid parts of South Australia have not yet been published. They show, however, that unstable soil areas such as steep hill sides, talus slopes, or the wide flood beds of intermittent creeks are colonized by pioneers many of which belong to the genera *Bassia* or *Zygophyllum*. Miss Collins (1923, p. 253) notes the importance of *Bassia brachyptera* on rubble slopes near Broken Hill. She is, however, inclined to regard the various species of *Atriplex*, *Kochia*, and *Rhagodia*, saltbushes and bluebushes in general, as pioneers within secondary areas in the community that she terms "acacia steppe" (1924, p. 13). With this broad generalization I am unable to concur without considerable reservation.

So far as my own observations go, made over an area ranging from the southern limit of saltbush to the MacDonnell Ranges in the north, and from Broken Hill in the east to Ooldea in the west, I can only regard the dwarf shrubland dominated by the various species of Chenopodiaceae variously termed saltbushes and bluebushes as a definite vegetation type. It has the characters of a climax. The mulga scrub is distinct. It may develop within the same district in areas of better water relations than the saltbush, *e.g.*, sand ridges, extinct river beds, or hill slopes. It must be remembered that in an arid area a hill slope may be a more favourable place for water supply than a plain. The catchment is greater, and rock crevices may provide small local reservoirs for moisture. Adamson and Osborn note (1924) that with the gradual extinction of the forest type nearing the Murray Basin *Casuarina stricta* forms the last vestige of the forest on granitic outcrops. The surrounding plain is occupied by mallee, a distinct and more arid formation. Also on Pearson and Flinders Islands, the highest woodland types occur on rocky outcrops (Osborn, 1923 and 1925). So with *Casuarina lepidophloia*, which commonly forms fringing woodlands by creeks in the arid area or colonises flats liable to flooding. This tree may, as Collins notes, occur on rocky slopes. It is, however, difficult to agree with her suggestion that this is because of the need for "better light relations" (1923, p. 247). It seems more reasonable to regard it as another instance of the better water relations of certain hill slopes. The work of Wood and the writer has tended to recognise what have been termed (Wood, 1924) "tomentose microphylls," as building up a definite vegetation type. That *Acacia aneura* scrub may in places be superposed on this does not invalidate the separation of the two. At their boundaries they may overlap, as mallee and satbush overlap. It is not impossible that mulga scrub and saltbush belong to the same formation; they may well be distinct subformations, much as Adamson and Osborn (1924) recognise two subformations in the savannah forest corresponding to the wetter and drier zones.

Whatever be the status of saltbush, it is clear that over considerable areas of the north-east of South Australia to-day, communities of *Atriplex vesicarium* or *Kochia sedifolia* have been replaced by annuals among which species of *Bassia* are most prominent (pl. xxiv., figs. 1 and 2).

This regression is serious. It means that not only are fodder plants of value disappearing, but that large secondary areas are open to the action of erosive forces, always severe in an arid climate. There being no covering of low bushes to hold the soil, it drifts. Attention has been drawn elsewhere to the important part taken by plants having the Nanophanaerophytic or Chamaephytic life form in the vegetation of arid Australia (Osborn, 1923 and 1925). The effect of the factors inducing regression is felt most severely by the low shrub.

In order to study regeneration in the arid areas, then, it is essential to have some typical area enclosed against all stock and vermin, and to have it cleared of rabbits. There alone can one hope to reproduce to some degree the conditions which must have obtained in Australia before settlement.

The Koonamore Vegetation Reserve.

Koonamore is a sheep station of 1,100 square miles situated in the north-eastern district of South Australia. It has an average rainfall of 8·18 inches. The area includes a considerable diversity of country, both plain and hill. The soil types range from gypsum salt-swamps to soils derived from both igneous and sedimentary rocks. During the past few years repeated visits have been made to the area, owing to the kindness of the owners, Messrs. Hamilton, Wilcox, Ltd., and their manager, Mr. J. P. Henderson. A study of the ecology of the area is in preparation, and, in the meantime, some of the observations made there have been the subject of communications by Wood and the writer.

Recognising the need for an enclosure for the study of the flora, Messrs. Hamilton, Wilcox, Ltd., have generously enclosed with a rabbit-proof fence an area of about 1,500 acres, which they have offered to the University of Adelaide as a vegetation reserve for the remainder of their lease. Mr. S. Wilcox, one of the Directors, has had a three-roomed house erected near to the entrance of the enclosure to serve as a field laboratory. It is the further purpose of this brief note to give a preliminary account of the reserve.

The land enclosed is of a slightly undulating nature with a general slope towards the north-west. There are no regular watercourses upon it, but, following heavy rains, two portions near the western boundary become flooded. The soil is generally a sandy loam with some travertine limestone, which outcrops near the south-east corner. The vegetation to-day is in a degenerate state. As one of the primary objects of the reserve is to study regeneration, the area selected for enclosure was deliberately chosen as being "the worst eaten-out corner of the paddock." Grazing effect is very often unequal in a paddock. During the summer months sheep graze down the wind. The prevalent winds at this season are from the south and south-west, so that that side of the paddock naturally tends to become eaten out first (pl. xxiv., figs. 1 and 2). The reserve is along the south fence of a paddock, and most of the perennial undershrubs in the original flora have disappeared.

The area must once have been a typical bit of scrub and dwarf shrubland. Most of the original scrub timber is left, but there are no young trees. The tree species represented are:—

Casuarina lepidophloia, Acacia aneura, Eucalyptus oleosa, Myoporum platycarpum.

Low trees and tall shrubs of secondary importance are:—

Fusanus acuminatus, Acacia Burkittii, Cassia Sturtii, Lycium australe.

Of the original undershrub covering little is left (pl. xxiv., fig. 3). There are a few plants of *Kochia sedifolia,* but the saltbushes seem to have disappeared. On the other hand, species of *Bassia, B. paradoxa, B. patenticuspis, B. obliquicuspis,* etc., are very abundant, and form the principal ground cover. On the flooded flats dense societies of the large blue-flowering composite *Erodiophyllum Elderi* are a prominent feature.

It is proposed to establish permanent quadrarts inside the reserve to study the regeneration of the different communities in detail. Further, when regeneration commences, grazing effects will be studied by enclosing selected areas and grazing by sheep for definite periods.

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DESCRIPTION OF PLATE XXIV.

Fig. 1. Portion of Vegetation Reserve at Koonamore looking south across the dividing fence to a relatively vigorous bluebush *(Kochia sedifolia)* community. Note the absence of low perennial vegetation in the foreground. The plants are *Bassia* spp. and *Salsola kali. Myoporum platycarpum* is the chief tree.

Fig. 2. View along division fence between the Vegetation Reserve, to right, and the neighbouring paddock. As explained in the text, the incidence of grazing has been much more severe on the portion to the right than on the left. On the left is a fairly vigorous bluebush community. On the right, within the Reserve, this has been completely destroyed, though the arborescent vegetation is left. This consists largely of *Ac. aneura* and *Ac. Burkettii.*

Fig. 3. General view in Vegetation Reserve showing open woodland of *Myoporum platycarpum* with secondary annual ground flora of *Bassia* spp. The dead undershrubs are *Cassia Sturtii* and *Kochia sedifolia.*

MISCELLANEA.

NOTE ON THE NON-EXISTENCE OF THE SUPPOSED ALDEHYDE "CNEORAL".

By A. R. Penfold, F.A.C.I.; F.C.S.,
Economic Chemist, Technological Museum, Sydney.
(Communicated by Dr. W. T. Cooke.)

In the Transactions of the Royal Society of South Australia, vol. xlvi., 1922, appears a paper, entitled "An Investigation of the Essential Oil from *Eucalyptus cneorifolia,* D.C.," by Philip A. Berry, B.Sc., in which he describes what is purported to be a hitherto undescribed aldehyde. The paper referred to has been widely abstracted, and in order to prevent needless confusion, I feel bound, in the interests of science, to bring under notice the opinion (based upon experiment) expressed by me in a private communication to the author in 1922, that the supposed new aldehyde had no separate existence, insufficient evidence being adduced in support. Moreover, the author had overlooked the writer's communication to the Chemical Society, London (Transactions, 1922, vol. 121, pp. 266-269), where the aldehyde "aromadendral" was shown to be a mixture of phellandral and cuminal. Mr. Berry in his statement "that four aldehydes are present in the oil of *E. cneorifolia*—cuminal, aromadendral, cryptal, and cneoral," entirely overlooks the fact that "aromadendral" consists, at times, mainly of phellandral, and ignores this last-named aldehyde altogether.

The fractions referred to by Mr. Berry as representing cneoral, p. 219, were obtained by me during 1920-21 when examining the aldehydes of *E. polybractea, E. hemiphloia,* and *E. cneorifolia,* but were found to consist of mixtures of phellandral, cryptal, and their alteration products. Mr. Berry, himself, produces the evidence in support of my contention by the preparation of a small quantity of an oxime of melting point 84-85° C., which was the melting point recorded by Baker and Smith (Trans. Roy. Soc. S. Austr., 1916, vol. xl., p. 485) for "aromadendral" oxime. I showed (p. 269, Transactions Chemical Society, London, 1922) that the mixtures of aldehydes separated from eucalyptus oils which yielded oximes of melting point 84 85° C. consisted largely of phellandral in admixture with small quantities of other aldehydes. Phellandral in admixture with small quantities of either cuminal, cryptal, or their alteration products, almost invariably yields an oxime of M.Pt, 84-85° C. With the single exception of the preparation of the oxime of phellandral, Mr. Berry has produced no evidence in support of the individuality of the supposed aldehyde. The writer's critical examination of the aldehydes present in the crude oils of *Eucalyptus polybractea, E. hemiphloia,* and *E. cneorifolia* has shown most conclusively that only three are present—cuminal, phellandral, and cryptal. The names, "aromadendral" and "cneoral" should, therefore, be deleted from the literature, as their retention will only cause confusion.

Evening Meeting, September 10, 1925.

THE ALDEHYDES PRESENT IN THE ESSENTIAL OIL OBTAINED FROM EUCALYPTUS CNEORIFOLIA.

(A reply to Mr. A. R. Penfold's Criticism of September 10, 1925.)

In a paper entitled "Notes on the non-existence of the supposed aldehyde cneoral" communicated to the Royal Society of South Australia on September 10, 1925, Mr. A. R. Penfold, F.A.C.I., F.C.S., criticises a paper (1) written by the present writer and published in vol. xlvi. (1922) of the Transactions of the Royal Society of South Australia.

The writer, in reply, stated that while he had not overlooked Mr. Penfold's communication to the Chemical Society, London, (2) in which it was claimed that aromadendral was a mixture of phellandral and cuminal, he was unable to obtain analogous results with the oil of *E. cneorifolia.*

The writer used the name aromadendral in reference to the aldehyde with the high laevo rotation which was separated by decomposing with sodium carbonate the solid bisulphite compound of the aldehyde with sodium acid sulphite, according to the method of Baker and Smith, (3) and was unable to confirm the presence of phellandral in this or any other aldehyde fraction from *E. cneorifolia* when working along the lines suggested by Mr. Penfold *(loc. cit.).*

Phellandral is easily oxidised in the air to an acid with a melting point of 144° C., and no fraction of the aldehydes which the writer separated from *E. cneorifolia* could be thus oxidised. The writer therefore stressed the point (4) that the aldehyde which he called cneoral could not be identical with phellandral, and still maintains this.

The writer previously admitted that the nature of these aldehydes had not been fully determined, and while still of the same opinion hopes to undertake further work on this subject in the near future.

P. A. Berry, B.Sc., A.A.C.I.,
C/o A. M. Bickford & Sons, Ltd., Adelaide.

References.

(1) An Investigation of the essential oil from *Eucalyptus cneorifolia,* D.C. (the "Narrow Leaf Mallee" of Kangaroo Island), by Philip A. Berry, B.Sc. Trans. Roy. Soc. S. Austr., vol. xlvi. (1922), p. 207.

(2) A Critical Examination of the Aromatic Aldehydes occurring in certain Eucalyptus Oils, A. R. Penfold. Journ. Chem. Soc., 1922, p. 266.

(3) A Research on the Eucalypts and their Essential Oils, R. T. Baker and H. G. Smith.

(4) Trans. Roy. Soc. S. Austr. (1922), p. 218.

ABSTRACT OF PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

(Incorporated)

FOR THE YEAR NOVEMBER 1, 1924, TO OCTOBER 31, 1925.

ORDINARY MEETING, NOVEMBER 13, 1924.

THE VICE-PRESIDENT (R. H. Pulleine, M.B.) in the chair.

NOMINATIONS.—Sir George Murray, K.C.M.G.; Prof. Wm. Mitchell, D.Sc.; Prof. Jas. A. Prescott; and L. S. Rogers, B.D.Sc.

PHOTOGRAPHS.—Photographs were received from Sir Charles Fergusson, Scotland, of his late father, Sir James Fergusson, President of this Society 1869-72, for the Society's records.

PAPER.—"New Australian Lepidoptera," by Dr. A. JEFFERIS TURNER.

DISCUSSION.—The following questions presented by the Royal Society of Western Australia were submitted by the Council for the opinion of the general meeting:—

1. That the Royal Societies in each State be recommended to form Sections for Mathematical and Physical Science (or to set aside certain meetings for dealing with such branches of Science).

2. That the Secretary of each such Section submit (in galley proof or typescript) suitable original Papers read before his Section to the Secretaries of the Sections of the other Societies for the purpose of having these read before their Sections or otherwise circulated amongst interested members.

3. That constructive criticism of such Papers should be invited from the Sections for submission to the authors.

4. That it would be highly advantageous for the various Royal Societies in Australia to adopt a uniform size of page for their publications.

It was decided that the matter be referred back to the Council for decision.

PATRON'S VISIT.—THE CHAIRMAN announced that His Excellency the Governor (Sir Tom Bridges), who had notified his intention of being present at the meeting, was prevented from coming by indisposition.

LECTURETTE.—"Central Australia," illustrated, by L. KEITH WARD, B.A., B.E.

ORDINARY MEETING, APRIL 9, 1925.

THE PRESIDENT (Sir Douglas Mawson, D.Sc., F.R.S.) in the chair.

NOMINATIONS.—Hon. Hermann Homburg; H. N. England; Prof. A. E. V. Richardson, M.A., D.Sc.; James H. Gosse.

ELECTIONS.—Sir Geo. Murray, K.C.M.G., LL.M.; Prof. Wm. Mitchell, D.Sc.; Prof. Jas. A. Prescott, M.Sc.; L. S. Rogers, B.D.Sc., as Fellows.

PAPERS.—"The Geographical Distribution of Fossiliferous Rocks of Cambrian Age in South Australia, with Geological Notes and References," by

Prof. Walter Howchin, F.G.S.; "On Rolling Downs Fossils collected by Prof. J. W. Gregory," by F. W. Whitehouse, M.Sc., F.G.S. (communicated by Edwin Ashby).

Obituary.—The President referred to the loss by death of two highly esteemed members of the Society, Messrs. Evan R. Stanley, F.G.S., and Oswald B. Lower, F.Z.S.; both gentlemen had contributed papers to the Transactions of the Society.

Congratulations.—The President extended to Prof. F. Wood Jones the hearty congratulations of the Society on his election as a Fellow of the Royal Society.

Exhibits.—Mr. Edwin Ashby, M.B.O.U., exhibited two skins of the Tasmanian *Strepera arguta,* collected recently at the Great Lake, Tasmania, at an altitude of 3,000 feet. Mr. Paul S. Hossfeld showed a specimen of fibrous gypsum from Stuart's Range opal field. Mr. A. M. Lea, F.E.S., exhibited specimens showing the life history of a small coconut moth, *Levuana iridescens,* now threatening the copra industry of Fiji, also a similarly destructive moth, *Brachartona catoxantha,* that occurs in the Malay States, Java, and Borneo, together with a fly parasite that efforts are now being made to introduce to Fiji to control the larvae of the *Levuana.*

Ordinary Meeting, May 14, 1925.

The President (Sir Douglas Mawson, D.Sc., F.R.S.) in the chair.

Nominations.—T. E. Barr Smith, B.A.; John Barker; A. Lewis, M.B., B.Sc.

Elections.—Hon. Hermann Homburg; H. N. England; Prof. A. E. V. Richardson, M.A., D.Sc.; James H. Gosse, as Fellows.

Papers.—"Flora and Fauna of Nuyts Archipelago and the Investigator Group: No. 17, The Scorpions," by L. Glauert, F.G.S. (communicated by Prof. F. Wood Jones); "Notes on the Geological Structure of Central Australia," by L. Keith Ward, B.A., B.E.

Members' Roll.—The President mentioned that the Council has informally decided that members should be asked to use every effort during the present year to strengthen the Society by the addition of new members.

Exhibits.—Mr. A. M. Lea exhibited some remarkable insects from Fiji, including a walking-stick insect destructive to coconuts, two large firefly beetles, some small fungus beetles, the small ladybird *Novis cardinalis,* and a series of butterflies showing a great range of variation though reared from a batch of eggs laid in captivity. Prof. F. Wood Jones exhibited a specimen of *Macroderina gigas,* a large bat-eating bat from Wooltana Caves, and a specimen of hair of Tasmanian aboriginals. Mr. L. Keith Ward showed specimens of *Cryptozoön,* glaciated pebbles of Permo-Carboniferous and possibly Cretaceous ages, sandstone with arenicolites, etc.

Ordinary Meeting, June 11, 1925.

The President (Sir Douglas Mawson, D.Sc., F.R.S.) in the chair.

Elections.—T. E. Barr Smith, B.A.; A. S. Lewis, M.B., B.Sc., as Fellows.

Papers.—"The Vanadium Content of Certain Titaniferous Iron Ores of South Australia," by A. R. Alderman, B.Sc. (communicated by Sir Douglas Mawson); "Notes on Certain Fossiliferous Terrestrial Formations of Recent Age in South Australia," by F. Chapman, A.L.S., F.R.M.S., and D. Mawson, D.Sc., F.R.S.

Discussion.—Mr. L. K. Ward reopened the discussion of his paper on Central Australia, read at the last meeting, and the President and other Fellows contributed to the discussion. The chief points dealt with were (a) the suggested Ordovician age of the whole of the Larapintine Series, and (b) evidence in favour of glacial action in Upper Cretaceous times.

Exhibits.—Mr. A. M. Lea exhibited a small collection of insects from Dorrigo, N.S.W., of which the most interesting were a new stag beetle and a remarkable earwig. Mr. Lea also showed seven skulls of Fijian natives, killed in an inter-island war, and obtained from a cave on an island in the Lau group. Dr. R. Pulleine exhibited two shaped stones from Sandy Cape, Tasmania, formerly the metropolis of the Tasmanian natives of the West Coast. Mr. H. M. Hale, for Mr. W. J. Kimber, exhibited sub-fossil chelipeds of crabs, obtained in the Pliocene cliffs at Port Willunga, probably representing three still existent species.

Ordinary Meeting, July 9, 1925.

The President (Sir Douglas Mawson, D.Sc., F.R.S.) in the chair.

Nominations.—Rev. W. O. North; W. J. Adey; W. B. Carr; Dudley C. Turner.

Welcome.—The President extended a welcome to Prof. Richardson and Prof. Prescott.

Notice of Motion.—The Treasurer (Mr. B. S. Roach) gave notice of motion: "That all fees received from Life Members be paid into the Endowment Fund."

Papers.—"The Flora of the North-east Corner of South Australia, North of Cooper's Creek," by J. B. Cleland, M.D., J. M. Black, and L. Reese; "A New South Australian Dormouse Opossum," by F. Wood Jones, D.Sc., F.R.S.; "A Dental Anomaly in the Skull of an Australian Aboriginal," by T. D. Campbell, D.D.Sc.; "Radio-active Ilmenite near Mount Painter, Northern Flinders Range," by A. C. Broughton.

Announcement.—The President intimated that applications were invited by the Australian National Research Council from persons qualified and desirous of visiting Sumatra during the coming Solar eclipse.

Exhibits.—Mr. A. M. Lea exhibited mole crickets from Virginia (South Australia), with seeds of wheat, trefoil, and clover stored by them; also three males of the beautiful butterfly *Ornithoptera brookiana*, taken by him in Malay. Mr. Edwin Ashby exhibited photograph fruit and seedlings of *Banksia serrata* from Tasmania, also two fruits of *Podocarpus Drouyiana* from south-west Western Australia. Sir Douglas Mawson exhibited some beautiful specimens of fossil algae, resembling Cryptozoön, from the limestone belt of the Flinders Range, a matter on which he was preparing a paper for presentation to the Society, also "lime biscuits" of organic origin, from Robe, South Australia.

Ordinary Meeting, August 13, 1925.

The President (Sir Douglas Mawson, D.Sc., F.R.S.) in the chair.

Nomination. Elmer A. Smith, Ph.D. (U.S.A.).

Elections.—Rev. W. O. North; William J. Adey; W. B. Carr; Dudley C. Turner, as Fellows.

Notice of Motion.—One notice having been given, Mr. B. S. Roach (Treasurer) moved: "That all fees received from Life Members be paid into the Endowment Fund." Carried unanimously.

PAPERS.—"Evidence and Indications of Algal Contributions in the Cambrian and Pre-Cambrian Limestones of South Australia," by Sir DOUGLAS MAWSON, D.Sc., F.R.S.; "Aboriginal Markings on Rocks near Burra (Kooringa)," by JOHN P. H. BIDDLE (communicated by Mr. A. G. Edquist); "Detailed Notes on the Aboriginal Intaglios near Burra," by T. D. CAMPBELL, D.D.Sc.; "Review of Australian Isopods of the Cymothoid Group, Part I.," by HERBERT M. HALE.

EXHIBITS.—Mr. C. T. Madigan, on behalf of Mr. H. L. SHEARD, exhibited a collection of aboriginal implements and other relics from Victoria and South Australia. Mr. EDWIN ASHBY exhibited Jonathan apples showing a curious affection. Mr. A. M. LEA exhibited a collection of bugs from Malay, Borneo, and Fiji; also specimens of *Peripatus gilesi* from Western Australia. Mr. H. M. HALE exhibited aboriginal rock carvings from Owieandana and Mannahill. Dr. T. D. CAMPBELL exhibited aboriginal implements from the famous aboriginal quarry on Mount William, Victoria.

ORDINARY MEETING, SEPTEMBER 10, 1925.

THE PRESIDENT (Sir Douglas Mawson, D.Sc., F.R.S.) in the chair.

NOMINATION.—Harold Sheard, Gawler, as Fellow.

ELECTION.—Elmer A. Smith, Ph.D. (U.S.A.), as Fellow.

AUDITORS.—Messrs. W. Champion Hackett and H. Whitbread were elected as Auditors.

OBITUARY.—THE PRESIDENT announced the death at Enghien, near Paris, on May 17, 1924, of M. Alexandre E. M. Cossman, who was an Honorary Fellow of this Society since 1893.

PRESENTATION.—The University of Adelaide presented a number of publications, including the "Dentition and Palate of the Australian Aboriginal," by T. D. Campbell, D.D.Sc.

PAPERS.—"The Tanunda Creek Granite and its Field Relations," by PAUL S. HOSSFELD, B.Sc.; "The Geology of the Fleurieu Peninsula, Part I., The Coast from Sellick's Hill to Victor Harbour," by C. T. MADIGAN, M.A., B.Sc.; "Notes on the Non-existence of the supposed Aldehyde Cneoral," by A. R. PENFOLD, F.A.C.I., F.C.S.; "Contributions to the Orchidology of Papua and New Guinea," by R. S. ROGERS, M.A., M.D.; "Australian Staphylinidae, Part II.," by ARTHUR M. LEA, F.E.S.

EXHIBITS.—Mr. W. J. KIMBER exhibited egg capsules of *Natica (polinices conica)*. Dr. T. D. CAMPBELL showed photographs and X-ray pictures of a unique case of misplaced upper molar tooth. Mr. R. GRENFELL THOMAS showed a preparation of the radio-active element Polonium, from Mount Painter ores. Mr. A. M. LEA exhibited weevils of the subfamily Gonipteridae and moths showing ravages of Museum vermin, and on behalf of Mr. H. A. STEPHENS a stone churinga from west of Oodnadatta.

ANNUAL MEETING, OCTOBER 8, 1925.

THE VICE-PRESIDENT (R. H. Pulleine, M.B.) in the chair.

ELECTION.—Harold Sheard, Gawler, as Fellow.

NOTICE OF MOTION.—Prof. W. HOWCHIN gave notice: "That in the interests of the Society the term of Corresponding Members be limited to five years from the date of their last contribution."

PAPERS.—"Crystal Forms of Tourmaline, Azurite, and Linarite," by Miss IRIS E. ROBERTSON (communicated by C. T. Madigan); "Additions to the Flora of South Australia, No. 23," by J. M. BLACK; "Flora and Fauna of Nuyts Archipelago and the Investigator Group, No. 18: Notes on the Vegetation of Flinders Island," by T. G. B. OSBORN, D.Sc.; "On the Ecology of the Vegetation of Arid Australia, No. 1: Introduction and General Description of the Koonamore Reserve for the Study of the Saltbush Flora," by T. G. B. OSBORN, D.Sc.

The ANNUAL REPORT AND FINANCIAL STATEMENT were read and adopted.

ELECTION OF OFFICERS.—The following officers were elected for 1925-26:—*President*, Prof. T. G. B. Osborn, D.Sc.; *Vice-Presidents*, Sir Douglas Mawson, D.Sc., F.R.S., Professor F. Wood Jones, F.R.S.; *Members of Council*, E. R. Waite, F.Z.S., C. Fenner, D.Sc., A. M. Lea, F.E.S.; *Hon. Secretary*, R. H. Pulleine, M.B.; *Hon. Treasurer*, B. S. Roach.

EXHIBITS.—Mr. A. M. LEA exhibited dragon flies from the Malay States, and scorpions from the Malay States, some of which are reported to be fatal to natives; also fossil shells and minerals from west of Oodnadatta on behalf of Mr. STEVENS. Amongst the latter Prof. Howchin detected *Ostrea, Mytilus*, and *McCoyella* (Cretaceous molluscs). Siliceous nodules of the Cretaceous Basin and some haematite were also exhibited.

ANNUAL REPORT

FOR YEAR ENDED SEPTEMBER 30, 1925.

PAPERS.—The traditional interest of the Society in research and discovery connected with the arid interior has been maintained in comprehensive papers, by Mr. L. K. Ward, "On the Geological Structure of Central Australia"; Prof. Osborn, "On the Ecology of the Vegetation of Arid Australia"; and Prof. Cleland and Messrs. Black and Reese, "On the Plants of the Far North-east." Mr. Ward also delivered an illustrated lecture on Central Australia. A high standard has been maintained in the papers contributed to the Society. About one-half of the papers read during the year dealt with geology and mineralogy; there were several very important botanical papers, and five dealing with biological subjects, mostly concerning the invertebrate groups; there were also three papers relating to the aborigines, and one minor paper of chemical interest.

Our knowledge of Cambrian geology has been added to by Sir Douglas Mawson, Prof. Howchin, and Mr. Madigan; of the Larapintine Series, by Mr. Ward; of Cretaceous palaeontology, by Mr. Whitehouse; and of Recent formations, by Mr. F. Chapman and Sir Douglas Mawson. The study of the petrology and mineralogy of our State has been contributed to by Mr. Alderman, Mr. Hossfeld, Miss Robinson, and Mr. Broughton.

Botanical papers were contributed by Prof. Osborn, Mr. Black, Dr. Rogers, Prof. Cleland, and Mr. Reese; it is of interest to note the large proportion of papers dealing with the more remote areas of the State. Zoological contributions came from Dr. Turner (Lepidoptera), Mr. Glauert (Scorpions), Prof. Wood Jones (a new Dormouse Opossum), Mr. Hale (Crustacea), and Mr. Lea (Staphylinidae). Dr. Campbell and Mr. Biddle dealt with matters of ethnological interest.

EXHIBITS.—These continued to be a feature of the monthly general meetings of the Society, and a variety of objects of considerable interest were exhibited and discussed; a record of same will be found elsewhere.

DEATHS.—The deaths of three Fellows are recorded with regret—Mr. Evan R. Stanley, F.G.S., late Government Geologist of Papua (elected 1910); Mr. Oswald Lower, F.Z.S., of Broken Hill, N.S.W. (elected 1888); and A. E. M.

Cossman, of Enghien, France (elected 1893). All these gentlemen had contributed valuable papers to the Proceedings of the Society; Mr. Evan Stanley, a young South Australian geologist, had contributed notably to our scientific knowledge of Papua and the Mandated Territories of New Guinea.

LIBRARY.—The Library Committee has met regularly and has instituted a number of new exchanges. This interchange of scientific literature with kindred Societies in other lands is now on an excellent footing. Consideration was given to the question of the better correlation of the scientific libraries of Adelaide, but no definite action was taken. The question of additional shelving, the need for which has been mentioned in every Annual Report for the past six years, was made the subject of a personal appeal to the Minister of Education by the President and the Representative Governor. Our representations were sympathetically received, and it is hoped that something will now be done to relieve the overcrowded shelves.

SUGGESTED NEW SECTION.—At the instance of Prof. Ross, of Western Australia, consideration was given to the matter of establishing a separate Mathematical and Physical Section, but it was decided not to take any action for the present. It was decided that, as far as possible, members should take steps to exchange galley proofs of Mathematical and Physical articles with interested members in similar Societies in other States.

COUNCIL.—The personnel of the Council has remained unchanged throughout the year. Ten Council meetings were held and the attendances were as follow:—Sir Douglas Mawson, 6; Dr. Pulleine, 9; Prof. Osborn, 8; Prof. Howchin, 9; Mr. Roach, 9; Prof. Cleland, 6; Prof. Wood Jones, 8; Prof. Robertson, 3; Mr. Waite, 9; Sir Joseph Verco, 10; Mr. Ward, 6; Dr. Fenner, 9. Sir Douglas Mawson and Mr. L. K. Ward were unavoidably absent from Adelaide on the occasion of several meetings.

MEMBERSHIP.—The present membership comprises 6 Honorary Fellows, 4 Corresponding Fellows, and 124 Fellows. The year has seen a distinct growth in the membership of the Society, and another notable feature has been an increased attendance of Fellows and a wider interest in the general meetings of the Society.

DOUGLAS MAWSON, *President.*
CHARLES FENNER, *Secretary.*

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Receipts and Payments Account for Year ended September 30, 1925.

	£ s. d.	£ s. d.
To Balance, October 1, 1924		463 14 1
,, Subscriptions—		
Royal Society	174 6 0	
Field Naturalists' Section	49 9 6	
		223 15 6
,, Grants from Government—		
On Subscriptions	122 13 5	
For Printing Reports and Scientific Investigations	150 0 0	
		272 13 5
,, Receipts for use of Room by other Societies	5 6 0	
,, Sale of Publications	5 15 0	
,, Difference in Exchange on Cheque	0 1 0	
		11 2 0
,, Interest—		
Savings Bank A/c	10 18 1	
Transferred from Endowment Fund	174 15 0	
		185 13 1
		£1,156 18 1

		£ s. d.	£ s. d.
By Transactions—			
Printing		343 10 0	
Illustrating		80 0 0	
Publishing		12 16 0	
			436 6 0
,, Grant—			
Field Naturalists' Section			50 0 0
,, Library—			
Librarian		45 4 6	
Book-binding		25 1 0	
			70 5 6
,, Sundries—			
Cleaning and Lighting		7 19 9	
Printing, Postages and Stationery		19 16 10	
Insurance		6 15 0	
Advertising		1 12 0	
Bank Account File		0 5 0	
			36 8 7
,, Life Members' Subscriptions—			
Transferred to Endowment Fund			75 0 0
,, Balance September 30, 1925—			
Savings Bank of S.A.		400 2 11	
Bank of Australasia	£93 7 1		
Less Outstanding Cheque	4 12 0		
		88 15 1	
			488 18 0
			£1,156 18 1

Audited and found correct,

W. CHAMPION HACKETT, } Hon.
HOWARD WHITBREAD, } Auditors.

Adelaide, October 6, 1925.

B. S. ROACH, Hon. Treasurer.

ENDOWMENT FUND.

(Capital £3,919 6s. 10d.)

	£	s.	d.	£	s.	d.
1924—October 1.						
To Balance, S.A. Government Stock ..	3,839	18	9			
Savings Bank	4	8	1			
				3,844	6	10
" Life Members' Subscriptions				75	0	0
" Interest received				174	15	0
				£4,094	1	10

	£	s.	d.	£	s.	d.
1925—September 30.						
By £500 S.A. Cons. Stock at 3 per cent. ..	292	8	9			
" £2,000 S.A. Govt. Stock at 3¾ per cent.	1,997	10	0			
" £100 S.A. Govt. Stock at 5 per cent.	100	0	0			
" £1,525 S.A. Govt. Stock at 5½ per cent.	1,525	0	0			
" Savings Bank Account	4	8	1			
				3,919	6	10
" Revenue Account				174	15	0
				£4,094	1	10

Audited and found correct.

W. CHAMPION HACKETT, } Hon.
HOWARD WHITBREAD, } Auditors.

B. S. ROACH, Hon. Treasurer.

Adelaide, October 6, 1925.

DONATIONS TO THE LIBRARY

FOR THE YEAR ENDED SEPTEMBER 30, 1925.

TRANSACTIONS, JOURNALS, REPORTS, ETC.,
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LIST OF FELLOWS, MEMBERS, ETC.

AS EXISTING ON SEPTEMBER 30, 1925.

Those marked with an asterisk (*) have contributed papers published in the Society's Transactions. Those marked with a dagger (†) are Life Members.

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 arrear.

Date of Election.

HONORARY FELLOWS.

1910. *BRAGG, SIR W. H., K.B.E., M.A., D.Sc., F.R.S., Director of the Royal Institution, Albemarle Street, London (Fellow 1886).
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., Emeritus Professor of Geology, University of Sydney, Coringah, Sherbroke Road, Hornsby, N.S.W.
1905. *HEDLEY, CHAS., c/o University, Brisbane, Queensland.
1892. *MAIDEN, J. H., I.S.O., F.R.S., F.L.S., Turramurra Ave., Turramurra, N.S.W.
1898. *MEYRICK, E. T., B.A., F.R.S., F.Z.S., Thornhanger, Marlborough, Wilts, England.
1894. *WILSON, J. T., M.D., Ch.M., Professor of Anatomy, Cambridge University, England.

CORRESPONDING MEMBERS.

1913. *CARTER, H. J., B.A., Kintore Avenue, Wahroonga, N.S.W.
1909. *JOHNCOCK, C. F., Clare.
1905. THOMSON, Hon. G. M., F.L.S., 209 Cargill Street, Dunedin, New Zealand.
1908. *WOOLNOUGH, WALTER G., D.Sc., F.G.S. (Fellow 1902).

FELLOWS.

1925. ADEY, W. J., Military Road, Grange.
1895. *†ASHBY, EDWIN, F.L.S., M.B.O.U., Blackwood.
1917. BAILEY, J. F., Director Botanic Garden, Adelaide.
1902. *BAKER, W. H., King's Park.
1902. *BLACK, J. M., 82 Brougham Place, North Adelaide.
1912. *BROUGHTON, A. C., The "Grosvenor," North Terrace, Adelaide.
1911. BROWN, EDGAR J., M.B., D.P.H., 172 North Terrace.
1883. *BROWN, H. Y. L., 286 Ward Street, North Adelaide.
1924. BROWNE, J. W., B.Ch., 169 North Terrace.
1916. *BULL, LIONEL B., D.V.Sc., Laboratory, Adelaide Hospital.
1923. BURDON, ROY S., B.Sc., University of Adelaide.
1921. BURTON, R. J., Belair.
1922. *CAMPBELL, T., D.D.Sc., Dental Dept., Adelaide Hospital, Frome Road.
1925. CARR, W. B., Partridge Street, Glenelg.
1924. CAVENAGH-MAINWARING, W. R., M.B., B.S., 207 North Terrace.
1907. *CHAPMAN, R. W., M.A., B.C.E., F.R.A.S., Professor of Engineering and Mechanics, University of Adelaide.
1904. CHRISTIE, W., c/o Griffiths Bros., Hindmarsh Square, Adelaide.
1895. *CLELAND, JOHN B., M.D., Professor of Pathology, University of Adelaide.
1923. CONRICK, JOHN, Nappermerrie, Farina.
1907. *COOKE, W. T., D.Sc., Lecturer, University of Adelaide.
1924. CRESPIGNY, C. T. C. DE, D.S.O., M.D., 172 North Terrace.
1916. DARLING, H. G., Franklin Street, Adelaide.
1887. *DIXON, SAMUEL, Bath Street, New Glenelg.
1915. *DODD, ALAN P., Prickly Pear Laboratory, Sherwood, Brisbane.
1921. DUTTON, G. H., B.Sc., F.G.S., 21 Da Costa Avenue, South Prospect.
1911. DUTTON, H. H., B.A., Dequetteville Terrace, Kent Town.
1902. *EDQUIST, A. G., 19 Farrell Street, Glenelg.
1918. *ELSTON, A. H., F.E.S., "Hatherley," Commercial Road, Unley Park.
1925. ENGLAND, H. A., 21 Davenport Terrace, Wayville West.
1917. *FENNER, CHAS. A. E., D.Sc., 42 Alexandra Avenue, Rose Park.
1914. FERGUSON, E. W., M.B., Ch.M., Gordon Road, Roseville, Sydney.
1923. FRY, H. K., D.S.O., M.B., B.S., B.Sc., Glen Osmond Road, Parkside.
1919. GLASTONBURY, O. A., Adelaide Cement Co., Brookman Buildings, Grenfell Street.
1923. GLOVER, C. R. J., Stanley Street, North Adelaide.
1904. GORDON, DAVID, 72 Third Avenue, St. Peters.

Date of Election.

1925. †Gosse, J. H., 31 Grenfell Street, Adelaide.
1880. *Goyder, George, A.M., B.Sc., F.C.S., 228 North Terrace.
1910. *Grant, Kerr, M.Sc., Professor of Physics, University of Adelaide.
1922. Grant, R. L. T., M.B., B.S., M.R.C.P., University of Adelaide.
1904. Griffith, H., Hove, Brighton.
1924. Guinnane, F. R., King Street, Brighton.
1916. Hackett, W. Champion, 35 Dequetteville Terrace, Kent Town.
1922. *Hale, H. M., S.A. Museum, Adelaide.
1922. *Ham, William, F.R.E.S., University of Adelaide.
1916. †Hancock, H. Lipson, A.M.I.C.E., M.I.M.M., M.Am.I.M.E., Angaston.
1924. Hawker, Captain C. A. S., North Bungaree, via Yacka, South Australia.
1896. Hawker, E. W., M.A., LL.B., F.C.S., East Bungaree, Clare.
1923. Hill, Florence M., B.S., M.D., University of Adelaide.
1925. Homburg, Hon. H., Grenfell Street, Adelaide.
1924. *Hossfeld, Paul S., Carey Street, Magill.
1883. *Howchin, Professor Walter, F.G.S., "Stonycroft," Goodwood East.
1918. *Ising, Ernest H., c/o Superintendent's Office, S.A. Railways, Adelaide.
1912. *Jack, R. L., B.E., F.G.S., Assistant Government Geologist, Adelaide.
1893. James, Thomas, M.R.C.S., 9 Watson Avenue, Rose Park.
1918. Jennison, Rev. J. C., 31 Kyre Avenue, Kingswood.
1910. *Johnson, E. A., M.D., M.R.C.S., 295 Pirie Street.
1910. *Johnston, Professor T. Harvey, M.A., D.Sc., University of Adelaide.
1920. *Jones, F. Wood, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., F.R.S., Professor of Anatomy, University of Adelaide.
1923. Judell, Lester M. W., B.Sc., Jamestown.
1918. Kimber, W. J., 28 Second Avenue, Joslin.
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., M.R.C.S., North Terrace.
1922. Lendon, Guy A., M.B., B.S., M.R.C.P., North Terrace.
1925. Lewis, A., M.B., B.S., Adelaide Hospital.
1922. *Madigan, C. T., M.A., B.Sc., University of Adelaide.
1923. Magarey, W. A., LL.B., Pirie Street.
1923. Marshall, J. C., Payneham.
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., F.R.S., Professor of Geology, University, Adelaide.
1919. Mayo, Helen M., M.B., B.S., 47 Melbourne Street, North Adelaide.
1920. Mayo, Herbert, LL.B., Brookman Buildings, Grenfell Street.
1923. McBride, R. M., J.P., 14 Giles Street, Toorak.
1920. McGilp, John Neil, Napier Terrace, King's Park.
1907. Melrose, Hon. Robert T., M.L.C., Mount Pleasant.
1924. Messent, P. S., M.S., 192 North Terrace.
1925. †Mitchell, Professor Wm., M.A., D.Sc., The University, Adelaide.
1897. *Morgan, A. M., M.B., Ch.B., 46 North Terrace.
1924. Morison, A. J., Deputy Town Clerk, Town Hall, Adelaide.
1921. Moulden, Owen M., M.B., B.S., Unley Road, Unley.
1925. Murray, Hon. Sir George, K.C.M.G., B.A., LL.M., Magill.
1925. North, Rev. Wm. O., Methodist Manse, Netherby.
1913. *Osborn, T. G. B., D.Sc., Professor of Botany, University of Adelaide.
1924. Pearce, C., 33 Capper Street, Kent Town.
1924. Perkins, A. J., Director of Agriculture, Victoria Square.
1925. Prescott, Professor J. A., Waite Agric. Research Institute, Glen Osmond.
1907. *Pulleine, R. H., M.B., Ch.M., North Terrace.
1916. Ray, William, M.B., B.Sc., Liberal Club Building, North Terrace, Adelaide.
1885. *Rennie, Edward H., M.A., D.Sc., F.C.S., Professor of Chemistry, University, Adelaide.
1924. Rice, P. W., M.B., B.S., 137 Henley Beach Road, Mile End.
1925. Richardson, Professor A. E. V., M.A., D.Sc., "Urrbrae," Glen Osmond.
1911. Roach, B. S., Education Department, Flinders Street, Adelaide.
1919. *Robertson, Professor T. B., D.Sc., D.Ph., University of Adelaide.
1924. Roeger, Miss M. T. P., c/o Central School, Goodwood.
1925. Rogers, L. S., B.D.Sc., Verco Buildings, North Terrace.
1905. *Rogers, R. S., M.A., M.D., 52 Hutt Street.
1922. *Samuel, Geoffrey, B.Sc., University of Adelaide.
1924. Sandford, J. Wallace, 75 Grenfell Street.
1924. Segnit, R. W., B.A., B.Sc., Architect-in-Chief's Office, King William Street.
1891. Selway, W. H., Treasury, Adelaide.
1920. Simpson, A. A., C.M.G., C.B.E., Lockwood Road, Burnside.

Date of Election.	
1924.	SIMPSON, FRED. N., Dequetteville Terrace, Kent Town.
1925.	SMITH, ELMER, Ph.D., Sc.D., 232 Garden Street, Hoboken, N.J., U.S.A.
1925.	†SMITH, T. E. BARR, B.A., 25 Currie Street, Adelaide.
1906.	SNOW, FRANCIS H., National Mutual Buildings, King William Street.
1923.	SPROD, M. W., M.B., B.S., Moseley Street, Glenelg.
1923.	STRONG, Professor Sir ARCHIBALD, M.A., D.Litt., University of Adelaide.
1922.	SUTTON, J., Fullarton Road, Netherby.
1925.	SYMONS, IVOR G., Church Street, Highgate.
1923.	THOMAS, J. F., 64 Elizabeth Street, Sydney.
1923.	*THOMAS, R. G., B.Sc., 5 Trinity Street, St. Peters.
1921.	*TIEGS, OSCAR W., D.Sc., University of Melbourne.
1923.	*TINDALE, N. B., South Australian Museum, Adelaide.
1894.	*TURNER, A. JEFFERIS, M.D., F.E.S., Wickham Terrace, Brisbane, Queensland.
1925.	TURNER, DUDLEY C., National Chambers, King William Street.
1878.	*VERCO, SIR JOSEPH C., M.D., F.R.C.S., North Terrace.
1914.	*WAITE, EDGAR R., F.L.S., C.M.Z.S., Director, South Australian Museum.
1924.	WALKER, W. D., B.Sc., St. Mark's College, Pennington Terrace, North Adelaide.
1912.	*WARD, LEONARD KEITH, B.A., B.E., Government Geologist, Adelaide.
1920.	WEIDENBACH, W. W., Rabaul, Papua.
1904.	WHITBREAD, HOWARD, c/o A. M. Bickford & Sons, Currie Street.
1912.	*WHITE, Capt. S. A., C.M.B.O.U., "Wetunga," Fulham.
1920.	*WILTON, Professor J. R., D.Sc., University of Adelaide.
1923.	*WOOD, J. G., B.Sc., Caius College, Cambridge, England.

APPENDIX.

FIELD NATURALISTS' SECTION

OF THE

Royal Society of South Australia (Incorporated).

FORTY-SECOND ANNUAL REPORT OF THE COMMITTEE FOR YEAR ENDED AUGUST 31, 1925.

The Committee has pleasure in presenting the Annual Report and to congratulate members on another successful year.

EXCURSIONS.—The excursions have been held on an average of once a fortnight throughout the year and have been well attended. Places of interest around the metropolis have been visited and several districts further afield have been journeyed to by charabanc and by train.

LECTURES.—Our schedule of lectures has been well maintained. Some were given in the Lecture-room illustrated by lantern slides, and were of a semi-public nature, while others were given in the Royal Society's Room, and were sometimes illustrated by lantern slides.

SHELL COLLECTORS' COMMITTEE.—Through the enthusiasm of Mr. W. J. Kimber this Committee has been formed and was successfully inaugurated in July. Mr. Kimber is Chairman and Mr. F. Trigg is Secretary. The membership totals 20. Meetings are held on the first and third Monday in each month and excursions are held on alternate Saturdays with the Section.

"THE SOUTH AUSTRALIAN NATURALIST."—Our journal completes vol. vi. this year and continues to be published quarterly under the editorship of Mr. Wm. Ham.

EXCHANGES.—Among the new exchanges are The Academy of Sciences, Philadelphia, and The Natural History Museum, Warsaw, Poland.

FLOWER SHOW, 1924.—This Show was the best yet held from the point of view of exhibits. Teachers and scholars of many public schools came to our aid and forwarded a fine assortment of flowers, and each school's exhibit was kept separate and labelled. Interstate Nature Clubs forwarded parcels of flowers. Many other branches of natural history were represented and many members worked willingly and made the fixture a success. The net profit was £35 18s.

HERBARIUM COMMITTEE.—The members of this Committee have met on numerous occasions at Prof. Cleland's rooms where the herbarium is stored. A number of parcels of specimens were received from various contributors and the work of classifying is steadily progressing, and more boxes and labels have been purchased. Apart from the Tepper Herbarium, we have now about 1,800 specimens.

MEMBERSHIP.—Members at the beginning of the year numbered 217, and 27 new members have since been admitted. Resignations and deaths amount to 60, so that 184 is the present total of members.

Obituary.—It is our sad duty to record the loss of Mrs. W. Champion Hackett, who had been a member for many years. Mrs. Hackett always took a special interest in our Wild Flower Shows, and her loss will be keenly felt. Another old member in the person of Miss M. L. Benda died just prior to the annual meeting, and her loss to the Section will be much felt. Miss Benda was a member for many years, and she was always an enthusiastic worker. The Committee extend to the relatives their deepest sympathy in the loss they have suffered.

Library.—The addition of several fresh volumes to our Library would be much appreciated by those members, who, consistently patronising it, have read practically all the books. As it is hoped that the Library will be adequately housed in the near future, we appeal for further books to afford a wider scope in reading to the members.

(Signed) E. S. Hughes, *Chairman.*
Ernest H. Ising, *Hon. Secretary.*

THIRTY-SIXTH ANNUAL REPORT OF THE NATIVE FAUNA AND FLORA PROTECTION COMMITTEE.

A severe blow was dealt by the Government to the water birds when the close season for duck was curtailed by opening it on December 21 instead of February 1. Immediately after the news of this alteration came to hand the Committee met and protested strongly by letter to the Premier and asked that action be reconsidered. The Committee, in conjunction with members of the Section, met on May 21 to confer with several citizens interested in Nature who were anxious to form a Nature Lovers' League. After discussion the meeting adjourned for the purpose of allowing the proposers of the League to place definite information before the Committee.

The Committee again met on August 11 to discuss the proposed alterations in the sanctuaries on the Coorong. It was considered by some members that by withholding the protection of the foreshore immediately opposite Pelican Island it would be laying open the unique breeding place of the pelicans to greater molestation. It was resolved that three of the members confer with other scientific bodies on the matter.

In spite of vigorous protests the destruction of our native trees and plants is still going on upon our roadsides and elsewhere. This is greatly to be deplored, seeing, with the trees and plants, must inevitably disappear so much of our bird, animal, and insect life.

(Signed) S. A. White, *Chairman.*
Marie L. Benda, *Hon. Secretary.*

FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY OF S.A.

Statement of Receipts and Expenditure for Year ended August 31, 1925.

Receipts.	£	s.	d.	Expenditure.	£	s.	d.
To Balance Brought Forward	10	11	8	By Postages	9	4	9
„ Cash in Bank due to Royal Society	1	2	6	„ Carriage	0	3	2
„ Cash in Hand due to Royal Society	0	7	0	„ Stationery	3	10	2
„ Members' Subscriptions	48	0	0	„ Library	5	12	9
„ Grants from Royal Society	50	0	0	„ Printing	34	12	2
„ Sale of Badges	0	19	6	„ Hire of Hall	5	1	4
„ Profit from Wild Flower Show	35	18	0	„ Advertising	2	5	4
„ Bank Interest	1	19	2	„ Sewell's A/c	2	4	0
				„ Subscriptions paid to Royal Society	49	9	6
				„ Balance	36	14	8
	£148	17	10		£148	17	10
„ Balance	36	14	8				

Adelaide, September 17, 1925.

Audited and found correct,
(Signed) WALTER D. REED, F.C.P.A., } Hon.
A. J. MORISON, } Auditors.

EXCURSION ACCOUNT.

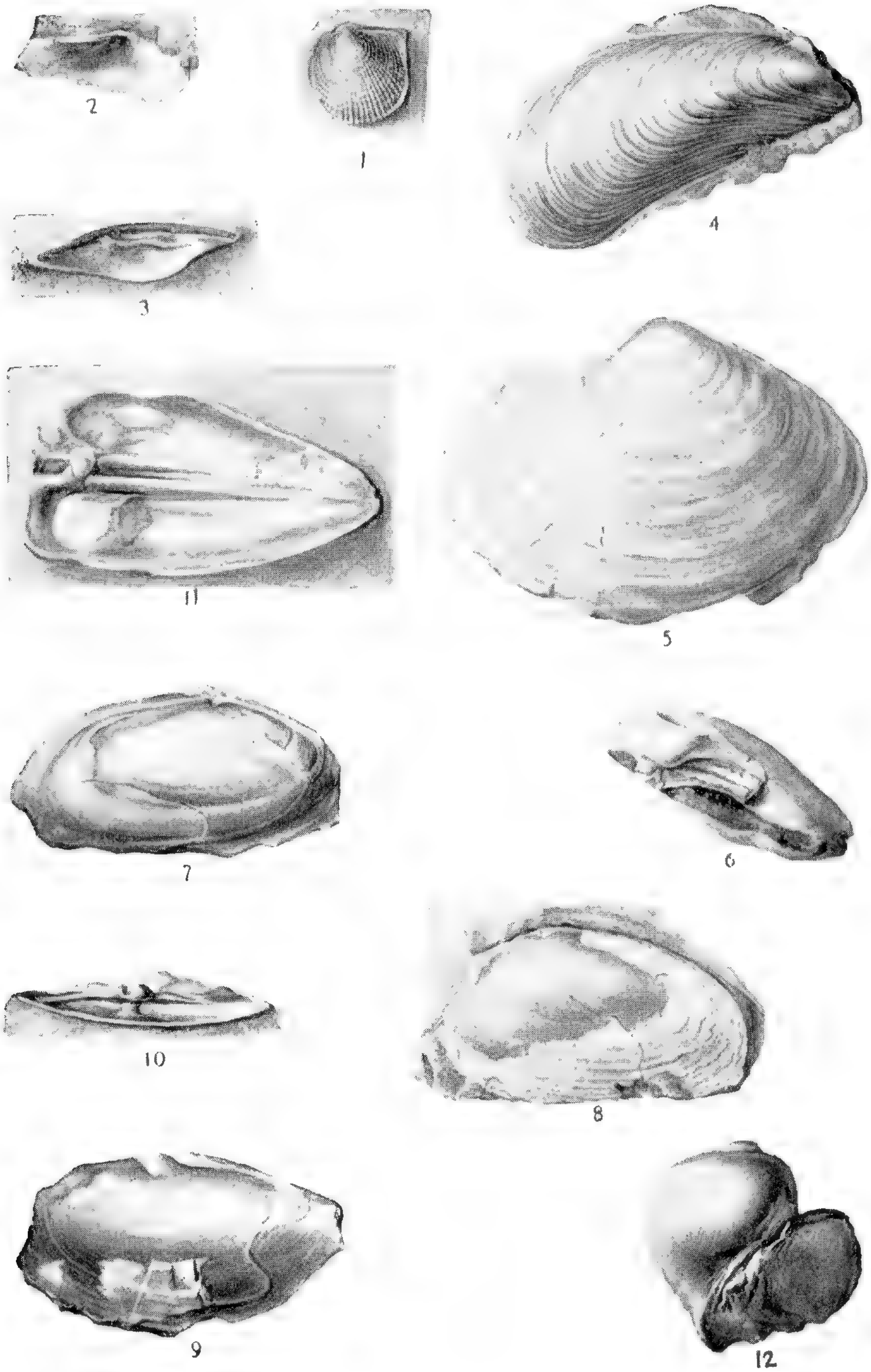
Receipts.	£	s.	d.	Expenditure.	£	s.	d.
To Balance Brought Forward	3	5	3	By Hire of Motors	56	12	6
„ Excursion Fares	65	2	0	„ Hire of Dredges	7	0	0
				„ Tips to Sailors	1	0	0
				„ Refreshments	0	6	9
				„ Balance	3	8	0
	£68	7	3		£68	7	3
„ Balance	3	8	0				

Adelaide, September 17, 1925.

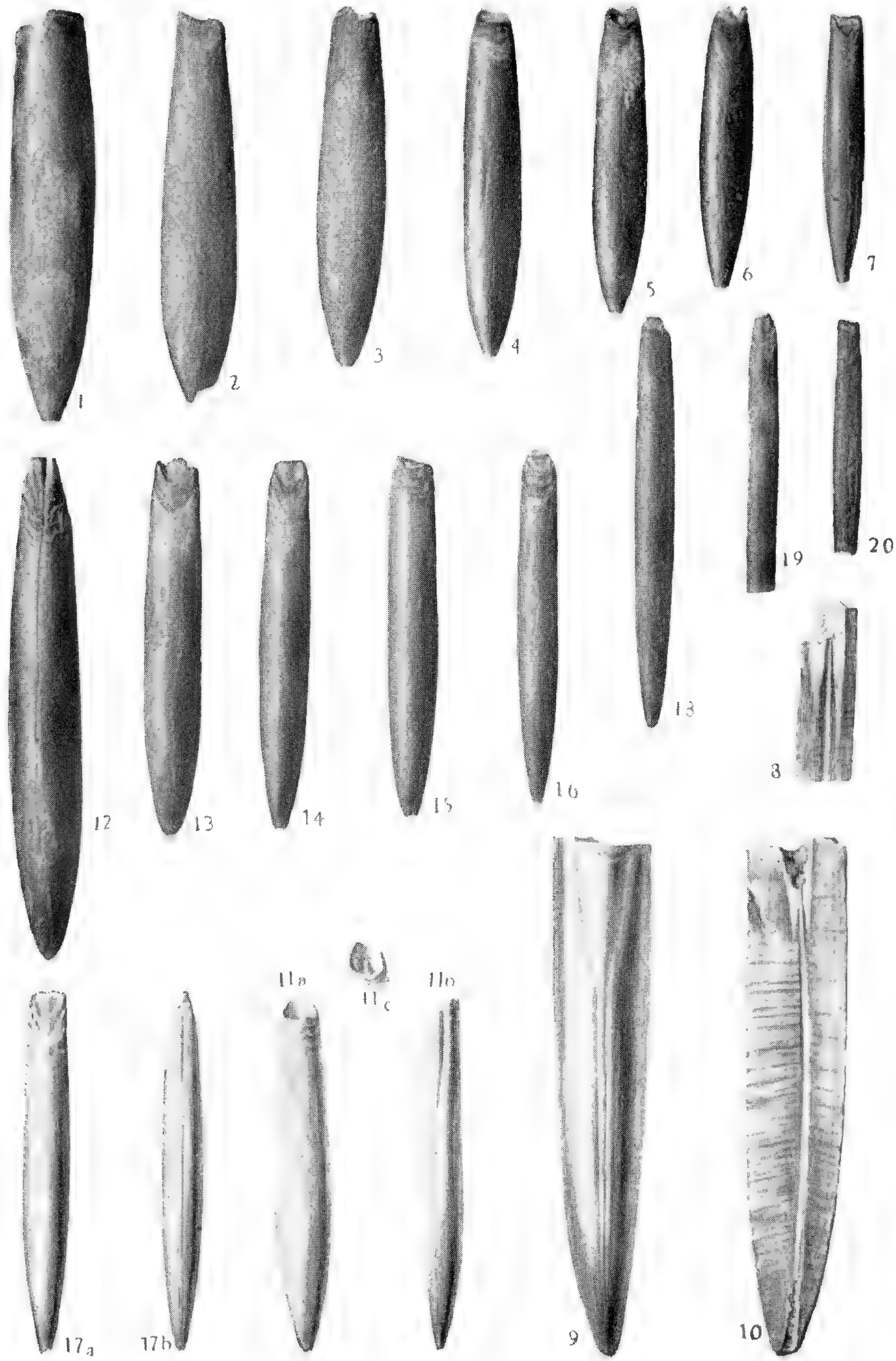
E. H. ISING, Hon. Sec.

GENERAL INDEX.

[Generic and specific names in italics indicate that the forms described are new to science.]



E. T. Talbot Del.
Gillingham & Co. Limited, Printers, Adelaide.



E. T. TALBOT, DEL.; W. TAMS, PHOTO.

Gillingham & Co. Limited, Printers, Adelaide.

Fig. 1. Crown Point and Cunningham's Gap from the south. In the left foreground is the tillite of Yellow Cliff. The bed of the Finke River is dry.

Fig. 2. View of Crown Point from the north, across the dry sands of the Finke River bed. The highly contorted tillite of Crown Point (the outlier) is the equivalent of uncontorted and essentially horizontal beds in the larger plateau remnant.

Fig. 3. Mt. Engoordina, at Horseshoe Bend, on the Finke River, showing the cross-bedded sandstone (white) with its siliceous capping, and beneath it the ripple-marked shales.

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Fig. 1. The northern front of Crown Point showing the highly contorted tillite. (Photo, Sir Baldwin Spencer.)

Fig. 2. Highly contorted tillite, the contortions accentuated by weathering, at a place a few miles north of Crown Point.

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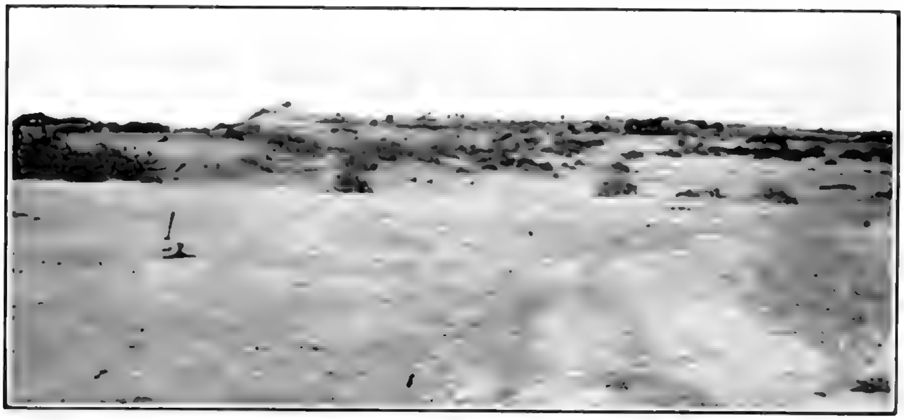

Fig. 1. Erratic boulders, resting on Cretaceous shales, Dalhousie Springs, South Australia.

Fig. 2. Erratic boulders of quartzite resting on Upper Cretaceous shales, near Arkeeta Claypans, South Australia.

Fig. 3. Erratic boulder of felspar porphyry, resting on Lower Cretaceous shales, near Coward Springs, South Australia.

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Fig. 1. Ooraminna Rockhole, in the Ooraminna Range, showing the dense siliceous crust capping Ordovician sediments.

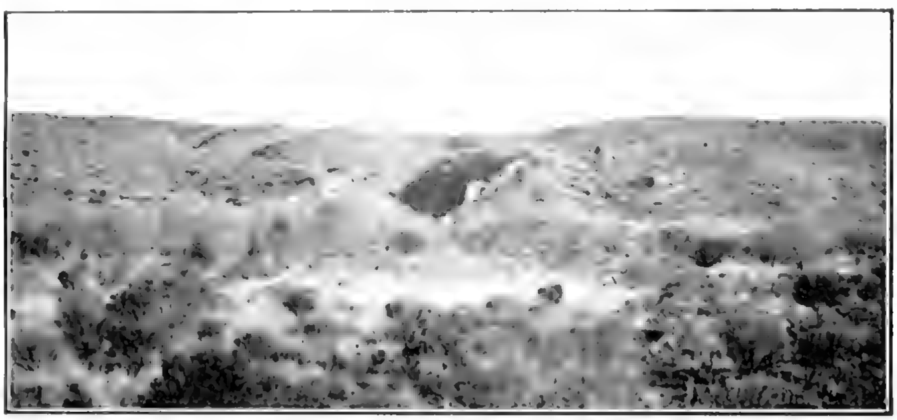

Fig. 2. The northern front of the James Range, north-east of Deep Well, showing "dykes" of chalcedonic quartzite in Ordovician sediments, formed by downward infiltration of silica along joint planes.

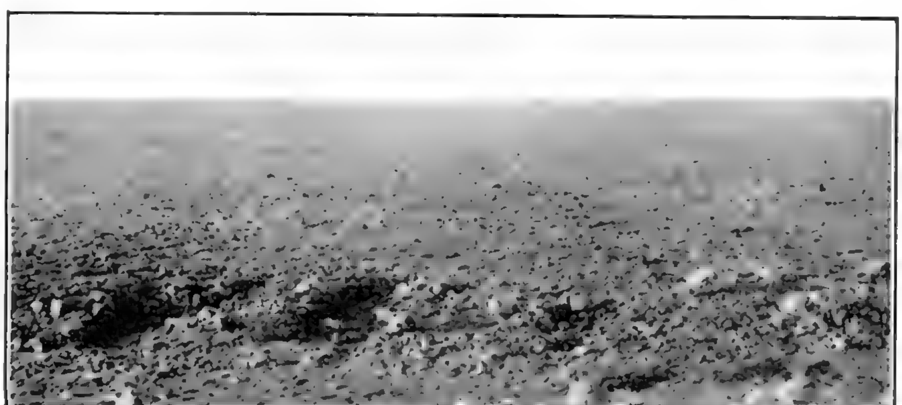

Fig. 3. The mantle of "gibbers," resulting from the breaking down of the crust of chalcedonic quartzite capping the Upper Cretaceous sediments. Near Hamilton Bore, South Australia.

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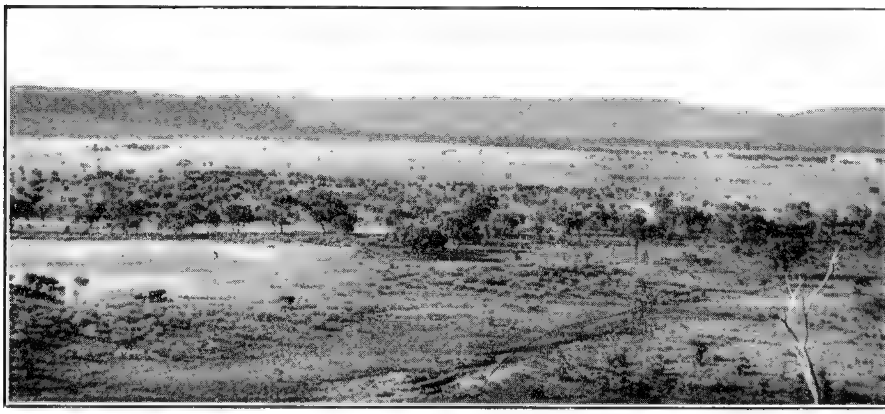

Fig. 1. Looking across the Racecourse at the southern front of the MacDonnell Ranges. See block diagram. On the left the wall of the middle quartzite and on the right the wall of the lower quartzite are seen.

Fig 2. Horizontal Ordovician sediments, carved by erosion into rounded bastions. Phillipson's Creek, north-east of Ooraminna Range.

Fig. 3. The northern front of the Krichauff Range, at Hermannsburg. The steep-walled valley is the entrenched meandering gorge of the Finke River.

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Fig. 1. Heavitree Gap, MacDonnell Ranges, cut by the Todd River through the lower quartzite of which the steep northern scarp is seen. Below the scarp are the slopes of schist, and in the foreground alluvium with bluebush vegetation. The outer wall of the middle quartzite is visible through the Gap. See block diagram.

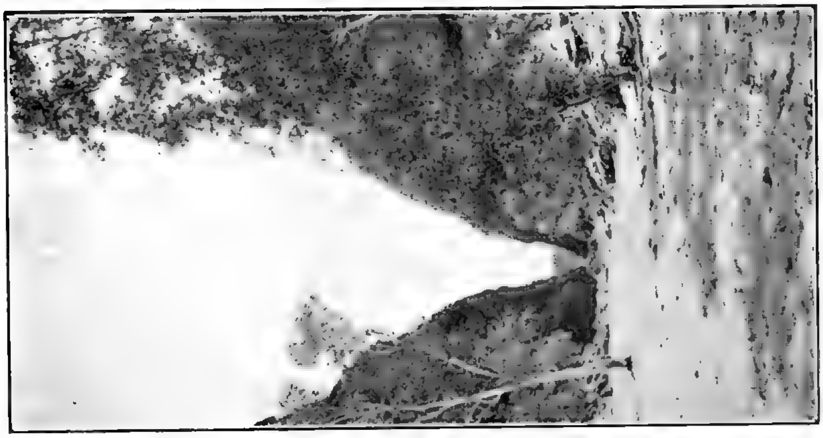

Fig. 2. Simpson's Gap, MacDonnell Ranges, 10 miles west of Alice Springs, as seen from the south. This Gap is cut through the lower quartzite of the Ordovician Series, on the northern limb of the great anticline.

Fig. 3. Temple Bar Gap, looking west. The "middle quartzite," seen on the left, is broken by faulting, and the western portion, seen on the right, shows a relative displacement to the north. This continuation of the ridge is viewed from the eastern end, and has the appearance of a rounded hill. See block diagram.

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Fig. 1. River Terrace below the Thirty Pound Pool, Burra Creek.

Fig. 2. Recent Beds dissected by the Burra Creek, Hundred of Bright.

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Fig. 1.

Fig. 2.

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Fig. 1

Fig. 2

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Fig. 1.

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Fig. 1.

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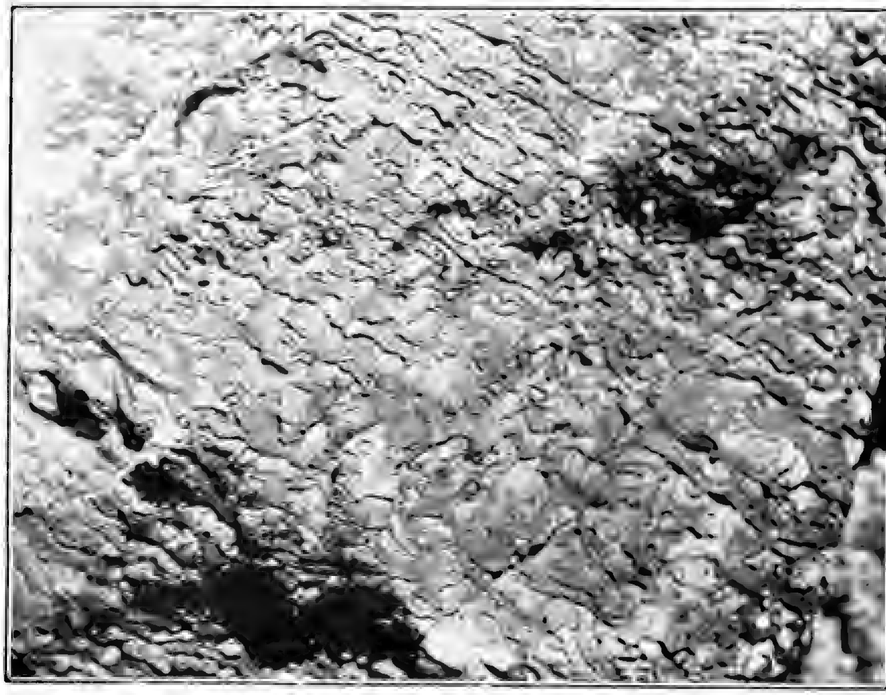

Fig. 1

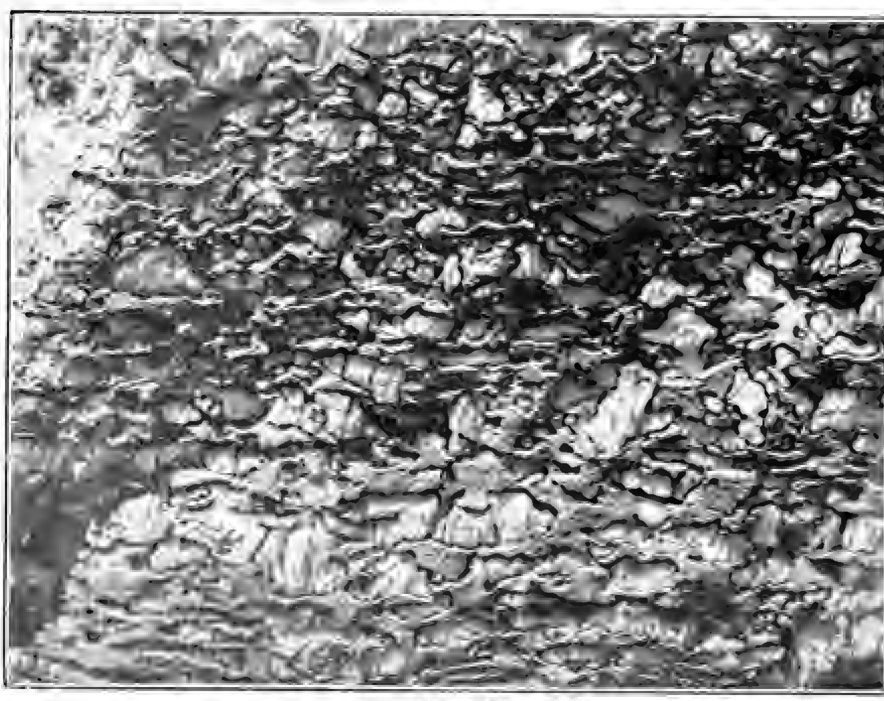

Fig. 2

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Fig. 1.

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Fig. 1.

Fig. 2.

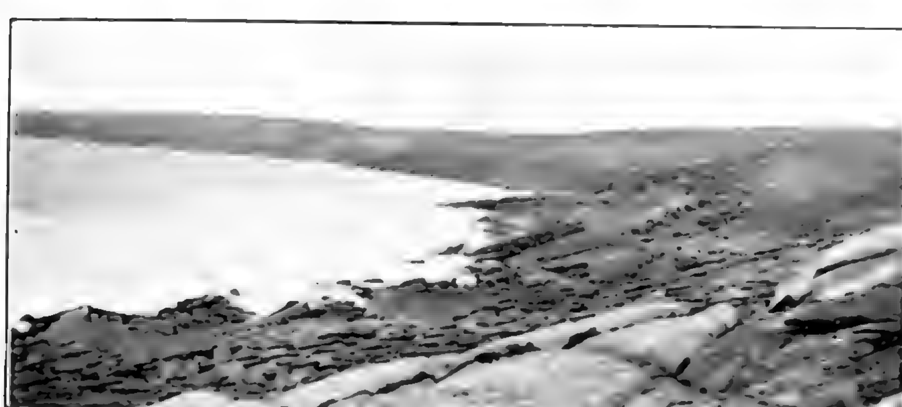

Fig. 3.

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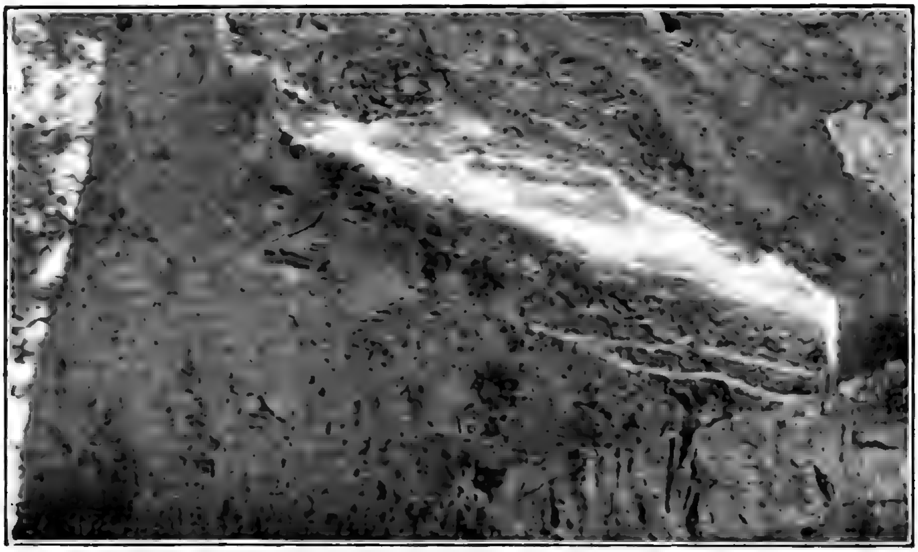

Fig. 2

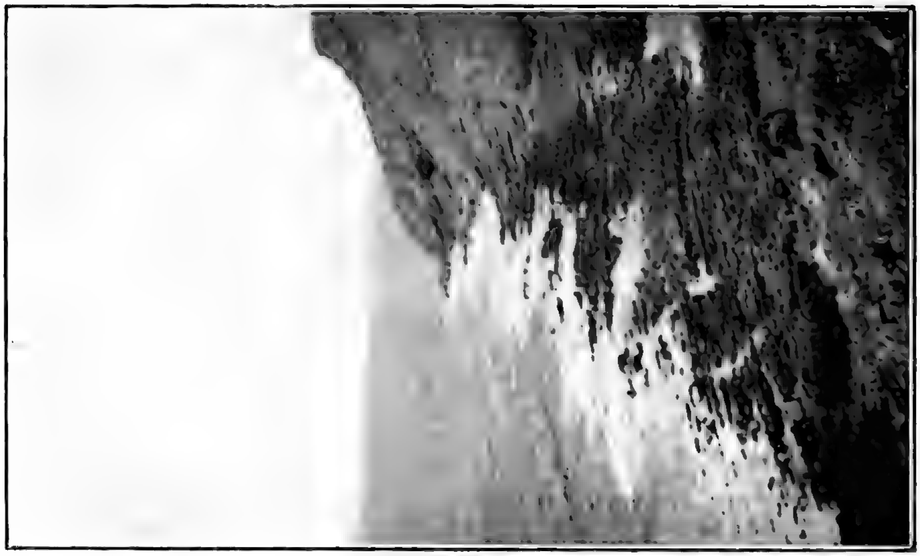

Fig. 1.

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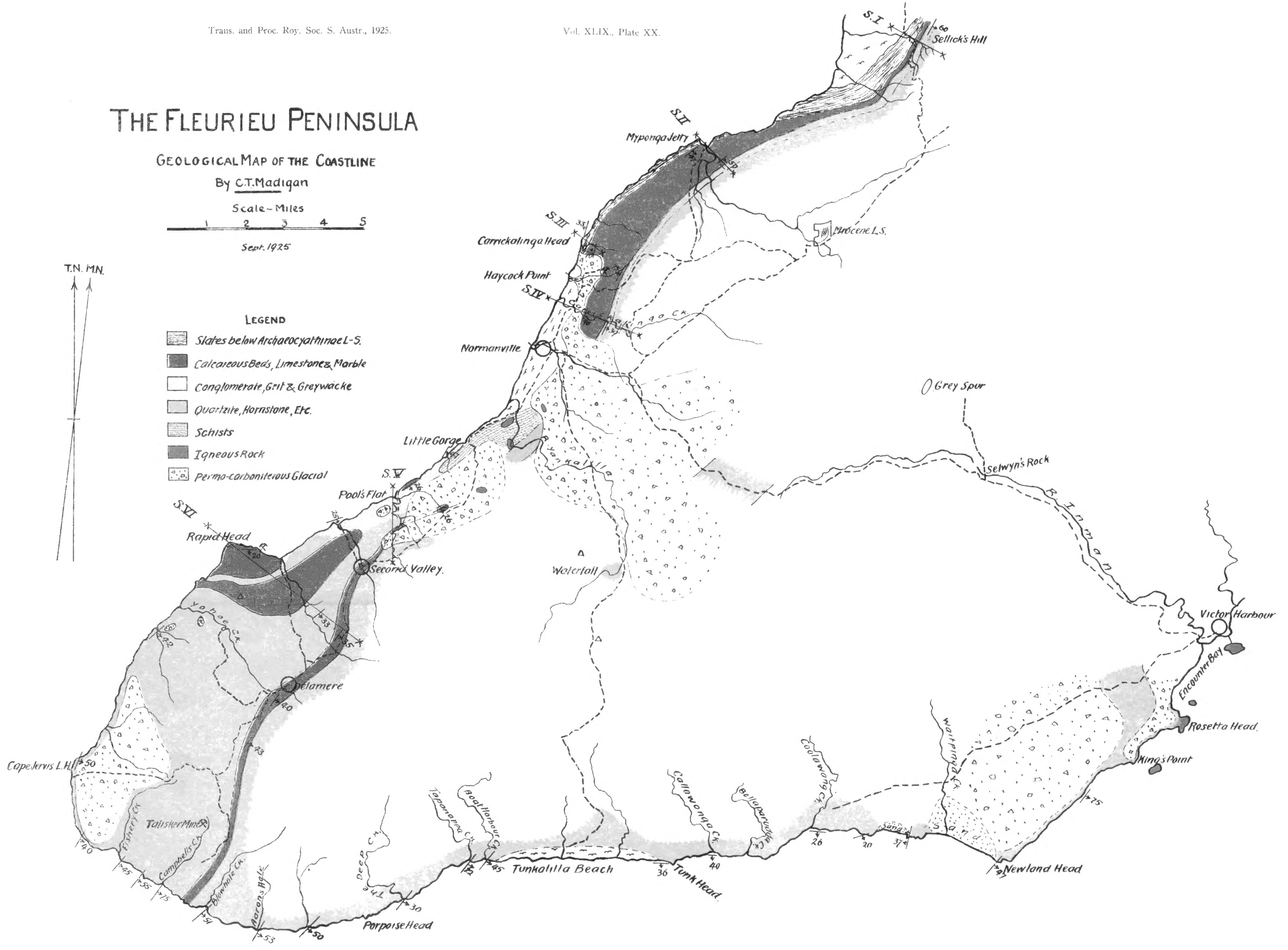
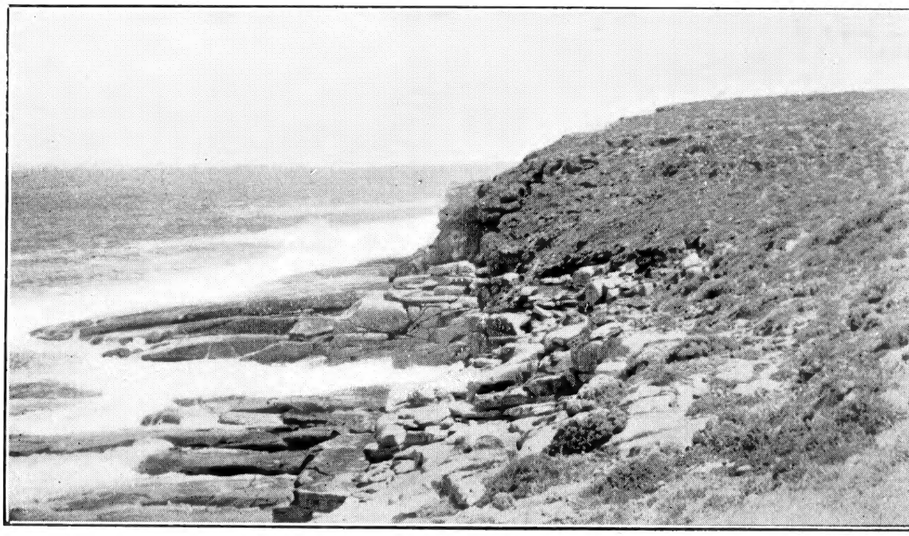

THE FLEURIEU PENINSULA
GEOLOGICAL MAP OF THE COASTLINE
By C.T. Madigan
Scale - Miles
1 2 3 4 5
Sept. 1925
T.N. M.N.
LEGEND
Slates below Archaeocyathinae L-S.
Calcareous Beds, Limestone & Marble
Conglomerate, Grit & Greywacke
Quartzite, Hornstone, Etc.
Schists
Igneous Rock
Permo-carboniferous Glacial
Sellick's Hill
Myponga Jetty
Miocene L.S.
Carrickalinga Head
Haycock Point
Normanville
Grey Spur
Little Gorge
Pool's Flat
Rapid Head
Second Valley
Waterfall
Selwyn's Rock
Inman R.
Victor Harbour
Encounter Bay
Rosetta Head
King's Point
Delamere
Cape Jervis L.H.
Talisker Mine
Fishery Ck.
Campbells Ck.
Blowhole Ck.
Aarons Hole
Deep Ck.
Porpoise Head
Tunkalilla Beach
Tunk Head
Newland Head
Callawonga Ck.
Coolawong Ck.
Waitpinga Ck.
Sand
S.I
S.II
S.III
S.IV
S.V
S.VI



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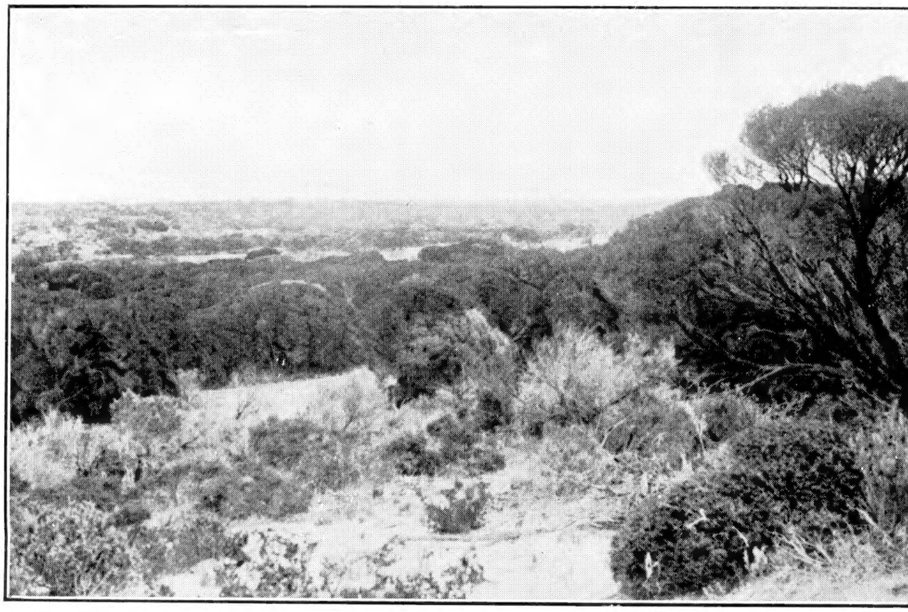

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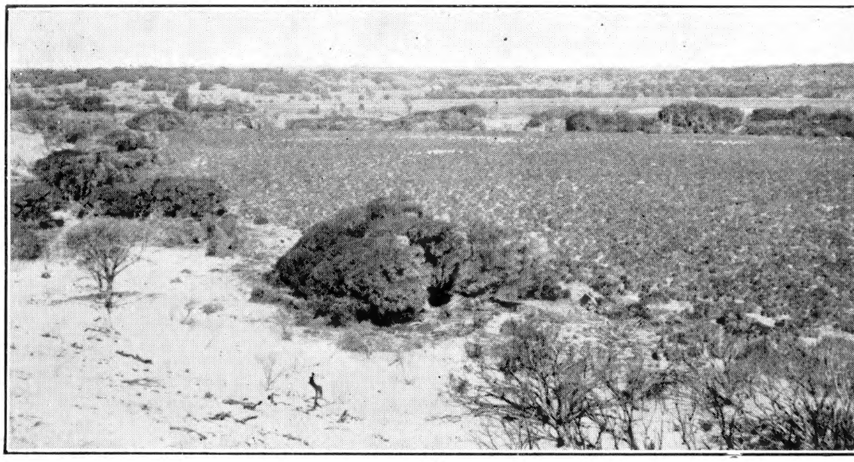

Fig. 1.

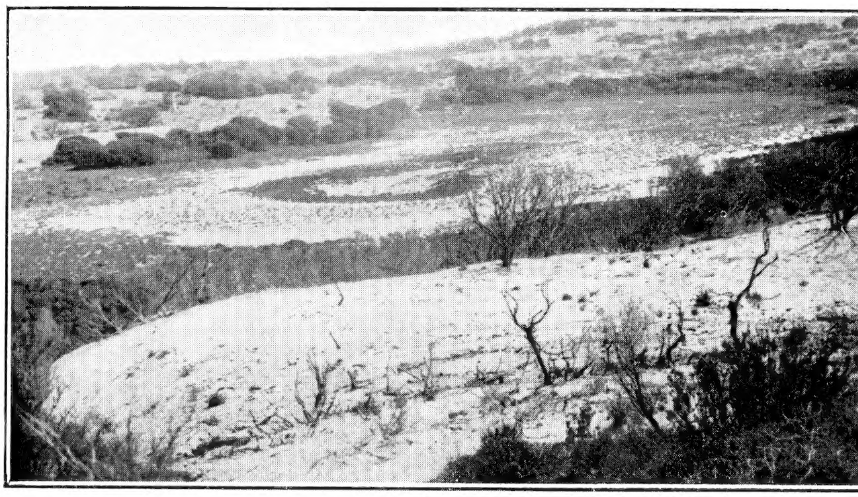

Fig. 2.

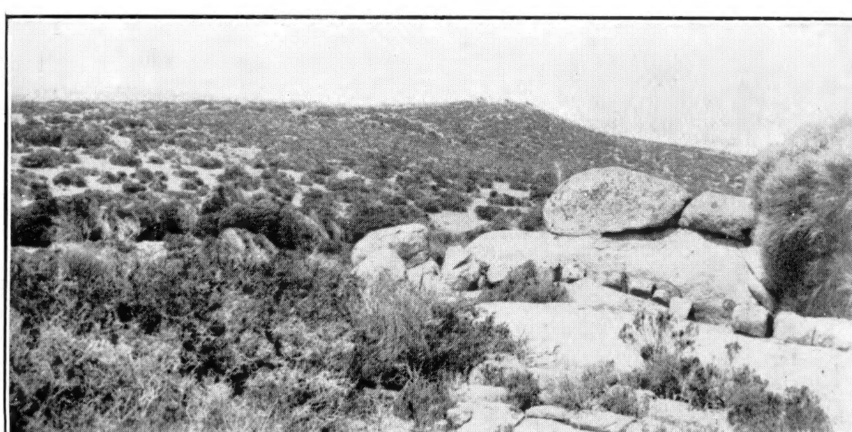

Fig. 3.

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