ROYAL SOCIETY

OF

TASMANIA

a

PAPERS & PROCEEDINGS

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FOR THE YEAR

1923

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ROYAL SOCIETY OF TASMANIA

The Royal Society of Tasmania was founded on the 14th October, 1843, by His Excellency Sir John Eardley Eardley Wilmot, Lieutenant Governor of Van Diemen's Land, as "The Botanical and Horticultural Society of Van Diemen's Land." The Botanical Gardens in the Queen's Domain, near Hobart, were shortly afterwards placed under its management, and a grant of £400 a year towards their maintenance was made by the Government. In 1844, His Excellency announced to the Society that Her Majesty the Queen had signified her consent to become its patron; and that its designation should thenceforward be "The Royal Society of Van Diemen's Land for Horticulture, Botany, and the Advancement of Science."

In 1848 the Society established the Tasmanian Museum; and in 1849 it commenced the publication of its "Papers and Proceedings."

In 1854 the Legislative Council of Tasmania by "The Royal Society Act" made provision for vesting the property of the Society in trustees, and for other matters connected with the management of its affairs.

In 1855 the name of the Colony was changed to Tasmania, and the Society then became "The Royal Society of Tasmania for Horticulture, Botany, and the Advancement of Science."

In 1860 a piece of ground at the corner of Argyle and Macquarie streets, Hobart, was given by the Crown to the Society as a site for a Museum, and a grant of £3,000 was made for the erection of a building. The Society contributed £1,800 towards the cost, and the new Museum was finished in 1862.

In 1885 the Society gave back to the Crown the Botanical Gardens and the Museum, which, with the collections of the Museum, were vested in a body of trustees, of whom six are chosen from the Society. In consideration of the services it had rendered in the promotion of science, and in the formation and management of the Museum and Gardens, the right was reserved to the Society to have exclusive possession of sufficient and convenient rooms in the Museum, for the safe custody of its Library, and for its meetings, and for all other purposes connected with it.

In 1911 the Parliament of Tasmania, by "The Royal Society Act, 1911," created the Society a body corporate by the name of "The Royal Society of Tasmania," with perpetual succession.

The object of the Society is declared by its Rules to be "the advancement of knowledge."

His Majesty the King is Patron of the Society; and His Excellency the Governor of Tasmania is President.

ROYAL SOCIETY OF TASMANIA

PAPERS AND PROCEEDINGS, 1923

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PAPERS

OF THE

ROYAL SOCIETY OF TASMANIA

1923

STUDIES IN TASMANIAN MAMMALS, LIVING AND EXTINCT.

Number VIII.

By

H. H. SCOTT, Curator of the Launceston Museum,

and

CLIVE E. LORD, F.L.S., Director of the Tasmanian Museum.

(Read 26th February, 1923.)

PLEISTOCENE MARSUPIALS FROM KING ISLAND.

The present specimens relate to the same find as that noted in our communication to this Society upon 13th June, 1921, when we detailed the characters relating to the humerus of *Zaglossus harrissoni*.

Nototherium mitchelli, Owen.—Female (?) animal. Our claim (1920, p. 24 and p. 107) that the plaster cast studied by Professor Owen, and practically elevated by him to the status of a type, was made from the skull of a female animal, is once more our theme, and the evidence is of some considerable interest. Of the animal to be studied, we have the nasal platform, some parts of the zygomatic arch, one tusk, the right upper maxillary with parts of four teeth *in situ*, and the fifth present, but detached. In addition to this, the atlas, axis, and third cervical are available to us—a most fortunate group of associated bones in view of the nature of our inquiry. We have given (1920, p. 81) a table of the calipered thicknesses of Nototherian nasal platforms, and to this we now add the following data:—

N. MITCHELLI.

	Female.	Male.
Thickness of right nasal boss	47 mm.	60 mm.
Thickness of left nasal boss	49 mm.	59 mm.
Central thickness of nasal platform	17 mm.	25 mm.
Thickness at base of nasal cartilage studs	18 mm.	22 mm
Thickness midway between studs and nasal bosses	16 mm.	16 mm.
Width of nasal platform	160 mm.	175 mm.

As far as it is possible to compare actual bones with a cast, these data agree very well with the skull case in question. In the item of total platform width, they agree exactly, since both give 160 mm. as a result.

Again, the general all-round reduction in size agrees with what might be expected from a female animal's skull, when studied in terms of a male animal of the same species. The surface of the bone of this nasal platform is so well preserved that it is easy to note even minute, superficial markings, and we accordingly supplied a sketch illustrating the contours, and grouping of vascular scars, etc., the diagram, we opine, being self-explanatory. Upon the assumption that the female animals carried a less massive nasal horn than the males, it naturally follows that the cervical vertebræ would share in a dimensional reduction, and this is exactly what we find to obtain.

COMPARATIVE CERVICAL VERTEBRÆ.

Assumed female.	Atlas.	Assumed Male.
Height of atlas	95 mm.	100 mm.
Anterior height of neural canal ..	60 mm.	77 mm.
Anterior width of neural canal ..	50 mm.	56 mm.
Across atlantean cups	110 mm.	125 mm.
	Axis.	
	mm. mm.	mm. mm.
Diameter of anterior centrum ..	82 x 40	100 x 50
Anterior width of neural canal ..	40	46
	Cervical 3.	
	mm. mm.	mm. mm.
Diameter of anterior centrum ..	62 x 42	75 x 47
Anterior height and width of neural canal	22 x 40	31 x 47

TUSK.

The single tusk belongs to the right upper side of the mouth, and what was said (1920, p. 107) needs little, if any, emendation, namely, "Female tusks flatter in outline, less "divergent, and less powerful in outline." As nothing remains to us anteror of the premolar, except the said tusk, and perhaps a mandibular tusk—to be noted later on—any remarks supplied respecting the amount of divergence would be largely speculative, deduced from a comparison with other King Island and Mowbray Swamp specimens, and if this is done the best conclusion we can arrive at is that, for the present at any rate, the descriptive terms "less divergent" hold good. As to size, the specimen measures in total length, between verticals, 134 mm., and seems to be intact. As usually obtains, the lower surface of the exposed area of the tusk is deeply excavated by the lower tusk, a sharply drawn cross line marking its point of contact with the second incisor (whose whole crown is generally excavated to the outline of the grinding surface of the mandibular tusk).

GENERAL CONCLUSIONS.

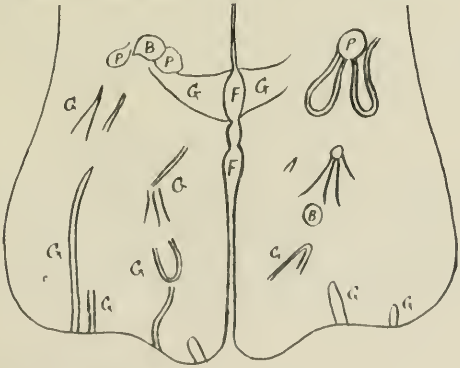
It would seem, therefore, that—as already suggested—the females of *Nototherium mitchelli* were fully armed and carried effective nasal horns, albeit less powerful than those of their mates. This conclusion is supported by the facts deduced from the study of the less solidly built nasal platforms, and weaker necks. That we are not here dealing with an immature male seems fairly assured, since the bones all suggest maturity, and the teeth have been well worn during the life of the animal. No feasible method of osteological development seems capable of converting this, apparently, matured nasal platform, of 160 mm. in width, into one of 175 mm. or more, or of expanding the cervical vertebræ to the size commensurate to the aggressive nature of the male animal. As noted in our former communication the specimens were recovered, and sent to us by Mr. K. M. Harrisson, of Smithton, during a trip to King Island upon survey work.

LITERATURE REFERRED TO.

1920 H. H. Scott and Clive Lord, Papers and Proceedings of the Royal Society of Tasmania, 1920, pp. 24 81, and 107.

NASAL PLATFORM OF *N. MITCHELLI*, ♀

Showing vascular grooves and scars relating to nourishment and repair of the horn.



NOTE.—Not drawn to scale.
B—Boss. F—Foramen. G—Groove. P—Pit.

STUDIES IN TASMANIAN MAMMALS, LIVING AND EXTINCT.

Number IX.

By

H. H. Scott, Curator of the Launceston Museum,

and

Clive E. Lord, F.L.S., Director of the Tasmanian Museum.

(Read 26th February, 1923.)

NOTOTHERIUM VICTORIÆ, OWEN.

Among the specimens recovered by Mr. K. M. Harrisson from the swamp lands of King Island, we have to record specimens relating to *Nototherium victoriæ*, which include the following items.

1. The right and left rami of the mandible of a young animal, minus the premolars in either case, but having upon the right side, in addition to molars 4, 3, and 2, the tusk relating to that half of the jaw. Upon the left side, there are present molars 4, 3, 2, 1. All the teeth manifest the character of immaturity, incidentally demonstrated by the small amount of wear. and the actual bone tissue is much lighter in texture than that seen in matured specimens from the same locality. The absence of premolar teeth is most unfortunate. and curiously enough all the Nototherian jaws yet received from King Island are in a similar condition Our present note is rather to record than describe the find, since they are chiefly valuable in a comparative connection.

2. The associated right and left upper maxillaries, from a skull of an older animal than that which supplied the mandible, the bony tissue being fully ossified and the teeth worn down to smooth surfaces. The right moiety gives us molars 4, 3, 2, 1, all *in situ*, and much in the same condition as they were when the animal was alive. Upon the left side molar 4 is present, but is detached, and molar 3 is mutilated at the point of contact with molar 4. Molars 2 and 1 are intact and still *in situ*.

NOTOTHERIAN TUSKS.

The tusk recorded above agrees exactly with specimens previously received from King Island, through the kindness of Mr. F. H. Stephenson, and its place in the skull can be stated with certainty since the complete set of four tusks were found with the bones recovered by Mr. Stephenson.

We are thus quite sure as to the kind of tusk that should be associated with skulls of *Nototherium victoriæ*, also the tusks of the male of *Nototherium mitchelli* are available for study, and, as already stated in our note upon the supposed female animal of that species, we have an upper tusk that in a general way conforms to the characters of the male of that species, but is upon the whole rather flatter. Mr. Harrisson's material also supplies us with a tusk that might very well represent the lower tooth of the female of *N. mitchelli*, whose remains we have just passed in review, since its ground point exactly fits the tusk relegated to that animal—also the second worn surface agrees very closely with the kind of wear associated with the second incisor of the upper jaw. If this relegation is a correct one, and we provisionally so place it, then the lower tusks of females of *N. mitchelli* depart somewhat from those of the males, and hold a middle place between the male tusks and those of *Nototherium victoriæ*. This is not a point to be pushed to an extreme limit, but is a side note that awaits future confirmation or otherwise. We have spent a lot of time over the classification of this tusk, and have been always driven back to the conclusion named, and therefore leave the matter at this stage with the hope of obtaining in the future further material for study.

STUDIES IN TASMANIAN MAMMALS, LIVING AND EXTINCT.

Number X.

By

H. H. Scott, Curator of the Launceston Museum,

and

Clive E. Lord, F.L.S., Director of the Tasmanian Museum.

(Read 26th February, 1923.)

GIANT WALLABY.

Macropus anak, Owen.

(Protemnodon anak.)

As is generally known, the animals called by Owen *Protemnodon anak*, *Protemnodon og*, and in part also *Sthenurus atlas*, now figure upon the lists as *Macropus anak* and *Sthenurus atlas*. In the British Museum Catalogue of Fossil Marsupials the late Richard Lydekker says at page 216:—"The followng specimens include those referred by Owen to "*Protemnodon anak*," and of the ten folios that follow, attention is drawn to No. 38,753—a left ramus from Queensland which Owen figured in Phil. Trans., 1874, plate 25, figs. 7 to 10. From the (recently acquired) material Mr. K. M. Harrisson obtained at King Island, we select for description a similar left ramus, that has no other skull associates, but supplies us with various parts of the skeleton. The premolar is missing, and the last molar has been badly mutilated, but the fangs of both broken teeth supply useful data. In total length, from the tips of the tusk to the end of the molar series, the measurement is 127 mm. both in our specimen and in Professor Owen's figure. The total length of the cheek series is given by Lydekker as being 66 mm., and this appears to agree exactly with our specmen if due allowance is made for the missing teeth—restoration being based on the alveolar evidence, and the comparative data supplied by Owen's figure. If our ramus is placed over the wood cut, it covers it, except for a slight reduction in stoutness which is obviously individual, and all its characters and measurements agree in other directions. Seemingly therefore the fossil Wallaby listed at the British Museum under No. 38,753 is here represented by a similar left ramus of the mandible, and the following parts of the skeleton now to be passed in review.

HUMERI.

	Right Humerus.	Left Humerus.
Total length (rubbed)	224 mm.	228 mm.
Greatest proximal width	56 mm.	57 mm.
Least proximal width	50 mm.	51 mm.
Girth of shaft including the pectoral ridge	103 mm.	101 mm
Head to deltoid tubercle	90 mm.	95 mm.
End of supinator ridge to the entepicondylar foramen	60 mm.	63 mm.
Articular width of distal condyles	46 mm.	46 mm.

That these two humeri are the associated arm bones of the same skeleton as that which supplied the ramus of the mandible, there seems to be no reasonable doubt, and the same applies to the appended descriptive data collected from the other bones available to us.

FEMORA.

Unfortunately, neither femur is intact, the left being only represented by the shaft, while the right supplies a shaft, and a complete distal end, but fails us at the floor of the trochanterian fossa. In these circumstances we are without knowledge as to the actual head, but the information supplied by these two bones leaves us in no doubt as to the kind of femur that obtained in this fossil skeleton. Seen in profile, the shaft is straighter than in modern animals, and the rotular groove does not ascend the shaft as in our living Wallabies, but spreads itself out into a more decided rotular fossa, the upper wall of which slowly subsides upon the surface of the shaft. Muscular scars and foramina are similar, and the condyles agree fairly well upon all their articular faces, but the intercondylar fossa is formed at an equal cost to either condyle, and not at a marked toll upon the internal condyle as in the Wallaby of to-day.

TABLE OF MEASUREMENTS.

Total length of imperfect specimen	251 mm
Distal condyles to floor of trochanterian fossa ..	225 mm.
Greatest distal width	67 mm.
Least distal width	56 mm.
Girth in centre of shaft	93 mm.
Girth above condyles	139 mm.
Girth around condyles	220 mm.
Greatest proximal width in the mutilated specimen which includes about 25 mm. of the trochanter above the floor of the fossa	66 mm.

All the above relate to the right femur, the left being reduced to a diaphysis of 145 mm. in length. This latter enables us to note that the bony substance of the shaft varies from 4 to 7 mm. according to the presence or absence of external muscular attachment scars.

Some twenty vertebræ, a calcaneum, and part of the sternum are among the available items, also parts of both ulnæ, the head of a radius, and the glenoid end of a scapula. The calcaneum is much stouter than that of the modern Forester Kangaroo, although similar as to length, the facets it presents suggest interesting points of comparison with that of the modern wallaby, with which it of course more closely agrees (upon the whole) than with the same bone from the foot of the kangaroo.

As a recent note from the pen of L. Glauert, F.G.S., of the Perth Museum (*vide* Pleistocene Fossils from the Fitzroy River, Kimberley, Western Australia, in Royal Society's Journal, Vol. 7), records a similar find, we have detailed our specimens for comparison.

CONCLUSION.

In reviewing Mr. K. M. Harrisson's King Island find, we see that the material has yielded specimens of the following animals:—

1. *Zaglossus harrissoni*,
2. *Nototherium mitchelli*,
3. *Nototherium victoriæ*,
4. *Macropus anak* (Owen's "*Protemnodon anak*"),
5. Bones of modern wombats, wallabies, and kangaroos,

the whole being associated in a common matrix.

The matrix in question is very like that of Smithton, being in point of fact exactly similar drained bog land, and the bones are in need of exactly the same form of treatment for future preservation. We beg to record our thanks to Mr. Harrisson for his kindness in presenting these very interesting remains to our Tasmanian Museums, thus enabling us to slowly build up valuable comparative collections of the extinct Pleistocene Marsupials.

NOTES ON A GEOLOGICAL RECONNAISSANCE OF MT. ANNE AND THE WELD RIVER VALLEY, SOUTH-WESTERN TASMANIA.

By A. N. Lewis, *M.C., LL.B.*

SYNOPSIS.

1. INTRODUCTORY.

(a) General.

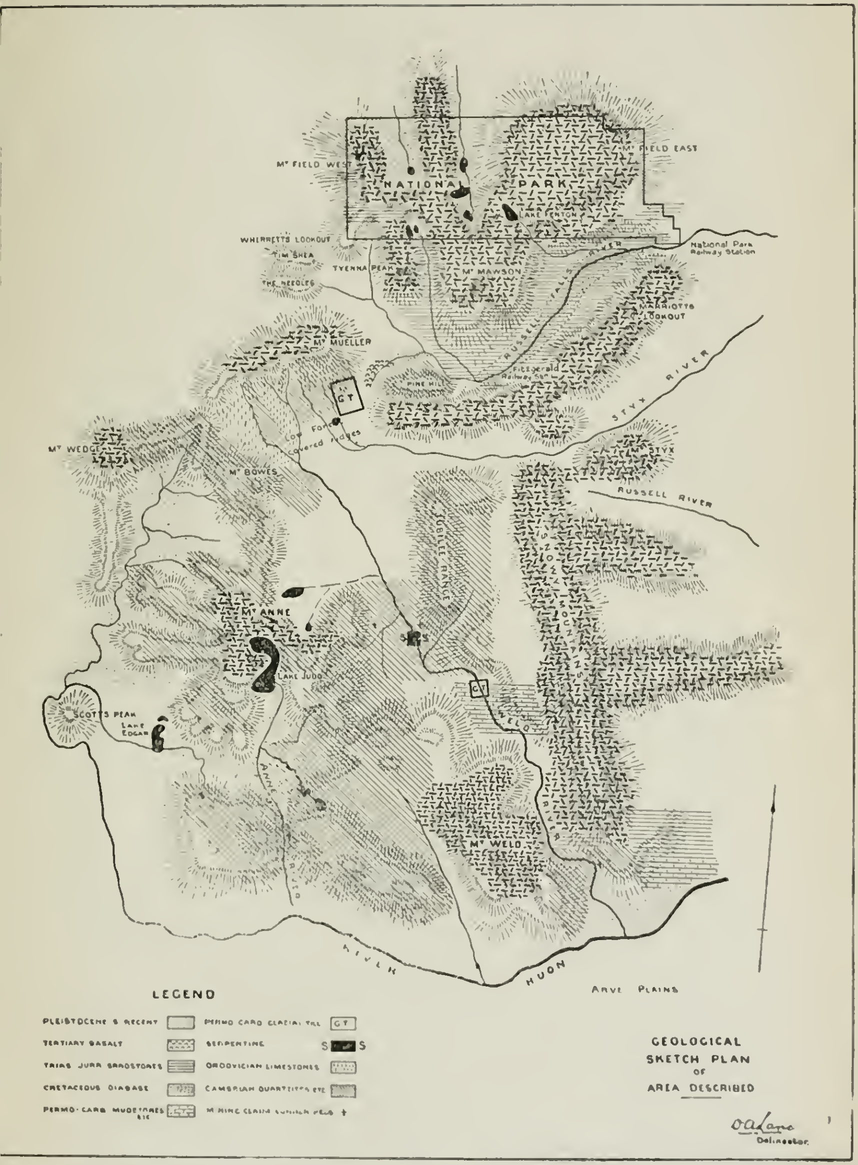
Major L. F. Giblin, D.S.O., and Mr. A. V. Giblin during the Christmas holidays of 1920, 1921, and 1922, organised and led three successive trips into the little-known country that surrounds Mt. Anne. The parties met with considerable difficulties, and most of the available time was used up in the endeavour to reach Mt. Anne, so the opportunities for an investigation of geology were few, but these fragmentary notes may be of assistance to future investigators.

(b) Geological Position and Access.

Mt. Anne lies about 45 miles due west from Hobart, near the head of the Huon River. From the top of the Tyenna Valley a line of rough hills runs westward from Mr. Mueller through Mt. Wedge to the Valley of the Serpentine. Farther west the rugged and almost unexplored Frankland and Arthur ranges bar the way to the West Coast and Port Davey. South of Tyenna, running towards the Huon Valley, is a confused mass of hills of varying height which to the east join up with Mt. Wellington. Between these two ranges is a large basin, twenty miles across in every direction, in the centre of which rises Mt. Anne, the most outstanding peak in South-West Tasmania. It is the highest point of a short ridge which extends on every side in a number of spurs. To the west is the broad, flat, swampy valley of the Huon, which passes without a perceptible divide across to the Serpentine, flowing from Lake Pedder to the Gordon. To the east runs the River Weld in a series of gorges and steep-sided valleys all filled with almost impenetrable jungle.

The area reviewed in this paper extends from the vicinity of Fitzgerald on the Russell Falls River, on the north, to the junction of the Huon and Weld rivers, on the south. These points are approximately the end of cultivation in this part of Tasmania. The area is bounded on the west by the Huon River.

Mt. Anne lies over thirty miles beyond the point to which roads have yet been pushed, and there is no natural feature giving ready access. The easiest route to the mountain is along the Tyenna-Port Davey track, which, starting where the southern read from Fitzgerald ends at Mayne's selection, winds round Mt. Mueller and Mt. Bowes to the Huon Plains, and eventually crosses the Huon River 25 miles from the end of the road. The track is a good one till it crosses Mt. Bowes and is at present passable for pack horses. On the Huon Plains, however, it is in a general state of disrepair, with bridges down and overgrown with bauera scrub and other obstacles. From the point at which the track crosses the Huon, Mt. Anne can be reached across open buttongrass plains. The second of the two western spurs presents a possible route to the summit of the Mt. Anne plateau.



ERRATA:—In Legend, for Ordovician Limestones read Silurian Limestones, and for Cambrian read Cambro-Ordovician.

SKETCH MAP OF MT. ANNE AREA.

Approximate Scale—Eight miles to the inch. Details approximate.

In the south of the area a passable road extends up the north bank of the Huon as far as the divide between the Denison and the Weld Rivers, from which point it is continued by a pack track to the Weld River at a point about three miles above the junction of the latter with the Huon, where a prospector named Fletcher has a lease and a hut. About 30 years ago a track was cut up the Weld Valley for about 10 miles, but this is now obliterated by horizontal scrub, and, although originally a well-made track, is useless in its present state. On the Tyenna-Port Davey track just east of the 14-mile hut is a notice "To Huonville 54M." This is a dangerous signboard, as there is no vestige of a track for the first ten miles, and the country is under heavy timber and dense scrub.

The old Craycroft track, a possible means of access to the Huon Plains, is reported to be quite obscured. The Valley of the Huon to the vicinity of its junction with the Anne River, and thence across the open plateau lying to the south of Mt. Anne, is a possible line of approach, but in the absence of any other cut tracks the route from Tyenna along the Port Davey track at present presents the fewest difficulties.

(c) Routes followed when the Investigations here recorded were made.

In December, 1920, Major L. F. Giblin and Mr. A. V. Giblin, with Messrs. V. C. Smith, J. Walch, and F. Steele, proceeded along the Tyenna-Port Davey track. Pack horses were got up to where the track debouches on the Huon Plains. The party made their main camp at the Huon crossing, but were here hampered by wet and misty weather. However, they accomplished the ascent of the Mt. Anne plateau, going by the southern of the two western spurs.

In December, 1921, the Messrs. Giblin, with a party consisting of Messrs. H. Hutchison, W. F. D. Butler, V. C. Smith, J. Walch, H. Kelly, H. Cooper, A. Hackett, V. E. Chambers, and the writer, endeavoured to reach Mt. Anne via the Weld Valley from the Huon. The party forced its way up the Weld Valley through horizontal scrub for three and a half days, reaching a point about 18 miles from its junction with the Huon, and then for another day up a large tributary flowing from the west, until a bare hill was reached. It was then seen that it would still take some days to reach the mountain, and the party was compelled to turn back. Great difficulty was experienced throughout the trip in cutting through the heavy scrub, carrying heavy loads. This route would be quite impossible in a wet season.

In December, 1922, the same party, with the exception of Messrs. Butler, Cooper, and Hackett, and with the addition of Dr. L. McAulay, made a further attempt, this time by the Tyenna-Port Davey track. The weather was almost continuously bad, and only one fine day was experienced. The pack horses could not be taken more than a mile beyond Mt. Bowes, and the party had the greatest difficulty in crossing the many flooded feeders of the Huon. The main camp was made under the second westerly spur of Mt. Anne. Several attempts were made to get round or across the third (south-westerly) spur in order to reach Lake Judd, but heavy scrub intervened, and it appears that the easiest access to the lake would be by a long circuit by Lake Edgar and the northern end of the River Anne gorge. On the one fine day Mt. Anne was ascended by the second westerly spur and the plateau examined. Messrs. Hutchison and Chambers attempted to ascend the pinnacle, but were stopped by a virtual face about 30 feet below the summit, which had blocked an attempt by the 1920 party.

(d) Previous Literature and Acknowledgments.

No detailed account of the district can be found. In 1874 the late Mr. R. M. Johnston, when exploring the Arthur ranges, does not appear to have crossed to the east of the Huon. In 1880 Mr. Henry Judd, of the Huon, after several attempts in earlier years, succeeded in penetrating the scrubs of the Weld Valley and reaching the plateau of Mt. Anne. He discovered and named Lake Judd, and has left a brief but vivid account of the remarkable features of the lake and the great north-eastern gorge in a little-known pamphlet dealing for the most part with quite other matters (Judd, 1898). In 1908 the late Mr. W. H. Twelvetrees and the late Mr. A. S. Atkins were engaged in a geological exploration of the country between Tyenna and the Gordon, but their investigation only extended to the north of the area described in these notes. Mr. Atkins ascended Mt. Anne, and there is a brief reference to it in Mr. Twelvetrees' report (Twelvetrees, 1908). In 1920 Mr. A. McIntosh Reid covered the area described by Mr. Twelvetrees, during the investigations for his Bulletin "Osmiridium in Tasmania," and added more information, with a very complete geological map (Reid, 1920). Mr. Renison Bell and other prospectors visited the district during the 90's, but no written reports can be found.

The present writer had the plans of Mr. Twelvetrees and Mr. Reid with him on the 1922 trip, and made full use of them as far as they extended.

The writer also wishes to acknowledge his indebtedness to all the members of the parties for the assistance rendered throughout the trips, to Sir T. W. Edgeworth David for his kind encouragement and suggestions, and to Colonel D. A. Lane for assistance rendered in drafting the plans accompanying this paper.

2. PHYSIOGRAPHICAL GEOLOGY.

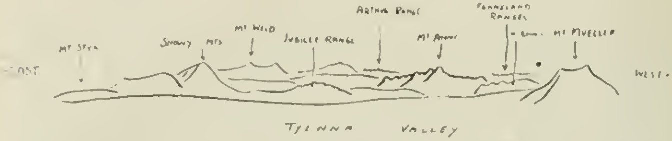
(a) Present Topography of Area.

The north of the district in question is marked by the line of elevated country extending from Mt. Mueller (about 4,000 feet) on the east about ten miles westward to Mt. Wedge (about 3,500 feet) and produced for three miles southward by the bold outlier, Mt. Bowes (2,500 feet). These hills form the watershed between tributaries of the Gordon. Derwent, and Huon Rivers. The valley of the Weld, which runs through the centre of our area, the divide between the Weld and the Huon, and the north-eastern portion of the valley of the Huon make up the area here described.

The Weld rises in many small streams in the centre of the range above mentioned between Mt. Bowes and Mt. Mueller. It is separated from the Styx for the first few miles of their courses by a watershed consisting of a confused series of small ridges densely covered with forest, among which it is difficult to tell which river many of the streams ultimately reach. The Styx, after flowing a few miles in a south-easterly direction, bends to the east, and passes out of the area with Marriott's Look-Out and the hills south of Tyenna on its north bank, and the Jubilee Range, Snowy Mountains, and Mt. Styx in succession on its south side. To the west the watershed of the Weld is separated from that of the Huon first by Mt. Bowes and then by a scarcely perceptible ridge joining that mountain to Mt. Anne, and farther south by the Mt. Anne range.

The Weld flows in a south-easterly direction for about twenty-five miles, the first five of which are through a broad valley with numerous insignificant ridges. Opposite Mt. Anne its course becomes a tremendous gorge with precipitous, scrub-covered sides rising to the eastern spurs of Mt. Anne on the west, and to the Jubilee Range on the east.

The valley opens out a little between Mt. Anne and Mt. Weld, and then narrows as the river runs between Mt. Weld and the Snowy Mountains in a steep-sided valley over 3,000 feet deep. For the three miles before its junction with the Huon it runs through a broad alluvial plain. The river consists of long deep pools separated by series of rapids. The river is difficult to cross throughout the lower half of its course, and appears liable to floods. It is one of the finest rivers in Tasmania, with a very considerable flow of water, and the scenery along the quiet reaches rivals that on the Gordon. A fine view of the valley of the Weld, which compares favourably with the gorges of the Forth and Mersey in the North, may be obtained from the slopes of Mt. Bowes.



The eastern side of the valley of the Weld is formed by the Jubilee Range and the Snowy Mountains, both running roughly north and south from the Styx Valley to the Huon, the Jubilee being about 10 miles long and lying west of the northern and less elevated extension of the Snowy Mountains. The Jubilee Range is a line of sharp, partly isolated, quartzite peaks, displaying the rugged outline and bare, precipitous flanks usual in these earlier Palæozoic ranges. It averages about 3,000 feet high, and when opened up will prove one of the most picturesque pieces of mountain scenery near Hobart. The Snowy Mountains are more elevated, but round in contour, as is the case with most of our diabase mountains. Their summit is roughly east of the summit of Mt. Weld, and their western slopes are broken by cliffs and huge talus slopes.

The Huon rises in the forest-covered southern slopes of Mt. Wedge and flows in a generally southerly direction to the south in a series of considerable bends and loops through a flat, swampy, buttongrass plain in places ten miles broad and clearly of glacial origin. The plain is continued to the north-west to Lake Pedder and the Serpentine Valley, and in places the flatness of the country makes it quite impossible to fix the location of the Huon-Gordon divide. The Huon, 20 miles south of Mt. Wedge, turns sharply to the east and ultimately joins the Weld, which thus becomes one —and probably the most considerable—of its tributaries.

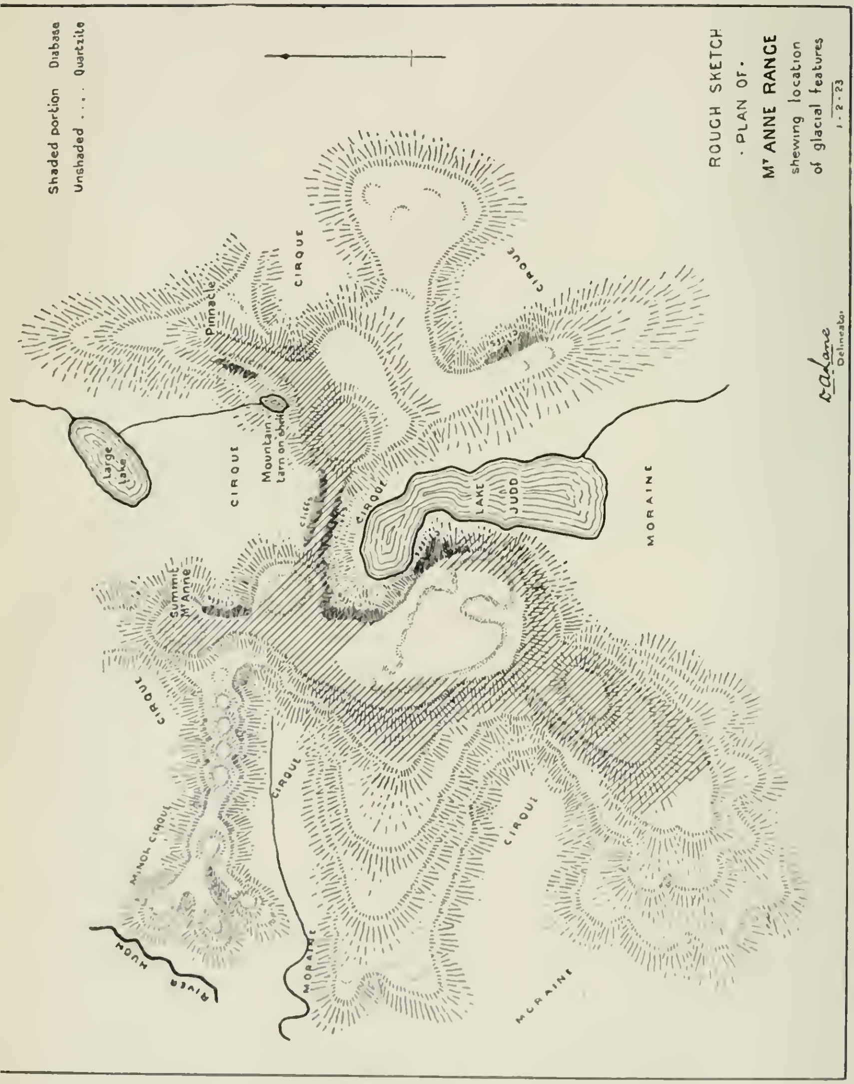
Fig. 1.

MT. ANNE RANGE FROM THE WEST.

Fig. 2.

THE MT. ANNE RANGE FROM MT. WELD.

(A. N. Lewis, photo.)



SKETCH PLAN OF MT. ANNE.

The country between the Huon and the Weld is rugged in the extreme. To the north is Mt. Anne, a narrow ridge running roughly north and south, perhaps four miles long, with the summit at the extreme northern end standing several hundred feet above the ridge of the mountain and over 4,500 feet above sea level. From the summit the mountain drops steeply to the north, north-west, and north-east, so that viewed from Mt. Field or any mountains to the north it appears as a fine pointed cone rising straight from the plains and far higher than any other of the mountains of the south-west.

Lower spurs radiate on every side. To the north, the least significant connects the mountain with Mt. Bowes. On the west two ridges run out to the Huon. The more northerly is a rugged chain of peaks, about 3,000 feet high, steep on all sides and precipitous on the north-west. The sky-line of this ridge is very picturesque. The second ridge runs parallel to it about a mile and a half farther south. The contour of this ridge is smooth and rounded, but the sides are nevertheless steep. A couple of miles farther south and running south-west from the corner of Mt. Anne is a third spur, shorter than the other two, but broken into a number of ridges covered with undergrowth, which extend in a series of low, broken, but steep hills for some miles towards Lake Edgar.

Behind this ridge lies Lake Judd, perhaps two miles in length and half a mile wide, resting in a kidney-shaped cirque which has been carved out of the very heart of the mountain. East of the head of Lake Judd stands another peak only a few hundred feet lower than the Mt. Anne plateau, to which it is connected by a jagged comb ridge circling round the north end of Lake Judd. From this peak several spurs radiate. A short one to the south-east forms the other side of the Lake Judd cirque, and is again cut into on the south-east by another cirque. A second spur appears to connect this peak with a flat-topped and isolated plateau which forms the south-eastern buttress of the Mt. Anne range, and is bounded on the south by the last mentioned cirque and on the north-east by another cirque. Farther north a third spur radiates to the east, stretching out several miles to the Weld Valley. On the end of the higher portion of this is a peculiar pillar of rock, standing several hundred feet above the level of the top of the main ridge in a tower only a few dozen feet in diameter, and forming the most conspicuous landmark of the range. It is one of the most remarkable mountain features in Tasmania, and the Messrs. Giblin appropriately named it "Lot's Wife." To the north of this spur is a very considerable precipitous walled cirque, in which lies a large bush encircled lake, not far from the Weld River.

South of Mt. Anne runs a long, rugged, but comparatively low quartzite plateau deeply dissected by gorges and occupying most of the country between Mt. Anne, Mt. Weld, and the Huon. It is separated from Mt. Anne by a deep, narrow, but flat-bottomed valley drained on the west by a stream flowing into Lake Edgar in the Huon Plains, in the centre by the Anne River, into which Lake Judd drains, and on the east by a considerable tributary of the Weld which has been named "Judd's Reward Claim Creek" from an old claim situated on its bank.

On the wall-like face of this plateau opposite Mt. Anne can be seen one large and three smaller mountain tarns, for the largest of which the name Smith's Tarn has been suggested, after Mr. V. C. Smith, who, of our parties, first saw it. The Anne River cuts through the plateau in a deep gorge. The plateau extends eastward to Mt. Weld, which eminence rises a thousand feet or more above it and forms its eastern buttress on the edge of the Weld Valley. Mt. Weld is over 4,000 feet in height and stretches for about eight miles, a narrow flat-topped ridge, ending precipitously at its northern end, and appearing an isolated peak when viewed from the north. It descends on the east very steeply to the Weld and on the west also steeply for a thousand feet or so to the level of the quartzite plateau. On the south its ridges reach to the Huon Valley.

(b) Development of Present Topography.

The present cycle of erosion in Tasmania dates from the time of the diabase intrusions, and it is difficult on the evidence at present available to be certain of conditions during the earlier ages. There is undoubtedly evidence of an old peneplain, lying between the Weld and Huon Rivers, formed in the Cambro-Ordovician strata prior to the diabase intrusions, and probably during late Devonian or early Permo-Carboniferous times. This peneplain is now much dissected by fluviatile and glacial action, but looking south from Mt. Anne the remarkable flat top of the quartzite plateau between Mt. Anne and the Huon catches the eye at once. The fact that the top of this stands at the same general level as the top of the quartzite under Mt. Anne, under Mt. Weld, under

Mt. Wedge, on the sides of Mt. Mueller and the exposed summit of Mt. Bowes, indeed of all the rocks of this series in the locality, points to the conclusion that these must all have once formed the top of a plain. Farther south and west the peaks of the Arthur and Frankland Ranges consisting of the old Pre-Cambrian schists have a remarkable accordance in altitude, suggestive of an ancient peneplain, but whether of the same or an earlier cycle of erosion is a problem for the future. There is no evidence at present upon which to fix the date of the peneplanation of the Cambro-Ordovician rocks of the area, but it was certainly earlier than the Permo-Carboniferous glaciation.

The diabase intrusions raised the sediments that had been deposited from the western lands in the coastal seas of Jurassic times and earlier and instituted our present cycle of erosion, but the extent to which the land to the west was affected by these intrusions or earlier and later earth movements and whether the older rocks of the West Coast were ever covered by the Trias-Jura sediments is not yet known. The diabase, however, certainly did force its way through the older quartzites in places, as at Mt. Anne.

The direction of the present drainage was probably determined by the landscape immediately after the diabase intrusions, during the Upper (?) Cretaceous. The rivers are therefore here, as throughout Tasmania, subsequent streams. The fact that the diabase with incumbent sediments rose to a height of 4,000-6,000 feet above present sea level, while the top of the older rock to the west now does not exceed 3,000 feet, yet the rivers run from west to east cutting, from the comparatively low lands of the west, in huge, steep sided valleys and gorges through the mountain systems that now stand highest, indicates that in Cretaceous times the mountains to the west stood, or were covered with other rock, since removed, which stood, twice as high as they now are to be seen—e.g., the Huon could reach the sea from its point of origin by several channels that do not rise over 1,000 feet, but it appears to cut through a ridge between Mt. Weld and Mt. Picton, 3,000 feet higher. It thus provides a good example of a subsequent stream being kept in its course by its original channel, formed in very different strata (in this case probably Trias-Jura sandstones) from those lying below, which now stand out as mountains of circumerosion.

The Huon, Weld, and Serpentine Rivers are on the verge of maturity although their tributaries are, as usual in Tasmania, typical of juvenile drainage. The main streams have cut through the diabase sill and extended their valleys considerably in the softer rocks below. They have thus captured the drainage of very considerable areas of country, and in widening their valleys have isolated remnants of the old plateau which stand out as erosion residuals, Mt. Anne being one of the best examples of this type of mountain in Tasmania. [Sir Edgeworth David has asked whether the topography has been all caused by differential erosion and suggests faulting as responsible for the escarpments east of Mt. Anne. The writer had this possibility in view, but could find no evidence of large scale faulting, and respectfully submits that erosion is responsible for the present topography. But the possibility of a fault scarp running up the west side of the Weld, past Mt. Stephen (Tim Shea), west of the Vale of Rasselas, and even to the west of the Cradle Plateau, should be borne in mind in future investigations.] In eroding their valleys the rivers have removed later sediments from and exposed the early Palæozoic topography, which, as Mr. Ward has remarked, is now exerting an influence on present topography (Ward, 1909). An interesting example of this is to be seen at the mouth of the Weld, where several miles of Cambro-Ordovician quartzites with an already developed topography are being exposed from beneath the sandstones. The topography of the western portion of the area has been moulded by glaciers during the Pleistocene Ice Age, the work of which will be dealt with later. The rivers are at present engaged in removing the morainal dams of the lakes and other remains of the glaciers.

3. STRATIGRAPHICAL GEOLOGY.

(a) Pre-Cambrian.

The highly foliated quartz-mica schists, ordinarily referred to the Proterozoic [the Algonkian of Ward and Twelvetrees], with which the Arthur and Frankland Ranges are made up do not appear to cross to the east of the Huon unless Scott's Peak [which was not examined] consists of these rocks, but this is unlikely. Mr. R. M. Johnston in his Geology of Tasmania placed the rocks of the western ranges in this system, and Mr. Twelvetrees describes the junction with the quartzites visible north of Mt. Wedge (Twelvetrees, 1908), but in the area being described the junction appears to be obscured beneath the glacial deposits of the Huon Valley. The Geological Map of Tasmania issued by the

Geological Survey in 1914 shows the eastern boundary of the Pre-Cambrians here from 3 to 5 miles too far east.

(b) Early Palæozoic.

Rocks of this age predominate in the area. They consist of massive and extremely hard quartzites with occasional beds of slate and conglomerates. The age of these beds, which occur considerably in south-west Tasmania, is not definitely fixed. They are to be seen overlying the Proterozoic (Twelvetrees, 1908) and at Tim Shea, the Needles, and the Thumbs they underlie beds of West Coast Conglomerate, now known to be the base of the Silurian (G. A. Waller 1904, Loftus Hills 1921) which cap these peaks. Beds of limestone occur south-west of Mt. Mueller, and these can be seen to be overlying the quartzites. Mr. W. S. Dun considers these limestones (Gordon River series) from palæontological evidence to be undoubtedly members of the Silurian system, and these beds of quartzite, allotted by R. M. Johnston, Twelvetrees, McIntosh Reid, and others, to the Cambrian, appear certainly to be Pre-Silurian. For the present Cambro-Ordovician appears the most correct classification.

On the east side of the Huon every eminence protruding from the glacial plain consists of quartzites of this age, always inclined at a high angle and in massive layers separated at intervals by thin layers of more flaky rock. Time did not permit of the working out of the details of the stratigraphy of these beds, but almost every outcrop showed a different angle of dip. The colour is generally white, but often tinged with pink. The cliffs to the north-west of the more northerly of the two western spurs of Mt. Anne show a beautiful salmon-tinted shade visible from some distance. On the western side of Mt. Anne the quartzite is dipping at an angle of about 50 degrees in a direction about 45 degrees W. of N. The quartzite is traversed in all directions by veins of white quartz, often over an inch in thickness.

The quartzite extends under the diabase cap of Mt. Anne, which is about 1,500 feet in thickness. Perched on the top of the diabase is another small layer of quartzite. This will be commented on later when dealing with the diabase. The quartzite can be seen emerging from under the diabase on every side of the mountain, and is continued southward at least as far as the valley of the Huon, comprising the plateau mentioned as lying south and south-east of Mt. Anne and extending eastward until obscured by the diabase of Mt. Weld.

South-east of the latter mountain it emerges again in a small outcrop round the mouth of the Weld River, where it forms a low line of hills some three miles long on the west side of the river, and on the east of the Weld a number of isolated cone-shaped, buttongrass covered hills known as "Glover's Paddocks." The quartzite is here dipping at an angle and in a direction similar to the beds on the west of Mt. Anne. Five miles up the Weld from its junction with the Huon the older quartzites disappear under Permo-Carboniferous and Trias-Jura sediments, which also cover the older rocks to the east and form the divide between the Weld and Denison Rivers. To the west it is obscured by the diabase of Mt. Weld.

At a spot some twelve or fifteen miles up the Weld the older rocks again appear in the bed of the valley, stretching right across from Mt. Anne to the Jubilees and northward to the head of the river. The Jubilee Range appears to consist of the same massive white quartzites, which, however, do not extend farther east than the foot of the Snowy Mountains. To the north, similar beds compose Mt. Bowes and the southern foothills of Mt. Mueller. On Mt. Bowes the quartzite is dipping at an angle of about 60 degrees a few degrees south of west.

On the west of Mt. Bowes are large beds of a hard reddish slate resembling burnt fireclay, which appear to be included in the quartzite beds. In the course of the Weld roughly 12 miles from its mouth are considerable beds of grey slate resembling in general appearance the Dundas slates of the West Coast (Cambro-Ordovician), but no indication of its exact horizon was found. Opposite the end of the Jubilee Range there is a small outcrop of serpentine or serpentinised rock to be seen in the bank of the river. It is overlying unconformably some beds of white sandstone which show no signs of contact. On the old track just above this outcrop is a corner peg blaze apparently of an intended claim, but no application was ever lodged. A bed of grey slate of small extent lies across the Port Davey track to the north-east of Mt. Bowes near the old Junction Huts.

The older rocks extend eastward in the Russell Falls River Valley as far as Pine Hill, three miles west of Fitzgerald Station. (On the beforementioned Geological Map they are shown as extending some eight miles too far east in the Tyenna Valley). They are overlain to the north and east by Permo-Carboniferous mudstones, to the west by basal conglomerates of that system, and to the south they are separated from the similar rocks of the Jubilee Ranges by ridges of diabase. They appear to underlie the diabase throughout the whole area and to be exposed when the valleys have been eroded sufficiently deeply. The writer is inclined to think that the area shown on Mr. Reid's map as occupied by Permo-Carboniferous sediments is too extensive, and that most of this country, except on the south-eastern slopes of Mt. Mueller, consists of older quartzites. The quartzites outcropping on the road to Mayne's Farm at the base of Pine Hill is streaked with veins of quartz containing quantities of iron pyrites.

As indicated on Mr. Reid's map and on the sketch accompanying this paper, two beds of limestone occur in the valleys of the two northern branches of the Weld. This is a hard white rock of the Gordon River Limestone series (Twelvetrees, 1908). The writer can only confirm Mr. Twelvetrees' remarks on the occurrence, which should be referred to for a more detailed account of the country traversed by the South Gordon track.

(c) Permo-Carboniferous and Trias-Jura.

Sediments of this age appear along the eastern side of the area, the line of the valley of the Weld being approximately the present junction line between the newer and older rocks in this part of Tasmania. The base of the Permo-Carboniferous system consists of glacial conglomerates. Two small but excellent examples of this formation, which is so well developed at Wynyard, are to be seen in the area.

One of these occurrences extends from about a mile west of Fourteen Mile Creek on the Tyenna-Port Davey track, to the top of the Russell Falls River-Styx divide on the south-eastern spur of Mt. Mueller. The beds are exposed for three miles or so along the track. They consist of the typically grey, clayey matrix, showing little signs of stratification, and only just resistant enough to require the use of a hammer, studded with pebbles and boulders of all sizes, but chiefly smaller than a cricket ball, consisting of grey quartzite, quartz, slate, and mica-schist. There is a strange absence of red granite. Mr. Twelvetrees mentioned the existence of Permo-Carboniferous conglomerate here, but apparently did not recognise its glacial origin. The Pre-Cambrian mica-schist boulders reported by him from Fourteen Mile Creek were probably derived from this tillite. Mr.

Reid states that he knew it was tillite. The present writer found ample confirmation in the numerous ice-scratched pebbles which were found in greater profusion than at Wynyard, although, as at the latter place, large patches of the tillite occur in which no scratched pebbles can be found. The glacial beds seem to occur between the 1,400 and 1,800 foot contour lines, and appear to be overlain by beds of a coarse sandstone at a height of 1,800 feet above sea level, but neither its highest point nor its boundaries can be ascertained from the track. It rests, on both sides, on Cambrian quartzites.

The second occurrence of glacial tillite of this age was noticed in the course of the Weld about 15 miles from its mouth, at an altitude of about 500 feet. The river has cut through the morainal deposit, which is exposed on its bank. It is similar to the Wynyard formation and that just described, on Mt. Mueller. The proportion of red granite pebbles and boulders is high, and several erratics are of considerable size.

It may be worth noting, in passing, the fact that four occurrences of the rare Permo-Carboniferous glacial till, namely these at South Cape Bay, Wynyard, and the two described, lie in an almost straight line, which if produced passes near Bacchus Marsh in Victoria, where similar beds occur. This may be only a coincidence but it is a point to be borne in mind when investigating these beds.

These beds are succeeded by 300 feet of a coarse but regular conglomerate of Permo-Carboniferous age, resembling in general appearance the recent river drifts of the Derwent and elsewhere, and consisting of a hard yellowish matrix cementing together quartzite pebbles about the size of a cricket ball. Its age is definitely fixed by some strata that occur in its upper layers on the ridge to the east of the river and which contain fenestella. The conglomerate appears to be the river drift or delta deposit of some ancient river which perhaps flowed through the marked gap which now separates the Arthur and the Frankland Ranges and is continued east in the deep valley south of Mt. Anne and north of Mt. Weld.

Lower down the Weld, Permo-Carboniferous mudstones flank the valley. In the bed of the river they are the lower marine series and contain many of the typical fossils of those rocks. They flank the southern end of the Snowy Mountains and probably the eastern side of Mt. Weld. An outcrop of horizontal strata under the diabase organ pipes of the northern end of Mt. Weld could be distinguished from

Mt. Anne. This looked like rocks of this or the succeeding system, but their actual nature could not be confirmed. Here as elsewhere the Permo-Carboniferous mudstones are succeeded by the Knocklofty sandstones of the Trias-Jura.

The Russell Falls River is cutting through the upper marine series of the Permo-Carboniferous, which is traversed at intervals by bars of diabase and overlaid at about the 800 foot contour round the valley by Trias-Jura sandstones through which the river has cut and which are now nearly all denuded away, leaving the diabase of the hillsides bare. Elsewhere in the area, if the older rocks were ever covered by these sediments erosion has now removed all trace of them.

(d) The Diabase Intrusions.

The reader is referred to Mr. P. B. Nye's remarks on the occurrence of the Cretaceous diabase in his "Underground Water Papers, Nos. 1 and 2," undoubtedly the best account of the subject yet published. The area described in this paper would repay detailed study on this point.

In Tasmania the diabase appears to occur either in laccolith-like mountains of greater or less extent such as are common in the centre, east, and south, and of which the Central Plateau, Mt. Field East, and Mt. Wellington provide examples, and which may be distinguished by the immense beds of Permo-Carboniferous and Trias-Jura sediments hoisted up on their flanks, or, more rarely, as mountains isolated by erosion from a once extensive sill of diabase which spread over the top of early Palæozoic rocks, for example, Barn Bluff, the Eldon Range, and most of the more western diabase mountains (see The Geological Survey's publication "Coal Resources of Tasmania," 1922).

The Snowy Mountains, Mt. Styx, Marriott's Look-Out, and the diabase hills south of the Tyenna Valley are of the laccolithic type and probably are connected with the Mt. Wellington range intrusion. Probably diabase has covered beds of the older quartzites along the edge of the known occurrence of these, and this is undoubtedly the case on the lower Weld and west of Tyenna, but it is difficult at present to say where the main upthrust of the diabase occurred and where the sills joined the laccolithic intrusions.

Mr. Twelvetrees has classed the diabase of Mts. Mueller, Anne, and Wedge as portions of sills (Twelvetrees, 1908). This certainly appears to be the case in regard to Mt. Anne and Mt. Wedge, but Mt. Mueller and Mt. Weld seem rather to belong to the laccolithic type with extensions westward in the form of sills. On the south-eastern shoulder of Mt. Mueller basal conglomerates of the Permo-Carboniferous appear at a height of at least 1,800 feet, while at Fitzgerald, six miles away, the top of the system can be seen at an elevation of 900 feet. This points either to a diabase uplift on the eastern slope of Mt. Mueller of at least 2,000 feet, or to a fault with a throw of that height running along the face of Mt. Mueller. In view of what has occurred throughout Tasmania it seems more probable that the diabase of Mt. Mueller has raised the tillite, with the quartzite that underlies it, to their present height. The diabase of Mt. Mueller appears to reach a low level on the north-eastern slope, but it does not appear to be connected with the diabase from the Mt. Field ranges, which extends westward in a broad sill now seen capping Field West, Tyenna Peak, the Knobs, and Wherrett's Look-Out. To the south-east the diabase of the hills south of Tyenna approaches, if it does not join, that of Mt. Mueller. To the west, the Mueller diabase appears to have extended over the quartzites in a sill in the direction of Mt. Wedge.

Mt. Weld is certainly a diabase uplift. There are considerable occurrences of diabase in the valley of the Weld between 5 and 10 miles from its mouth at a height under 300 feet above sea level, whence it appears to lead right to the summit over 4,000 feet above. Alongside Fletcher's Hut on the banks of the Weld the diabase can be seen penetrating the quartzites in a large dyke of very close-grained rock. To the west the diabase appears to extend for some distance in a sill over the top of the quartzites.

Mt. Wedge is crowned with a cone of diabase, apparently a portion of an old sill resting on the older quartzites, but the writer has no data at present on which to determine from which direction the sill originally came.

Mt. Anne is also capped with diabase, probably portion of an old sill. It lies on top of the highly inclined quartzites, and appears now to be 1,200-1,500 feet in thickness. The most interesting feature of its occurrence here is the existence on the top of the Mt. Anne plateau of a small area of quartzite, perhaps a square mile in extent and 100 feet thick. This is an almost unique feature in the Tasmanian occurrence of diabase. This mass of quartzite, which appears to be a remnant of the rocks through which the sill penetrated and which probably originally overlaid it, has either been lifted 1,500 feet from its bed by the intruding sill or has been sheared from the top of some mass of quartzite and been carried along by the diabase. As the quartzite varies considerably from one locality to another it should be possible to discover whence this mass came, and the light such an investigation would throw on the mechanics of the diabase intrusions would well repay the trouble.

The diabase adjacent to the quartzite is of a glassy, homogeneous texture for about 100 feet, in which space it changes to the ordinary coarse-grained crystalline rock common on the mountain tops. This is interesting as showing conclusively that coarse crystals in the diabase are not an indication that the rock in question cooled at a great distance below the then surface. This close-grained diabase is sufficiently different in nature to be clearly distinguishable from the ordinary diabase at a distance of several hundred yards.

In the centre of the quartzite patch a small cirque has cut into it to a depth of about 75 feet, and in the centre of this depression can be seen a dyke of glassy diabase about 12 feet wide penetrating the quartzite. The junction line between the quartzite and the diabase is finely marked, but the former rock shows no signs of having been affected by the diabase.

The diabase cap of Mt. Anne has been greatly denuded by glacial action and has nearly disappeared. On the sides of the cirques that eat right into the heart of the mountain the junction between the diabase and the country rock it overlies can be clearly distinguished. There is probably no place in Tasmania in which the diabase intrusions can be studied with greater prospects of good results.

(e) Post-Diabase Sediments.

Since Cretaceous times this portion of Tasmania appears to have been enjoying sub-aerial conditions, and no signs of Tertiary sedimentary rocks were seen. A little Pliocene (?) basalt occurs at Mayne's selection, six miles west of Fitzgerald, as shown on Mr. Twelvetrees' and Mr. Reid's maps. Pleistocene glacial deposits litter a great part of the countryside. These will be described in the next section. Post-Tertiary alluvial deposits exist in the Russell Falls River Valley (Twelvetrees, 1908) and on the lower Weld, at the mouth of which there is a curious delta of alluvial material stretching some three miles up the river and three miles along the bank of the Huon, consisting of small, round, water-worn pebbles, chiefly of quartzite, and is more or less swampy ground. This appears to be a flood plain of the Weld, deposited as the swift current was slackened as it debouched into the Huon Valley. As the Huon deepened its bed or the sea level altered, the Weld has cut through and partially drained this plain. An apparently similar, though more extensive feature occurs on the other side of the Huon, and is known as the Arve Plains.

4. GLACIAL GEOLOGY.

(a) Descriptive Account.

The western half of the area dealt with in this paper and all the mountain tops in it show evidence of intense glaciation during the Pleistocene. In the Upper Huon Valley between Mt. Wedge, Lake Pedder, Mt. Anne, and the Arthur Range, the whole topography has been moulded by ice action. The flatness of the plains, stretching, as they do, for ten miles and more in an almost level swamp, and the sinuous courses and sluggish currents of the streams indicate that these plains are not due to the erosion of the streams that now occupy them. A recent elevation above the sea could have produced such a landscape, but there is no evidence of any sufficient uplift or of marine deposits here, and it is not the still undrained top of a plateau, as it is surrounded by lofty peaks. The rivers starting their course as mountain torrents flow for several dozens of miles through plains in a very mature stage of erosion and then finish their course in a more or less juvenile stage. Clearly an "accident" has occurred to the drainage of the Huon and Serpentine Plains, which do not present the characteristic features of river erosion, and the cause of that accident has been the intervention of the ice sheets and glaciers of the Pleistocene glacial epoch.

The general aspect of the whole region, the sides of the hills rising in a clean curve nearly vertically out of the plain, the U-shaped gaps between adjacent hills when they occur close together, the absence of water-worn valleys in the extraordinary level plain, all support this view. Some low hills break the surface of the plain at considerable intervals. These are almost always narrow, steep-sided ridges, apparently scraped bare by ice. The lower slopes of the main mountains and spurs are in general smooth and decidedly concave in section—ordinary water-worn hills being convex, streams gathering strength to erode as they descend —while the more elevated crests are extremely rugged above the 3,000-foot contour with picturesque pinnacles and crags. The outstanding spur of the Frankland Range that rises to the south-east of Lake Pedder is decidedly Tind-like when viewed from Mt. Anne.

Fig. 3.

LOOKING SOUTH FROM THE SOUTH END OF MT. ANNE PLATEAU.

Fig. 4.

THE HUON PLAINS LOOKING WEST FROM THE S.W. OF MT. ANNE.

(A. N. Lewis, photo.)

All this can be seen at a glance when the landscape is viewed in panorama from an elevation and points to an invasion of the whole district as indicated, by a great ice sheet, probably 1,500-2,000 feet in thickness [the elevation of the rugged and apparently unglaciated crags above the floor of the glacial valleys], growing from the tremendous snow precipitation of the West Coast and moving down the Huon, Serpentine, and Anne River Valleys, and perhaps reaching the sea at Port Davey. An ice cap must cover the whole of the land surface of the area (Hobbs, 1910). It is doubtful at present whether the ice that filled the Upper Huon at this stage covered the top of the surrounding mountains with a continuous white sheet. The rarity of moraines definitely attributable to this epoch of glaciation is an indication that here at any rate very little rock surface was showing above the ice. But even if the more prominent ranges protruded it was a very considerable glacier bearing close resemblance to an ice cap, and the ice moved radially over the flat country between the ranges impelled rather by weight of successive accumulations of snow than by the slope of the ground. This ice cap carved the main features of the topography of these western plains before the advent of the glaciers, which have left us the more obvious traces, and which by the action of their cirques eating into the sides of the mountains have carved the present topography of the elevated mountain ranges.

These later glaciers have left remains that are easily recognisable all round Mt. Anne, which has been subjected to the biscuit-cutting process described by W. D. Johnson (Hobbs, 1910), and approximates to the topography he calls a "karling" (using Nussbaum's term) illustrated on Plate 8 of Hobbs' 1922 edition. The mountain has been cut to the heart by three tremendous cirques, in two of which lie considerable lakes dammed back behind walls of morainal material which covers the plain at the entrance to the cirques Other cirques have cut into the outliers on the south-east and west.

Between the two western quartzite outliers is a tremendous cirque, cutting into the mountain to the diabase cap and standing at the head of a decidedly U-shaped valley some three miles long. The cirque that terminates the valley had not started to enlarge at its head before the conclusion of the glacial period and the walls do not present as fine a circle of cliff as is common in Tasmania. The glacier that flowed from here has strewn the floor of the valley with moraine in which diabase boulders alternate with quartzite ones. The moraine has not at any place completely dammed the valley, and there is no lake here. At the time this glacier was in the field several other ice flows must have moved a few miles out on to the plain from the numerous small recesses along the south-western face of the mountain. These have not left any well-defined cirques and could never have been extensive, but the plain near the foot of the mountain is littered with morainal material, amongst which diabase boulders are common, and these must have been carried some miles.

Apparently the crest of the more northern of the two western spurs stood out from the ice at this period, and the glaciers that flowed along each side have sapped back into the quartzite and produced a fine comb ridge. For the whole length of this spur its top culminates in a knife-like edge which the sapping effect of the ice has cut through at regular intervals, with the result that the top is crowned with a series of pinnacles rising precipitously 100 feet or more from the general line of the summit of the ridge. Its northern face shows some fine ice sculpturing, and is cut by several cirques. The Port Davey track skirts the foot of an escarpment 1,000 feet in height that appears to be a cirque wall. The end of the spur is divided into several minor features by cirques that have cut deeply into it and have, by enlarging their heads, thrown into relief the rock sentinels at the entrance to the cirques described by Professor Hobbs (Hobbs, 1921) which now stand out as quite prominent peaks. The second spur appears to have been under the ice for a long period and possesses a round contour without cliffs or irregularities, which anyone ascending the mountain finds to be a great advantage.

Farther to the south lies the Lake Judd Cirque, which, commencing at the south-west corner of the mountain, has eaten right into the centre of the pre-glacial plateau and nearly meets the western cirque just described. It is a fine example of this glacial feature, that to such an extent makes our mountain scenery. The floor of the cirque is almost entirely occupied by Lake Judd, a handsome sheet of water, perhaps two miles in length and a half a mile wide, crescentic in shape and set in the very heart of the mountain, with cliffs probably 2,000 feet high rising on three sides almost vertically from its waters. To the north-east and the south-east the cirque has enlarged its basin until it has met other cirques and eroded the entire pre-glacial surface

Fig. 5.

LOOKING EAST FROM NEAR THE SUMMIT OF MT. ANNE.

Fig. 6.

THE WESTERN END OF LAKE JUDD FROM THE MT. ANNE PLATEAU.

(A. N. Lewis, photo.).

of the plateau. The cirque wall now terminates in a unique example of a comb ridge, so precipitous and jagged that it would defy experienced climbers to traverse it. Impounding the lake is the most pronounced moraine in the locality. For a mile or more the country between the shore of the lake and Lake Edgar in the Huon Valley to the south-west and the Anne River to the south-east is covered with the confused succession of ridges and hollows typical of terminal morainal country so admirably described by Mr. A. McI. Reid (Reid, 1919). Lake Judd closely resembles Lake Seal in the National Park and Lake Dove on Cradle Mountain, but is a grander piece of scenery than either of these.

To the east of Mt. Anne is the most extensive cirque in the district. It appears to be deeper and is certainly broader than the other two mentioned. Its western wall must descend in a series of sheer precipices for 3,000 feet to the level of the Weld Valley, where lies a forest-encircled lake perhaps half a mile long, presumably of glacial origin. This cirque has eaten through the plateau until it has just met the western cirque and has carved out the other side of the comb ridge at the head of the Lake Judd Cirque. The size of this cirque gives another example of the general rule that the maximum snow action occurs on the lee of the ridge—in Tasmania, the eastern side. This cirque is a composite one with two main lobes and many smaller sub-divisions. In its south-west corner it meets another cirque that has grown from the south-east of the mountain. Between these two cirques is a second comb ridge, somewhat shorter but as rugged as the one before described. This forms the summit of a long diabase spur at the end of which stands the peculiar feature that has been named "Lot's Wife," mentioned earlier. This pinnacle, standing many hundred feet as perpendicularly and straight-sided as a tower, is a striking example of a glacial horn. It has grown at the entrance to two cirques, which, enlarging their heads behind it have removed the entire top of the pre-glacial spur to a depth of some 500 feet and left this pillar of rock standing at the end of the dividing ridge, the uneroded remnant of the pre-glacial spur with its summit representing all that is left of the original surface.

On the south-east side of the mountain there are two considerable cirques, the one mentioned above which has met the eastern cirque, and the other a mile farther west which has left a narrow ridge separating it from the Lake

Judd Cirque and a plateau of quartzite between it and the former of this pair. Between these two cirques, the Lake Judd Cirque and the one on the eastern side of the mountain, is a peak which provides a good example of a young glacial horn. The cirques have met or all but met all round it and have started to cut down the comb ridges, leaving this mass of mountain standing well above the surrounding cols, which are in process of being lowered, although the process was not a quarter of the way towards completion when the glaciers vanished.

These glaciers ended where we now see their terminal moraines, but the water flowing from them carried much material with it. To the east this was washed down the comparatively rapid Weld to the sea, but to the west the many streams emerging from the glaciers' ends spread their deposit over the flat plain already in existence, caused by the previous ice invasion. They thus formed large areas of glacial outwash aprons. It is these masses of rock and gravel strewn by numerous glacial streams over the older glacial valleys that form the great buttongrass plains of Western and South-Western Tasmania.

High up in various parts of the plateaux at about the 4,000 feet level and a little higher are several small cirques, some containing mountain tarns. These are evidently due to glacial action as described in the Field Ranges by Professor Griffith Taylor (Taylor, 1921). On the top of the main plateau there is a very perfectly formed and easily recognisable pair of cirques eating into each side of the quartzite patch before described and nearly cutting it in two, and several lakelets are to be seen to the south-east of the head of the Lake Judd Cirque.

A few other evidences of past glacial action were observed. To the south of Mt. Anne on the face of the quartzite plateau opposite the mountain could be seen four small tarns, the largest of which, as has been mentioned, has been called Smith's Tarn. These are all of glacial origin and are splendid examples of small cirques, Smith's Tarn rivalling the (so-called) Crater Lake on Cradle Mountain. The ice descended by a rock stairway to the basin of the tarn a few hundred feet below it, and thence probably to the valley of the Anne River.

The old moraine from Mt. Mueller noticeable from the Port Davey track is described by Mr. Twelvetrees (Twelvetrees, 1908), and although evidence of glacial action is not otherwise obvious, the glacial theory of the origin of this deposit seems reasonable. There are indications of a young cirque on the south-western corner of the summit of Mt. Mueller, and glacial action would be expected here at an elevation of 3,000 feet at least. Probably ice more resembling an ice cap than a glacier radiated across the spurs and adjacent plains of Mt. Mueller. Mt. Weld and the Snowy Mountains have the altitude and the area to provide névés for glaciers. From information given by some prospectors there is a marked glacial shelf on the eastern side of Mt. Weld on which repose some mountain tarns, and on the Snowy Mountains there are several lakes, one at least of considerable size.

(b) Glacial Epochs in Tasmania.

In the Northern hemisphere it is definitely established that, during Pleistocene times, the ice sheets descended four times over considerable portions of the continents of Europe, Asia, and America. These glacial invasions are known in Switzerland respectively as the Gunz, Mindel, Riss, and Würm ice ages, and are separated by inter-glacial periods of temperate climate. If conditions were similar for both hemispheres—as is the present theory—and if the temperature was sufficiently cold during each of these periods to cause glacial conditions as far north as Tasmania we should find signs of four corresponding invasions amongst our glacial remains.

Recently the Director of the Geological Survey, Mr. Loftus Hills, made the important discovery of the track of a very old glacier in the Pieman Valley. He has told the writer that glacial pavements formerly considered to belong to the Permo-Carboniferous glaciation were really caused by ice during the Pleistocene, but at a date far anterior to the more obvious signs of glaciation on the West Coast range. His opinion was confirmed by Sir T. W. Edgeworth David after a visit in March last year. Later, Mr. Hills has informed the writer that he found signs of two distinct glaciations in the vicinity of Lake Augusta at the head of the Ouse, where one moraine appears superimposed on another, with a peaty deposit from an intervening interglacial period between the two glacial deposits. Observations collected in the National Park indicate the existence of three ice invasions (Lewis, 1921). This idea has now been strengthened by additional data collected around Mt. Anne and the kindly confirmation given by Professor Sir T. W. Edgeworth David, our universal friend and helper.

It now appears that during the Pleistocene times we have traces of three ice invasions. The earliest apparent one was by far the most considerable, and was followed by two later phases. The writer suggests that this would correspond with the Mindel ice sheet of the Northern hemisphere. The size and intensity of this have obscured, if not obliterated, the traces of the Gunz in Tasmania, if any ever existed. The succeeding ice invasions may correspond with the Riss and Würm respectively. This theory is not yet proved, but may be useful as a working hypothesis. The finding of definite traces of interglacial periods between the various morainal deposits is necessary for the proof of the theory.

In the Mt. Anne region, in the National Park, and in Cradle Valley and elsewhere in Western Tasmania, there is every reason to believe that the obvious moraines are deposited on the top of a previously formed glacial topography. The regularity with which lakes appear in pairs, one superimposed on the other with, occasionally, mountain tarns at a greater altitude, the fact that this arrangement is never exceeded, and the definite signs of an older and a newer glaciation mentioned before, are indications that the apparently superimposed deposits are not merely a later phase in a receding cycle of glaciation, but are due to separate invasions. This contention, however, still remains to be proved.

If it will be borne out by future investigations the history of the Pleistocene glaciation in Tasmania will be in general this: The traces of the Gunz glaciation have been obliterated. During perhaps Mindel times a tremendous ice cap covered the western and south-western highlands and the more elevated portion of the central plateau. In the west the ice descended nearly to the sea. It covered, and so protected, the higher mountains, but moved down the valleys and out from the edges of the cap in great glaciers which, as Sir Edgeworth David has informed the writer, have left great outwash deposits in the vicinity of Strahan, and were responsible for the old glacial pavements of the Pieman, and the big terminal moraine seen at 13½ miles from Strahan on the railway track to Zeehan. Lake St. Clair was possibly a cirque formed at the head of a glacier growing from this ice sheet, which then filled the Cuvier Valley and covered the surrounding hills. Farther east, as at Cradle Mt. and Mt. Field, the ice cap covered the summits of the higher ranges but did not reach the bottom to coalesce with ice from neighbouring hills; for example, the Florentine Valley formed a gap of several miles between the ice cap of Mt. Field and the ice in the Vale of Rasselas. On these mountains the ice moved for some distance down the pre-glacial valleys, leaving its imprint on the topography. During this invasion the ice cap spread far out over the central plateau, being responsible for the many lakes and tarns between Cradle Mountain and the Ouse, and most probably responsible directly, or indirectly through the action of the intense cold on the rocks of the plateau, for the origin of the basins in which the Great Lake, Lake Echo, and Lake Sorell lie. It is possible that these are rock basins scooped by the ice sheet, but there is at present no direct evidence to couple their origin with ice action. The small glaciated areas on Mt. Wellington and Ben Lomond possibly belong to this period, and there are indications that many of the mineral-bearing drifts of the north-eastern highlands are glacial outwash fans. The characteristic remains of the possible Mindel glaciation in Tasmania are the broad flat plains throughout the western parts that are generally known as buttongrass plains.

At present we do not know anything about interglacial epochs, but following this period came the invasion by the Riss glacial epoch. Conditions were far less severe than during the Mindel times. The more elevated regions only were affected. Valley glaciers of the Dendritic type (Hobbs, 1910) grew from névés on the ranges and crept a short distance down the mountain valleys. These glaciers are responsible for the great cirques that contribute so much to our finest mountain scenery. As a rule the glaciers did not debouch far from their mountain valleys. They spread great deposits of moraines over the plains surrounding the valley mouths and for some distance up the valleys themselves, where morainal banks frequently dam back fine sheets of water. Between the cirques and U-shaped glacial valleys there still remains much of the older surface showing the rounding effects of the older Mindel ice cap. The glaciers occurred during this period on all mountain ranges in the western half of Tasmania over an elevation of 3,000 feet, and near the coast evidently reached much closer to sea level. The cirques and moraines of Lake Judd, Lake Seal in the National Park, Lake Dove in Cradle Mountain, and all the more striking signs of glacial action belong to this Riss period, which may be termed the cirque-forming period. The rounding effect of the Mindel ice sheet and the cirque-form ing effect of the Riss glaciers have left almost contrary results on our glacial topography.

Following this and clearly superimposed on it come the relics from the Würm glaciation, typified by the mountain tarn. The period of glaciation was this time far less intense than during the Riss period. Only the tops of the more elevated mountains were affected, and the nivation line appears to have rested at an elevation of about 4,000 feet at Cradle Mountain, as evidenced by Lake Wilks, and similarly in the National Park and Mt. Anne, as shown by the elevated tarns at about that height. The duration was only sufficient for very small cirques and rock-scooped basins to be formed. Small hanging or cliff glacierets and horseshoe glaciers grew, but did not travel far or obscure the evidence of the Riss glaciation. One of the best specimens of a moraine the writer has seen, however, lies to the east of Lake Newdigate in the National Park, and is attributable to this period. The distinguishing feature of the Würm glaciation may be said to be the mountain tarn.

A point that warrants passing note here and needs further investigation is the effect of one of these periods of glaciation on the edge of our higher mountains. At about 3,500 feet round the mountains of the centre, south, and north-east of Tasmania run lines of cliffs. The regularity with which these occur suggests that during one of these ice periods, probably the Würm, the nivation layer in the atmosphere rested at this height round the contour of the mountains, and here the intense frost action carved out the lines of cliffs so common near the tops of our mountains, such as the "Organ Pipes" on Mt. Wellington, the Bluffs of Ben Lomond, and the cliffs in which the northern face of the Western Tiers culminates. The concave shape of many high mountain peaks, Mt. Ida and Wyld's Crag for example, may be due to the fact that they protruded their summits into this nivation layer, which has worn a circlet of cliffs round the peak. These cliffs formed the starting point of an ice flow, resembling a collar round the mountain, which descended the slope for some distance before melting. There is ample evidence on Mt. Wellington and on the track to Lake Fenton under Mt. Field East of accumulations of rocks resembling moraines and almost certainly ice borne. At least many of them could not have rolled into their present position, and it is clear that they reached their present position before the present vegetation grew up.

Fig. 7.

THE SUMMIT OF MT. ANNE.

Fig. 8.

THE TERMINAL PEAKS OF THE NORTHERN OF THE TWO WESTERN SPURS OF MT. ANNE. (A. N. Lewis, photo.)

(c) Cycle of Glacial Erosion in Tasmania.

There is one further phase of the study of the Pleistocene glaciation in Tasmania that deserves passing mention. As in the case of water-eroded topography, we have in glacial topography a cycle of erosion corresponding to the length of time during which a locality has been subjected to the effects of ice. Professor Hobbs defines the possible classes as follows:—

(1) The youthful channelled or grooved upland.

(2) The adolescent early fretted upland.

(3) The fretted upland of full maturity.

(4) The monumented upland of old age.

In the case of (1), cirques and glacial valleys merely groove the upland, leaving much of the pre-glacial surface still existing and clearly recognisable. In (2) the cirques have extended until they have met, and are separated by a serrated "Comb" ridge representing all that is left of the original surface. In (3) these lateral combs have disappeared leaving glacial horns (e.g., the Matterhorn) standing at the place where the heads of the cirques of the district junction. In (4) even this has disappeared, and all that is left are pairs of twin peaks, or "monuments," which formed that part of the upland which stood at the entrance to the U valleys, these being the last to be affected by the cirque enlargement, which takes place from the head outwards (Hobbs, 1910, 1921).

In Tasmania most of our glaciated areas have reached a stage bordering on the adolescent, early fretted upland. In most areas there is very little pre-glacial upland left. In the case of the National Park there are stretches of pre-glacial surface a few hundreds of yards across on the Field West and Mt. Mawson ridges and a mile or so on the Field East ridge, where the glaciation has not been so severe, while the Hayes and Newdigate Cirques have eaten into the Rodway ridge until the pre-glacial surface has disappeared, and we see the beginning of the formation of a comb ridge.

On La Pérouse there is a very fine example of a comb ridge. On the Mt. Anne range the process has extended a little farther. The cirques have commenced to cut down the comb ridges between them, and we see rudimentary glacial horns appearing in "Lot's Wife," the cone-shaped pinnacle to the east of Lake Judd, and the summit of Mt. Anne itself. On Cradle Mountain the process has gone still farther until the separating ridges have been quite smoothed out and the main pinnacles of Cradle Mountain and Barn Bluff stand out 1,000 feet above the surrounding cols. These are glacial horns in the making, but the process is far from complete, and it can hardly be called a type of fully mature glacial topography. Doubtless the extremely hard diabase cap of most of our mountains has hindered the development of the glacial cycle as it is hindering the development of the river cycle, and if we had had mountains of soft sedimentary rocks we would probably have had peaks to rival the Matterhorn, in outline if not in altitude. It is the Riss glaciation that has been responsible for the development of this topography. The Mindel ice sheet had more of a rounding effect and the Würm was of too short a duration to have a great effect, although it has accentuated the degree of erosion at the top of the Riss cirques and in many places has completed the formation of the comb ridge.

5. ECONOMIC POSSIBILITIES OF THE AREA.

(a) Mining.

It is difficult at present to see a great future before the district. As settlement extends the eastern part will be absorbed into the cultivated portion of Tasmania, but, short of the discovery of mineral wealth, it is hard to see what use can be made of the bulk of the area. For many years there have been rumours of the existence of gold under Mt. Anne, and the area has been constantly prospected, chiefly by parties from the Huon, but without appreciable results. The quartzites of the area are potential mineral-bearing rocks, but beyond this there appears little justification for hopes of discovery of a great mineral field here. The tiny patch of serpentine on the Weld is the only trace of an occurrence in the district of an igneous rock with which minerals are usually associated. The veins of quartz that traverse this bed of quartzite of Cambro-Ordovician age lying between Mt King William and La Pérouse do not appear to be an indication of the presence of minerals.

The locality has been well prospected. The western slopes of Mt. Anne would be easy to examine, and it is reasonable to suppose that they have been well searched. A lode there would be difficult to miss if a prospector investigated the faces of the main spurs. In the Weld Valley, on the other hand, the country is most densely covered with jungle and cannot have been at all thoroughly investigated, while the presence of a little serpentine is a hopeful sign. If mineral wealth exists here the eastern slopes of Mt. Anne, the western slopes of the Jubilee, and the gorge of the Weld between seems to be the most likely location. Although little hope in this respect can be held out the area warrants, and would possibly repay, a detailed investigation by the Geological Survey.

Mr. Renison Bell reported the existence of gold somewhere in the area, but exactly where he located it cannot be ascertained. He evidently did not consider the find of much value. On 2nd February, 1897, Henry Judd and Michael Gallagher lodged an application for a reward claim for gold reported to have been found on the north bank of the large western branch of the Weld. Their corner peg blaze is still distinguishable at the end of the old track up the creek, as indicated on the sketch plan attached to this paper. However, the applicants did not pay the fees and the block was never surveyed. The application lapsed, and apparently was not considered of value by the applicants. There is also a corner peg blaze on the old Weld track just above the patch of serpentine, but no application for a lease of this or any other spot in the area has been lodged with the Mines Department.

At the mouth of the Weld a reward claim for nickel and cobalt was awarded to H. E. Evenden in 1920. A little work has been done here and the lease is still effective, but apparently nothing is being done towards extended operations. The minerals here were obtained from the alluvial flat described above, just at its upper border. If the river has cut through any old lodes, minerals may exist in this flat. Some of the small boulders removed from a small shaft on this claim bore close resemblance to flint, and Mr. Gilbert Rigg, of the Electrolytic Zinc Ltd., who was good enough to have some pieces analysed, considered the specimens were true flint. Some specimens were then submitted to the Geological Survey, but the Director reports that although they bear a close resemblance to flint they are only a form of chalcedony. Some deposits of a very pure clay also occur near the mouth of the Weld. On the Styx a claim has been taken up for lithographic stone.

(b) Agricultural.

Agriculturally the area does not appear to have great possibilities. The lower third of the Weld Valley possesses fair soil of a nature and depth common in diabase and mudstone country in Southern Tasmania, and the sandstone higher on the hills indicates that somewhat better soil exists there. The entrance to the Weld Valley over the river flats and quartzites is unpromising, but there appears to be some ten miles or so of country which is at least no worse than the majority of the Huon district. There is some similar country around Mt. Mueller and doubtless on the flanks of the Snowy Mountains, all of which will warrant opening up as facilities are pushed farther out.

But the quartzite country that composes most of the area is very poor. The hard siliceous rock weathers very slowly, and with the heavy rainfall that exists there steep hillsides are washed bare before soil can accumulate to any depth, and will only support buttongrass and small flowers. Around the head waters of the Styx and Weld soil from this quartzite and the limestone deposits there has accumulated to a considerable depth and now supports a luxuriant forest growth. Much of this land will probably support agricultural crops when its turn comes to be opened up, and the heavy rainfall will assist cultivation, but when the forests are removed it is doubtful whether the shallow soil will not be washed away.

The timber in the Weld Valley appeared poor and patchy although there are good quantities of Beech (*F. cunninghami*). On the south-west of Mt. Mueller there is a fine but small area of Yellow Gum (*E. gunnii*) and mountain peppermint (*E. coccifera*). The lower slopes of Mt. Mueller will yield quantities of valuable timber for the Tyenna mills, and the Weld Valley possesses enough to make it worth while protecting until it can be milled, but it is not a preeminent timber area.

The western half of the area is at present valueless. Half has been scraped bare of soil by recent glaciation and the other half strewn with outwash gravels consisting largely of small angular chips of quartzite. The utilisation of the great buttongrass swamps of the west is one of the most pressing problems at present. It would pay the Government handsomely to institute research work into their possibilities and requirements for cultivation, but without systematic scientific research every effort to use them will be wasted, and it would be certainly a leap in the dark to spend money on them in, for example, planting exotic pines, without knowing more about them than we do at present.

Should this area ever be used it is to be hoped that the possibility of canalising the Huon and joining it by a canal via Lake Pedder to the Serpentine and thence to the Gordon will not be overlooked. This should prove quite possible, and on the surface appears the cheapest way of providing transport facilities to the back country here.

Mt. Anne when opened up will prove one of the foremost scenic areas of our island, and probably its most promising future appears to lie in its being made accessible for ordinary tourists.

APPENDIX (A.)

(Extract from account by H. Judd, 1898.)

Contributed by Major L. F. Giblin.

You pass on up the same river [Weld] until you come under the northern end of the Weld Mountain, which is very high and rugged, and here you hear the sound of a distant waterfall. The next object you see is Mt. Ann, which has a pinnacle of rock, which takes many different forms as you go round the mount, which is 5,020 feet high. Upon the southern side there is a stream of water that flows over a ledge of rock upon the top of the mount into space. So very high is it that it is thrashed into vapour before it can get to the earth, and has the appearance of a floss of silk floating about in the air by the change of wind. In this way the forest is watered by a vapour from it. At the western end of Mt. Ann you enter a small belt of low gum trees, then comes before you one of the most enchanting sights that anyone ever wished to behold.

This mountain has been burst open by some great power in Nature, leaving it with perpendicular walls of over 4,000 feet high upon three sides, and filled up with a beautiful lake called Lake Judd, discovered in 1880. This lake is about one and a half miles long and half a mile broad; perhaps it is larger, as I had no means of measuring it. The beauty here cannot be exaggerated. As you look into the water you at once see all the surrounding beauty of these high walls, with their rugged rocks and lovely spots of all sorts of green and dead reflected in the water below, with the dropping water from the snow above. When I first found this lake I was upon the top of the mountain, and came suddenly upon the edge of the large vault below, which made me tremble with fear, as I was in snow at the time, December. Opposite to this, westerly, is another opening between two mountains, and as you enter it you come to where the sides of the hill are broken back and a miniature lake in the centre. Proceeding further a new sight bursts into view, and you find that the inner part of the high mountain is thrown back on every side, opening out the bowels of the earth to view, with hundreds of different strata of rock of all sorts and thickness one above the other down to the slate formation. In the centre of this great amphitheatre, with its ledges of rocks to sit upon is a large lake in the centre and a conical-shaped rock of different coloured slate, polished smooth by the fallen rain and storms of passing time. Here you can sit and study geology from Hugh Miller's book of nature, as I call it, with all the quiet that surrounds thought in such places.

APPENDIX (B.).

EXPLANATION OF PLATES AND TEXT FIGURES.

PLATE I.—Sketch of the area described. The scale is approximately 8 miles to the inch. The scale and details must be taken as very approximate.

ERRATA.—In Legend for Ordovician Limestones read Silurian Limestones, and for Cambrian read Cambro-Ordovician.

Text figure is a sketch across the area described from east to west made looking south from the side of Mount Field East.

PLATE II., Fig. 1.—Shows the Mount Anne Range from the west. It is taken from the edge of the Huon Plains looking up the large cirque between the two western outliers, seen on both sides of the picture. The summit of Mt. Anne is at the left (north) end of the range. An easy ascent can be made up the spur seen on the right of the picture.

PLATE II., Fig 2.—Looking north-west at the Anne Range from the foothills of Mt. Weld. "Lot's Wife" is seen on the right of the range, and the summit of Mt. Anne is the next peak to the left. One of the two south-eastern cirques is seen in the centre of the picture. The valley in the foreground is that of the western branch of the Weld. Judd's Reward Claim is in the valley at the extreme right of the picture. This photo was taken from the farthest point reached by the party in 1921.

PLATE III.—Sketch plan of Mt. Anne showing the location of the more important features. The relative positions of the south-eastern features are very approximate.

PLATE IV., Fig. 3.—Looking south from the south end of the Mt. Anne Plateau. Smith's Tarn can be seen in the centre of the opposite ridge. The south-east end of the Arthur Range is in the background.

PLATE IV., Fig. 4.—The Huon Plains looking west from the southern of the two western spurs of Mt. Anne. The Huon runs in the line of scrub in the far distance. Lake Pedder lies at the back of the prominent hill on the right centre. The ranges in the background are the southern terminals of the Frankland Range. The mountain in the background on the left is Mt. Giblin.

PLATE V., Fig. 5.—Looking east from near the summit of Mt. Anne down the large cirque on the east of the summit. "Lot's Wife" is in the centre, and the Snowy Mountains in the background, with the Weld Valley in between.

PLATE V., Fig. 6.—The south-western end of Lake Judd taken from the Mt. Anne Plateau. Mt. Picton is in the distance in the centre, and Precipitous Bluff is the conical mountain to its left.

PLATE VI., Fig. 7.—The top of Mt. Anne looking across the western cirque from the top of the second spur, the quartzite of which can be seen in the foreground. The light patches on Mt. Anne are slopes of Diabase talus.

PLATE VI., Fig. 8.—The terminal peaks of the northern of the two western spurs of Mt. Anne. Cirques separate these peaks, which are glacial monuments in an early stage of development.

(Photos by the writer.)

APPENDIX (C.).

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VINCULUM SEXFASCIATUM, RICHARDSON.

AN ADDITION TO THE FISH FAUNA OF TASMANIA.

By Clive Lord, F.L.S.
Director of the Tasmanian Museum.

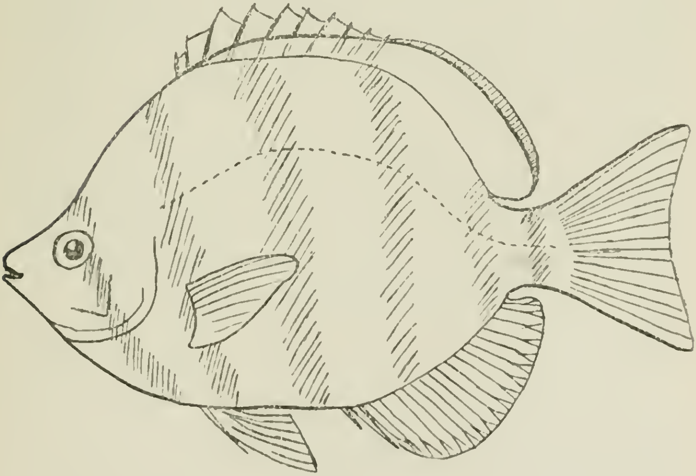
(Read 9th July, 1923.)

The following species has been recorded from Western Australia and Victoria. It has also been reported from New South Wales, but McCulloch (1922, p. 65) queries the reliability of this record. The species has not previously been recorded from Tasmanian waters.

FAMILY *CHÆTODONTIDÆ*.

Vinculum sexfasciatum, Richardson.

Six-banded Coral Fish.



Vinculum Sexfasciatum Richardson X¼

Chætodon sexfasciatus.

Richardson, A.M.N.H. (1842), p. 26.
Gunther, B.M. Cat. Fish (1860), p. 35.
Castelnau, P.L.S. N.S.W. (1879), p. 350.
Macleay, P.L.S. N.S.W. (1881), p. 388.
Kershaw, Vict. Nat. (1911), XXVIII., p. 34.

Vinculum sexfasciatum.

McCulloch, Endeavour Scientific Results (1914), II., 3, p. 110.

McCulloch, Aust. Zoologist, II., 3, p. 91.

Waite, Fishes of S.A., Rec. S.A. Museum, II., 1, p. 115.

The genus *Vinculum* was proposed by McCulloch (1914, p. 110). It differs from *Chætodon* in having very much smaller scales and fewer dorsal spines. The latter being limited to ten.

The specimen recently presented to the Tasmanian Museum was secured on the East Coast of Tasmania by Messrs. Dale and Davis. It is the first of the *Chætodontidæ* to be recorded from Tasmanian waters. The specimen measured 375 mm. (over-all measurement when fresh), and its occurrence on our coasts is of interest.

Tasmanian Museum Catalogue, No. D. 730.

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1922 McCulloch, Fishes of New South Wales, Aust. Zoo Handbook, No. 1, p. 65.

A NOTE ON THE BURIAL CUSTOMS OF THE TASMANIAN ABORIGINES.

By Clive Lord, F.L.S.,
Director of the Tasmanian Museum.

(Read 9th July, 1923.)

The methods of burial as practised by primitive races are of distinct interest in assisting to trace their evolutionary history. Owing to the lack of authentic information in detail of the customs of the Tasmanian aborigines, our knowledge is, in many matters, vague and uncertain. Often the observations relating to the aborigines were made years after their contact with the white race, and naturally their customs had been affected.

Further, the more one studies the early records and observations made by early colonists, the more one realises their contradictory nature. The available evidence which could be gathered from early records has been admirably summarised by Ling Roth (1899, pp. 116-122). A later paper by Noetling (1908, p. 36) dealt with the supposed native burial ground near Ross, but, personally, I am unable to agree with all the conclusions arrived at by Dr. Noetling. In a later paper Noetling (1910, p. 271) again referred to the matter, but his deductions are at variance with the observations of the French naturalist Péron, who distinctly states that the tombs found by the French on Maria Island in 1802 were placed near the camping ground.*

There is sufficient evidence to show that the natives usually burnt their dead, and often, after cremating the body, the residue would be buried or certain portions carried as a charm. In some cases the body would not be burnt, but would be placed in a hollow tree or a shallow grave.

I am not aware of any authentic records as to the position of the buried body, and hope that the following observation, made in exhuming aboriginal remains, may be of interest, as information on the point helps to illustrate the evolutionary status of the race.

*It must be remembered of course that in regard to the tombs referred to by Peron the bodies had first of all been cremated and the remains gathered and placed in the ground, over which a frail superstructure of grass and bark had been raised.

In January, 1919, a number of Tasmanian aboriginal remains were found at Eaglehawk Neck, as already recorded in the Papers and Proceedings of the Royal Society of Tasmania (1918, pp. 118-119; 1920, pp. 140-152). In exhuming these remains I particularly noticed that the bodies were doubled up in most cases, the skull being closely wedged between the femurs. Owing to doubts as to how the skeletons came to be there and also owing to the fact that the sand dune in which the excavations were made showed signs of movement, it was not thought fit to make any comment at that time. Recently, however, a further discovery was made in the sand dunes at the south end of Ralph's Bay, where Mr. E. A. Calvert found portion of an aboriginal skeleton. This he kindly presented to the Tasmanian Museum. I subsequently visited the site of the discovery in company with Mr. Calvert, and, in questioning him as to the exact position of the bones, I found that, according to his description, they were placed in practically the same position as the ones which had been found at Eaglehawk Neck.

Judging from observations made in the above mentioned cases there is some evidence to show that such bodies as were buried were placed in the thrice bent sitting position. Further evidence is needed, however, before it is safe to assume that the above position is typical, and the present note is written merely in the hope that it may be of assistance in the event of further discoveries being made.

LITERATURE REFERRED TO.

1899 Roth, H. Ling, Aborigines of Tasmania.

1908 Noetling, Papers and Proceedings Royal Society of Tasmania, 1908.

1910 Noetling, Papers and Proceedings Royal Society of Tasmania, 1910.

MOLLUSCA OF KING ISLAND.

By W. L. May.

WITH DESCRIPTIONS OF FIVE NEW SPECIES.

Plate VII.

(Read 9th July, 1923.)

During the month of November, 1922, I spent some days on King Island visiting relatives, and took what opportunity offered to investigate the Mollusca. No really comprehensive list of the Island's shell fauna appears to have been published. In one of the early French expeditions in 1802 the Naturalists Péron and Lesueur made considerable collections, their take being worked up principally by Lamarck and Blainville. Some of the species described by Tenison-Woods in the seventies of last century were from the Island, and they and others appeared in his Census which was compiled in 1877. Some of these, however, have not been retaken and require confirmation. The late Professor Tate had a small parcel of King Island shells sent him by some correspondent, and they were recorded by Tate and May in their Revised Census, 1901. There also appeared in the Victorian nature publication, "The Wombat," Vol. V., page 35, 1902, a fairly long list containing 135 species.

I collected at Currie Harbour, Surprise Bay, Fraser, and near "Grassy." The first two on the West Coast, and the others on the East.

The most remarkable feature was the absence of many common Tasmanian shells, particularly the larger bivalves. I saw no sign of our common edible mussel, *M. planulatus*, no *Dosinia* or *Mactra*, scarcely any *Pectens*, neither *Tellina*, *Gari*, nor *Cardium* appeared, and the *Veneridiæ* were only represented by *Antigona lagopus* and *Gomphina undulosa*. I saw no Trigonias, but was assured that they have been taken near Fraser. The Chitons are moderately represented, *Heterozona subviridis* being extremely abundant, but *Sypharochiton pellis-serpentis*, so common all round the Tasmanian coast, was not seen. The West Coast is very rough and wild, and quite exposed to the prevalent westerly gales; here the rock fauna were Limpets, *Monodonta*, *Bembicium*, and a few Chitons, with a goodly number of minute forms, found in shell sand, such as generally live under and amongst stones and rocks. A much more sheltered spot is Fraser on Sea Elephant Bay, Middle East Coast, and here washed up on the beach were most of the larger species taken. A longer residence at this spot would doubtless add considerably to the list. Two species of land shells were taken, and the larger one *Chloritis victoria*, is very interesting, as its appearance seems to suggest the necessity of land communication with Victoria at some period, as this species occurs in that State, but not in Tasmania. The great majority of the marine species are also common to Tasmania, although a few Victorian species appear which have not yet crossed to Tasmania. An extremely small percentage appear peculiar to the Island; one of them is *Cantharus kingicola*, Tate and May, and there are four minute species which appear to be new to science, and which I take this opportunity to describe. In the following list there are some species not taken by myself; those of them which appear in the "Wombat" list are marked by an *, and those from Tenison-Woods' descriptions and Census by a †. Altogether I here catalogue 227 species.

Philobrya subpurpurea, Sp. nov.

Shell minute, ovately pyriform, hinge line straightish. Proto-conch small and inconspicuous, consisting of a minute boss on a small flattened area. Colour yellowish, purplish brown at the umbos, extending downwards over part of the shell. Dead shells are white, with a purple stain branching from the umbo on each side of the centre of the valve. The exterior is smooth except for rather prominent growth lines. The hinge consists of a series of vertical ridges and grooves on a flattened plate, and below this are about six ridges or liræ which slightly crenulate the margin on what I take to be the posterior side.

Dimensions of Type.—Height, 2; breadth, 1.7 mill., but some specimens are rather larger. Pl. VII., fig. 1.

Type from Fraser, King Island, taken by Mr Basset-Hull. I also collected numerous single valves in shell sand at Currie Harbour.

Mylitta polita, Sp. nov.

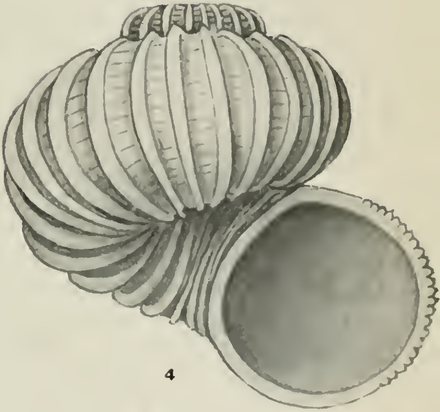
Shell minute, smooth, glossy, shining, and semi-transparent, very inequilateral, much produced on the anterior side, umbos small. Internally there is a strong flattened

1

3

3a

2



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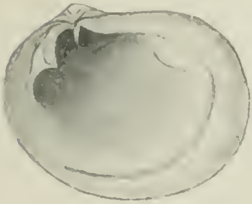

2a

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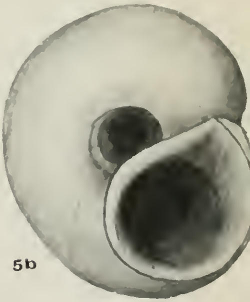
5a



5b

1. *Philobrya subpurpurea.*
2, 2a. *Mylitta polita.*
3, 3a. *Natica kingensis.*
4. *Brookula consobrina.*
5, 5a, 5b. *Argalista kingicola.*

posterior tooth, and a minute prong-like tooth immediately beneath the umbo.

Height, 2; width, 2.4 mill. Pl. VII., figs. 2, 2a.

Hab.—Surprise Bay, King Island, in shell sand, six single valves.

In size, and to some extent outline, this resembles *M. gemmata*, Tate, from South Australia, but that species is ornamented with divaricating sculpture, and is still more inequilateral. Shells of this genus are usually strongly sculptured; the present species is therefore remarkable for its perfect smoothness.

Natica kingensis, Sp. nov.

Shell very small, ovately turbinate with a small spire, perforate. Colour light yellowish chestnut, a darker band immediately below the suture, and a broader light band below that; there is a patch of deeper colour behind the umbilicus, which is rather small, narrow, and deep. Whorls four, rapidly increasing, the body whorl large. Aperture semi-lunar, sharply pointed above.

Height, 2.5; diameter, 2 mill. Pl. VII., figs 3, 3a.

Hab.—Plentiful in shell sand at Currie Harbour, King Island, where about 200 specimens were collected, which are of very uniform size.

I place this little shell in *Natica*, as its general characteristics seem to point to that genus, but this may not be its final location.

Argalista kingensis, Sp. nov.

Shell small turbinate, solid, dull white, with faint brown rays, perforate. Whorls four, rapidly increasing; spire not much elevated. The upper surface is faintly spirally lirate; under surface smooth. Aperture roundly pyriform, the columella lip somewhat expanded, behind which is an ample umbilicus.

Major diameter, 2.5; height, 1.8 mill. Pl. VII., figs. 5, 5a, 5b.

Hab.—Type with three others from Surprise Bay, King Island, in shell sand. All the specimens are rather beach worn.

This is close to *A. fluctuata*, Hutton, from New Zealand, which differs principally in its smaller umbilicus and stronger sculpture, which persists on the base. Better preserved examples may prove the King Island shell to be a variant of the New Zealand species.

Brookula consobrina, Sp. nov.

Shell minute, globosely turbinate, perforate, solid, dirty-white, rather corroded. Whorls four, first one and a half unsculptured and scarcely raised above the succeeding whorls, which are crossed by strong axial ribs widely separated and laminate, about 30 on the first turn of the body whorl, the interstices crossed with fine regular liræ which are scarcely discernible on most specimens. Aperture almost round continuous, outer edge finely notched by the revolving liræ. Umbilicus medium sized and deep.

Diameter, 1.5; height, 1.3; Pl. VII., fig. 4.

Type with 18 others from 40 fathoms off Thouin Bay, Tasmania.

This species is a very typical *Brookula*, and scarcely differs from the type of the genus *B. stibarochila*, Iredale, from the Kermadecs. Pro. Mal. Soc. X., pt. iii., 1912, p. 220. Our shell appears rather higher and has a smaller mouth. It is also very close to *B. densilaminatum*, Verco, which shell has a more elevated pullus, and ribs about twice as numerous. Intermediate forms may yet be found.

LIST OF KING ISLAND MOLLUSCA.

Pronucula micans, Angas.
Lissarca rhomboidalis, Verco.
Arca metella, Hedley.
Glycymeris flabellatus, Ten.-Woods.
**Philobrya fimbriata*, Tate.
Philobrya subpurpurea, May
Notomytilus ruber, Hedley.
Ostrea Spe?
Neotrigonia margaritacea, Lamk.
Pecten medius, Lamk.
Chlamys asperrimus, Lamk.
Lima strangei, Sowerby.
Brachyodontis rostratus, Dunker.
Modiolus australis, Gray.
Myochama anomioides, Stutchbury.
Venericardia amabilis, Deshayes.
Venericardia exulata, Smith.

*_Cardita calyculata_, L.
Condylocardia crassicosta, Bernard.
†_Codakia bella_, Conrad.
*_Codakia lacteola_, Tate.
*_Codakia minima_, Ten.-Woods.
*_Lucinida assimilis_, Angas.
*_Diplodonta zelandica_, Gray.
*_Neolepton rostellata_, Tate.
Rochefortia donaciformis, Angas.
Lasæa australis, Lamk.
Lasæa miliaris, Phil.
*_Mylitta auriculata_, Smith.
*_Mylitta deshayesi_, D'Orb.
Mylitta polita, May.
*_Mylitta tasmanica_, Ten.-Woods.
Macrocallista diemenensis, Hanley.
Antigona lagopus, Lamarck.
Gomphina undulosa, Lamk.
Venerupis exotica, Lamk.
Solen vaginoides, Lamk.
*_Spirula spirula_, L.
Sepia apama, Gray.
Sepia cultrata, Hoyle.
Ischnochiton atkinsoni, Iredale and May.
Isch. iredalei, Dupuis Var.
Isch. lineolatus, Blainville.
Isch. smaragdinus, Angas.
Isch. evanidus, Sowerby.
Isch. subviridus, Iredale and May.
Isch. virgatus, Reeve.
Callistochiton meridionalis, Ashby.
Plaxiphora albida, Blainville.
Plaxiphora tasmanica, Thiele.
Acantho. costatus, Ad. and Ang.
Acantho. sueurii, Blainville.
Acantho. variabilis, Ad. and Ang.
Acantho. kimberi, Torr.
Cryptoplax striatus, Lamk.
Scissurella rosea, Hedley.
Schismope atkinsoni, Ten.-Woods.
Schismope beddomei, Petterd.
Scutus antipodes, Montfort.
Hemitoma aspera, Gould.
*_Emarginula bajula_, Hedley.
*_Emarginula candida_, Adams.
*_Lucapinella nigrita_, Sowerby.

Puncturella harrissoni, Beddome.
Haliotis albicans, Quoy and Gaim.
Haliotis emmæ, Reeve.
Haliotis nævosum, Martyn.
Stomatella imbricata, Lamk.
Gena strigosa, Adams.
Clanculus flagellatus, Phil.
Clanculus limbatus, Quoy and Gaim.
Clanculus maugeri, Wood.
Clanculus plebejus, Phil.
Clanculus yatesi, Crosse, var. *Aloysii*, Ten.-Woods.
Cantharidus eximius, Perry.
**Cantharidus irisodontes*, Quoy and Gaim.
Monodonta adelaidæ, Phil.
Monodonta concamerata, Wood.
Monodonta constricta, Lamk.
Monodonta odontis, Wood.
Cantharidella tiberiana, Crosse.
Calliotrochus legrandi, Petterd.
Fossarina petterdi, Crosse.
**Calliostoma hedleyi*, Prit. and Gat.
Calliostoma meyeri, Phil.
Euchellus baccatus, Menke.
Euchellus scabriusculus, Ad. and Ang.
Phasianella australis, Gmelin.
Phasianella perdix, Wood.
Phasianella rosea, Angas.
Turbo gruneri, Phil.
Turbo undulatus, Martyn.
Astræa aurea, Jonas.
Astræa fimbriata, Lamk.
Cirsonella weldii, Ten.-Woods.
Zalapais inscripta, Tate.
Microdiscula charopa, Tate.
Lodderia minima, Ten.-Woods.
Liotina subquadrata, Ten.-Woods.
Argalista kingensis, May.
Nerita melanotragus, Smith.
Patelloida alticostata, Angas.
**Patelloida conoidea*, Quoy and Gaim.
Patelloidea inradiata, Reeve.
Patelloidea marmorata, Ten.-Woods.
Patelloida scabrilirata, Angas.
Patella ustulata, Reeve.
Cellana limbata, Phil.
Melarhaphe prætermissa, May.

Melarhaphe unifasciata, Gray.
Bembicium melanostoma, Gmelin.
Risellopsis mutabilis, May.
Haurakia strangei, Brazier.
Haurakia supracostata, May.
Lironoba tenisoni, Tate.
Lironoba unilirata, Ten.-Woods.
Merelina cheilostoma, Ten.-Woods.
Merelina hulliana, Tate.
Dardanula melanochroma, Tate.
Estea approxima, Petterd.
Estea incidata, Frauenfeld.
Anabathron contabulatum, Frauenfeld.
Rissoina fasciata, Adams.
†*Rissoina gertrudis*, Ten.-Woods.
Rissolina angasi, Pease.
**Diala semistriata*.
Diala lauta, Adams.
Potamopyrgus nigra, Quoy and Gaim.
†*Acmea scalarina*, Cox.
Hipponix conicus, Schumacher
Hipponix foliacea, Quoy and Gaim.
Plesiotrochus monachus, Crosse and Fischer.
**Ataxocerithium serotinum*, Adams.
Pyrazus demenensis, Quoy and Gaim.
**Bittium granarium*, Kiener.
Cerithiopsis turbonilloides, Ten.-Woods.
Seila albosutura, Ten.-Woods.
Triphora tasmanica, Ten.-Woods.
**Epitonium aculeatum*, Sowerby.
Epitonium australe, Lamarck.
**Epitonium granosum*, Quoy and Gaim.
Epitonium jukesianum, Forbes.
Cymatium spengleri, Perry.
Eugyrina subdistorta, Lamarck.
Personella eburnea, Reeve.
Personella verrucosa, Reeve.
**Phalium semigranosum*, Lamarck.
Natica kingensis, May.
Sinum umbilicatum, Quoy and Gaim.
Cypræa angustata, Gmelin.
Trivia australis, Lamarck.
Scaphella undulata, Lamarck.
Ancilla marginata, Lamarck.
**Ancilla petterdi*, Crosse.
Marginella albida, Tate.

Marginella angasi, Crosse.
Marginella formicula, Lamarck.
Marginella subbulbosa, Tate.
**Marginella ovulum*, Sowerby.
†*Cancellaria purpuriformis*, Kuster.
Cancellaria spirata, Lamarck.
**Cancellaria undulata*, Sowerby.
Terebra albida, Gray.
Duplicaria ustulata, Deshayes.
Conus anemone, Lamarck.
**Conus rutilus*, Meuke.
Apaturris alba, Petterd.
**Guraleus mitralis*, Adams and Angas.
Guraleus pictus, Adams and Angas.
Austrodrillia beraudiana, Crosse.
†*Inquisitor immaculata*, Ten.-Woods.
**Eucithara compta*, Adams and Angas.
**Etrema bicolor*, Angas.
Nepotilla tasmanica, Ten.-Woods.
Asperdaphne deuseplicata, Dunker.
Fasciolaria australasia, Perry.
Latirofusus spiceri, Ten.-Woods.
†*Verconella dunkeri*, Jonas.
Verconella pyrulata, Reeve.
**Verconella tasmaniensis*, Adams and Angas.
Mitra australis, Swainson.
**Mitra analogica*, Reeve.
Mitra glabra, Swainson.
†*Mitra legrandi*, Ten.-Woods.
Mitra pica, Reeve.
**Mitra tasmanica*, Ten.-Woods.
Cominella eburnea, Reeve.
Cominella kingicola, Tate and May.
Cominella lineolata, Lamarck.
Euthria clarkei, Ten.-Woods.
**Fusus bednalli*, Brazier.
Fusus mestayeræ, Iredale.
Nassarius pauperus, Gould.
**Pyrene acuminata*, Meuke.
**Pyrene leucostoma*, Gaskoin.
Pyrene pulla, Gaskoin.
Pyrene semiconvexa, Lamarck.
Zafra fulgida, Reeve.
Zafra legrandi, Ten.-Woods.
**Murex angasi*, Crosse.
Murex triformis, Reeve.

**Murex umbilicatus*, Ten.-Woods.
Trophon goldsteini, Ten.-Woods.
**Trophon petterdi*, Crosse.
Thais baileyana, Ten.-Woods.
Thais succincta, Martyn.
**Lepsiella adelaidæ*, Adams and Angas.
Lepsiella reticulata, Blainville.
Lepsiella vinosa, Lamarck.
Marinula parva, Swainson.
Marinula xanthostoma, Adams.
Leuconopsis pellucidus, Cooper.
Siphonaria diemenensis, Quoy and Gaim.
Succinea australis, Ferrusoac.
Chloritis victoriæ, Cox.
Rhytida ruga, Cox.
**Odostomia metcalfei*, Prit. and Gat.
Odostomia portseaensis, Gat. and Gab.
**Turbonilla hofmani*, Angas.
Turbonilla mariæ, Ten.-Woods.
Eulima augur, Angas.
Eulima tenisoni, Tryon.
Melanella petterdi, Beddome.
Pseudorissoina tasmanica, Ten.-Woods.
Retusa apicina, Gould.
Haminœa tenera, Adams.
Philine angasi, Crosse and Fischer.

STUDIES IN TASMANIAN MAMMALS, LIVING AND EXTINCT.

Number XI.

By

H. H. Scott, Curator of the Launceston Museum,

and

Clive Lord, F.L.S., Director of the Tasmanian Museum.

NOTES ON A MUTILATED FEMUR OF *NOTOTHERIUM.*

(Read 6th August, 1923.)

Among some recently acquired fragments of *Nototherium* bones presented to the Tasmanian Museum by Mr. Burnley, of Mella, near Smithton, and therefore in the locality of the Mowbray Swamp, is the shaft of a femur, obviously that of a Nototherian calf. The bone lacks the head and major trochanter at its proximal end, and distally both the condyles are missing, yet in spite of the several mutilations, the specimen is of especial interest.

It is the thigh bone of an animal that has apparently been hunted, and gripped by a carnivorous animal. Both edges of the bone have suffered, thus suggesting a double attempt at dragging the creature down, one of which was made upon the outer side and a second from between the legs. Two foes falling at a time upon a calf would equally well account for the facts, and if the Carnivores of Pleistocene Australia hunted in packs, this latter is the more likely of the two possibilities.

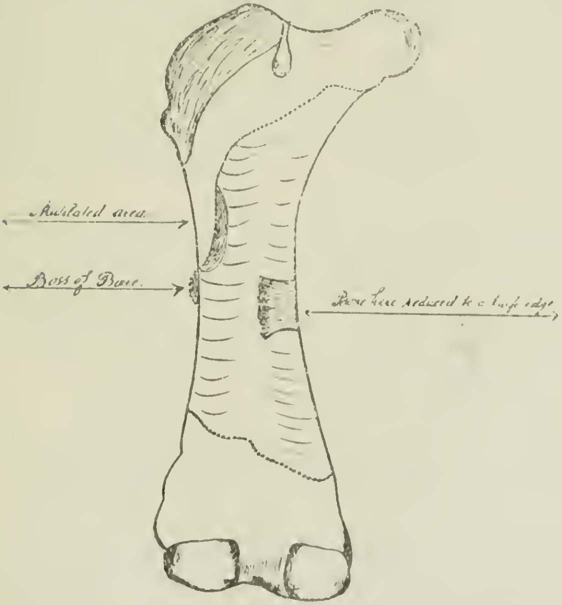
As a second femoral shaft of similar size, and apparently the associate of the mutilated bone, is also present, a very exact comparison of the two is open to us. The wounded animal having escaped its foes, carried to the day of its death the marks of the encounter, in the shape of two contracted bony areas, in which absorption in one instance has reduced one edge to 1 mm. in thickness from a normal of 30 mm.

Externally, the shaft has undergone a series of alterations, resulting in the formation of a groove about 100 mm long, with a thickened boundary edge that in one case at least formed a long boss that has extended beyond the normal outline of the diaphysis.

The diaphysis itself, upon all its faces, has been thrown into a series of transverse hollows and ridges—suggesting a contraction of the periosteal membrane and a later bony secretion that followed the contour of the several corrugations.

The whole character of the double wound upon the inner and outer edges of this Nototherian femur leads to the conviction that a carnivorous animal had at one time attempted the life of its owner. A strong kick would not have produced such results, whilst the imprisonment of the leg in a cleft among rocks or an accidental slip into a hole would have affected more directly the themal and anconal aspects of the shaft.

We are of the opinion that the mutilations were caused by one of the larger marsupial Carnivores, and look to the future for obtaining material proofs of the former existence of *Thylacoleo* and associated animals in the Pleistocene formations of Tasmania.



Text fig.—Approximately one quarter of natural size.

AUSTRALIAN *DIXIDÆ*. [Dipt.]

By A. L. Tonnoir,
Research Student in *Diptera* at the Cawthron Institute,
Nelson, N.Z.

(Communicated by Clive Lord.)

(Read 6th August, 1923.)

INTRODUCTION.

Previously nothing was known of the representatives of this family in Australia except a record of Skuse [(1)] saying that he knew three species belonging to the genus *Dixa* in New South Wales; they remained, however, undescribed, and I have been unable to find the specimens in his collection, preserved *pro parte* in the Australian Museum in Sydney and *pro parte* in the Macleay Museum in Sydney University.

During a short stay in New South Wales and Victoria and one summer spent in Tasmania, I found five species of *Dixa*, and recently Mr. A. J. Nicholson discovered another in New South Wales, which he kindly gave me for study, for which loan I am much obliged to him.

These Australian species indubitably belong to the genus *Dixa*, as they differ very little from the forms of the rest of the world; like them, they are differentiated from each other by mere details of colouration, relative length of antennæ, peculiarities of venation such as the position of *r-m* and relative length of fork of R_{2+3}, and chiefly by the structure of the hypopygium.

Their larvæ of which three types have been secured, differ also very little from the European forms. Like them, some have the peculiar crown of hair on the dorsum of the abdominal segments 2-7, and some present this dorsum completely smooth; they are provided also with the pair of pseudopods on the two first abdominal segments, the armature of hooks on the 6-8 segment; the mouth-parts and spiracular armature present only minute differential characters in their structures.

(1). Austral. Ass. Adv. Sci., Melbourne, Vol. II., 1890, p. 530.

ADULTS.

Table For Male and Females.

1. Antennæ long, nearly as long as the body, or at least, as the abdomen; basal joints of flagellum elongated and scarcely distinct from each other; *r-m* placed well before fRs. 3.

   Antennæ rather short, about as long as thorax; the basal joints of the flagellum somewhat fusiform, well distinct from each other; *r-m* placed at or after fRs. 2.

2. Mesonotum nearly all orange; front legs rather dark; stem of R_{2+3} much longer than R_2; smaller species. *D. FLAVICOLLIS*, n.sp.

   Mesonotum with three well-marked dark bands; all legs yellow with dark tip at femora and tibiæ; stem of R_{2+3} somewhat shorter than R_2; larger species. *D. GENICULATA*, n.sp.

3. No other marking on the wing but a spot on *r-m* which extends along the stem of Rs up to R_1; mesonotum orange with two dark bands connected in front. *D. TASMANIENSIS*, n.sp.

   Wing spot never extending up to R1; or else wing nebulous and colouration of mesonotum nearly all black. 4.

4. Besides the roundish spot around *r-m* the wings are infuscated on some other parts, chiefly on the apical region; nearly completely dark species. *D. HUMERALIS*, n.sp.

   Wing presenting only one spot near *r-m* or scarcely any trace of one. 5.

5. The spot of the wing distinctly marked, rather large, extending on the whole length of the stem of Rs. *D. UNIMACULATA*, n.sp.

   The spot of the wing very faint, restricted only alongside *r-m* *D. NICHOLSONI*, n.sp.

DIXA FLAVICOLLIS, n.sp.

Fig. 1. Hypopygium of *D. flavicollis* from above and from the side.

Male: Face and snout dark yellowish; palpi black; antennæ with scape brown, flagellum black; vertex black, shining. Thorax rather dull orange, with exception of the prothorax blackish; on the middle of the mesonotum, anteriorly, there is the beginning of a dark band, another dark band on the pleuræ between the front and the hind coxæ; a brownish space below the wing's base; coxæ yellow, also the base of femora, which are gradually darker towards their extremity, the hind ones lighter; tibiæ and tarsi brown; apical swelling of hind tibiæ very conspicuous, claws large; halteres with orange stem and light brown knob. Abdomen brownish black, little shining; hypopygium large, completely black; wing nearly hyaline with a small infuscated spot on *r-m*.

Antennæ short, somewhat less than the head and thorax together, with very distinct joints in the flagellum, the basal ones being rather short and fusiform. The palpi with a short first joint, the second and third subequal, about four times as long as wide, last joint about twice the length of the third.

Venation: Origin of Rs well after the tip of Sc; *r-m* before fRs; first part of the stem of Rs three times larger than the second part; stem of R_{2+3} distinctly larger than R_3.

Hypopygium small, the lamellæ showing between the base of the side pieces presenting rounded angle; apical internal process of the side pieces axe-shaped, rather short and hairy on their whole surface; claspers shorter than the side pieces, subcylindrical at base, and then suddenly curved downwards and tapering into an acicular extremity; ædœagus little developed, without any conspicuous hook or process.

Length of wing: 3 mm.

Female: Similar to male in colour, but the median band of the mesonotum more marked, and with two lateral very faintly marked dark bands; otherwise agreeing completely with the type as to colouration and wing venation.

Type and allotype, which were the only specimens captured, come from Sassafras, Victoria, 19th October, 1922. They are in the collection of the Cawthron Institute.

DIXA GENICULATA, n.sp.

Fig. 2. Hypopygium of *D. geniculata* from above and from the side.

Similar to the preceding species but larger, and with darker marks on body but with lighter legs.

Male: Face and snout orange-yellow as well as the scape of antennæ; the flagellum black; palpi also black, vertex brown shining; mesonotum orange with three disconnected brown bands, the median one much abbreviated behind, the lateral ones in front; scutellum orange; post scutellum infuscated; halteres with orange stem and black knob. Prothorax brown, somewhat dark marks on the pleuræ from the front coxæ to the base of the abdomen and on the lower part of the mesosternum. Abdomen blackish brown, rather dull; coxæ, femora, and tibiæ yellow, the femora with black tip, the tibiæ with slightly darker base and black tip, tarsi brown, the metatarsi somewhat lighter towards their base on the anterior legs, the hind metatarsi distinctly lighter with dark base and extremity. Wing hyaline or scarcely greyish, with Sc and R1 as well as the costal field yellowish, one dark subcircular spot round *r-m* extending downwards on *m-cu*.

Antennæ short, about the length of the thorax, the basal flagellum joints very distinct from each other; palpi as in preceding species.

Venation: Origin of Rs after tip of Sc; first part of stem of Rs double the length of the second part, therefore *r-m* well before fRs; stem of R_{2+3} somewhat shorter than R_2. Hypopygium built on the same plan as in *D. flavicollis*, but the parts differ as follows:—The lamellæ, visible from above between the base of the side pieces, are produced in a small blunt digitation; the internal distal processes of the side pieces are rather long, about half the length of the claspers, and much widened at their extremity, which carries a row of small setæ; the claspers are about as long as the side pieces and nearly straight, their tip, which is suddenly pointed, is somewhat turned down; no conspicuous process or hooks on the ædœagus or the tergum of the hypopygium; as a whole, all the parts are relatively more developed and robust than in *flavicollis*.

Length of wing: 3 2-3 mm.

Female: Similar to the male, the legs very slightly darker, especially the front ones.

Type and allotype from Burnie (Tasmania), 26th, 27th October, 1922. In the collection of the Cawthron Institute. Four paratypes, one male and three females from the same locality, and one female from St. Patrick's River, 21st October, 1922.

This last-mentioned specimen from St. Patrick's River has the dark marking of the mesonotum much obliterated; it corresponds very well in every other point. One female from Sassafras, captured at the same spot as *D. flavicollis*, agrees very well with the characters of *geniculata*, with the size, the wing venation and marking, and the yellow scape, but differs from it in the completely orange mesonotum and halteres as well as by the darker legs. I was, therefore, at first disposed to consider the Tasmanian form as a variety of the Victorian one, but closer examination showed that the points of difference are well marked and justified considering them as different species.

This difference in characters may be summed up as follows:—

Size larger in *geniculata*.

Scape distinctly orange and not brown.

Mesonotal dark bands well marked, and in mesonotum nearly completely orange.

Knob of halteres distinctly black and relatively short.

All femora and tibiæ yellow with dark tip.
Anterior veins yellow.
Spot of the wing extending alongside *m-cu*.
Greater robustness of hypopygium, with some of the parts presenting a different shape.
Stem of R_{2+3} about equal to R_2 and not very much longer, as in *flavicollis*.

D. TASMANIENSIS, n.sp.

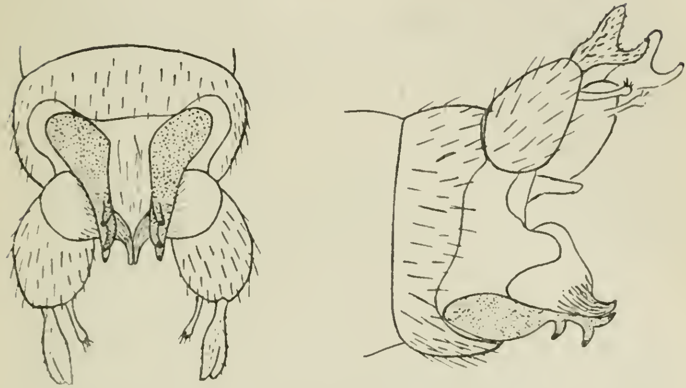


Fig. 3. Hypopygium of *D. tasmaniensis* from below and from the side.

Male: Head shining black, proboscis yellow, palpi and antennæ black, but the scape a little lighter on the side. Mesonotum yellowish-orange with three brown-black bands, confluent anteriorly, the median one divided by a very thin line, and shortened behind so as to leave a large yellow space in front of the scutellum, which is also yellowish, except on the sides; post-scutellum black; pleuræ blackish, lighter below the base of the wings. Front coxæ brown at base, yellowish at tip as well as the others, and the base of femora, which are more or less testaceous on their whole length, their tip being distinctly black; the middle femora are somewhat darker; tibiæ and tarsi brownish, the hind tibiæ a little lighter, chiefly at base. Base of stem of halteres yellowish, then dark, and the knob again yellowish. Abdomen black, moderately shining; hypopygium also black, the claspers lighter; wing greyish with a moderately marked brown spot extending from the base of Rs towards fRs and *r-m*, also a slight shadow near the extremity of Cu.

The antennæ are as long as the abdomen at least, and very thin towards the end; the joints are elongated, cylindrical, indistinguishable from each other, especially towards the end; relative length of palpal joints as in preceding species.

Venation: *r-m* placed after fRs; stem of R_{2+3} only a little shorter than R_2.

Hypopygium: Side pieces moderately long with an internal pre-apical thin process about as long as the claspers and swollen at tip, which carries three or four small bristles, two of which are stouter; claspers broad, triangular, ending in two branches separated by a semi-circular notch, the inferior branch curved upwards and with its tip black, strongly chitinous; the two lateral inferior pieces of the ædœagus dark and with three hooky spines, two pointing downwards and the terminal one upwards.

Wing length: 3 1-3 mm.

Female: Colouring exactly the same as in male; stem of Rs relatively shorter, wing marking more intensive, especially the shadow around the extremity of Cu.

Type and allotype from Mt. Wellington, Tasmania, 25th November, 1922. In the collection of the Cawthron Institute. A dozen paratypes from the same locality and from Hartz Mt., 9th December, 1922; Burnie, 21st January, 1923; Eagle-Hawk Neck, 15th November, 1922; Mt. Field, National-park, 18th December, 1922; Mt. Farrell, 9th February, 1923. All these localities in Tasmania.

D. NICHOLSONI, n.sp.

Fig. 4. Hypopygium of *D. nicholsoni* from above and from the side.

Male: Head with appendages dark brown; mesonotum with three confluent broad dark bands which leave only very little dull ferruginous colour on the sides and before the scutellum, this and post-scutellum obscurely ferruginous. Pleuræ with exception of sternopleuræ testaceous-orange, as well as all the coxæ; legs brownish, the femora slightly lighter. Base of stem of halteres testaceous, the rest and the knob brown. Abdomen black, more or less shining, with dark scarce pubescence; hypopygium ferruginous; wings grey with a very indistinct smoky marking on fRs and *r-m*.

Antennæ filiform as in preceding species; palpi also similar.

Venation: Origin of Rs in front of the end of Sc, *r-m* placed after fRs; stem of Rs equal to stem of R_{2+3}

Hypopygium: Side pieces with an internal pre-apical process of moderate length and bifid at the end; claspers cylindrical without any spines, hooks, or bristles, their ends blunt; ædœagus complicated, presenting two downward pointing processes (2) ending in a sharp black spine and presenting a small tuft of hair at base of this spine, the internal parts of the ædœagus in form of two strong hooks pointing upwards.

Wing length: 3 mm.

Female: The colouring seems to agree well with that of male as far as it is possible to judge from alcohol specimens; there is agreement in all morphological details.

Type and allotype from Mill, Allyn River, N.S.W., 18th December, 1922. In the collection of the University, Sydney.

Nineteen paratypes in spirit collected in the same locality at the same date, by Mr. A. J. Nicholson, who found these flies clustered on stones.

D. HUMERALIS, n.sp.

Fig. 5. Hypopygium of *D. humeralis* from below and from the side.

Male: Very similar to *D. nicholsoni*, but its general colouration very much darker. The thorax, which is rather

(2). The hypopygium of *Dixa* as in most *Culicoidea* is inverted, the tergum being situated ventrally.

shining, is only yellow-orange at the shoulder and at inferior part of the mesosternum; halteres uniformly dark yellowish; all coxæ yellowish, the femora also, but with dark tip; anterior tibiæ brownish, the hind one yellowish, with dark, moderately swollen extremity; tarsi brown; wing nebulous, with a rather strongly marked roundish spot near the base of Rs, and extending on fRs and *r-m*, a slight infuscation on the whole wing tip from the level of fR_{2+3}, but extending more towards the base of R_{4+5}, a slight infuscation also at base of the anal area, then under the first half of Cu and on both sides of the extremity of Cu.

Antennæ and palpi as in preceding species.

Venation: Origin of Rs after the tip of Sc; stem of Rs shorter than the stem of R_{2+3}; *r-m* placed at fRs; stem of R_{2+3} a little shorter than R_2.

Hypopygium: Small, the side pieces *without* any internal process, the claspers bifid, the upper branch blunt, the inferior one thinner, curved upwards, and with a black hard tip; the ædœagus with two downward directed long, thin, yellow hooks, with a dark tip, and carrying some short hair in tuft on the middle of their inferior side.

Wing length: 2½ mm.

Female unknown.

The type, a unique specimen, was collected on Mt. Wilson (Blue Mts., N.S.W.), 20th November, 1921, and is in the collection of the Cawthron Institute.

D. UNIPUNCTATA, n.sp.

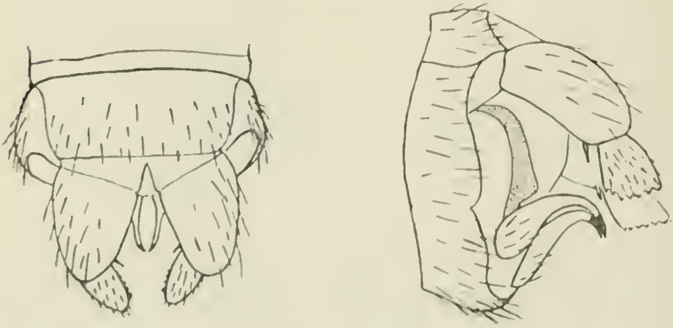


Fig. 6. Hypopygium of *D. unipunctata* from above and from the side.

Male: Clypeus yellowish, palpi brown, antennæ with the scape brown, flagellum black; vertex shining black. Thorax orange-yellow, with the exception of the prothorax, which is dark; three dark disconnected bands on mesonotum; a very wide dark band across the pleuræ from the anterior coxæ to the base of the abdomen; all coxæ yellow, also the femora, especially at base, the hind ones completely, except for the tip, which is black, whereas the anterior ones become gradually darker towards the tips; anterior tibiæ brownish with dark tip, the hind one yellowish with black moderately swollen extremity; tarsi blackish; halteres completely orange-yellow. Abdomen brownish black, rather dull, hypopygium slightly brownish, wing greyish with an infuscated roundish spot on the last half of the stem of Rs on fRs and *r-m*, also a very indistinct shadow on the last part of Cu.

Antennæ elongated as in preceding species, and relative length of the palpal joint similar.

Venation: Origin of Rs not much after the tip of Sc, *r-m* placed a little after fRs; stem of Rs about equal to stem of R_{2+3}, the latter about half the length of Rs.

Hypopygium: Small, side pieces with a very small inconspicuous internal distal process, which looks like a small spine, but is composed of a cylindrical basal part on which are inserted two small bristles; claspers about half the length of the side pieces, axe-shaped, their outer edge serrated; ædœagus with two conspicuous orange hooks pointing downwards with black tip.

Length of wing: 3½ mm.

Female unknown.

Type from St. Patrick's River, Tasmania, 1st November, 1922. In the collection of the Cawthron Institute. One paratype from the same locality and date.

LARVÆ.

The three larvæ which have been secured up to now are not referred to the three particular species by way of rearing, but only by simultaneity of capture of the imagines in the same spot where the larvæ had been found. Therefore their identity remains somewhat dubious, although in each case only one species of the adult had been found at the same time with the larvæ hereafter described. None of the pupæ are known.

TABLE OF KNOWN LARVÆ.

1. Dorsum of abdominal segments 2-7 carrying a conspicuous crown of hairs; armature of spines present only on the abdominal sternite 5 and 6 *D. GENICULATA*, Tonn.

   The abdominal segments without crown of hairs; armature of spines present on the abdominal segments 5-7 2.

2. Base of the lateral plates of the spiracular armature connected by a chitinous plate; spiracles round; caudal appendage not much longer than the lateral plates. *D. TASMANIENSIS*, Tonn.

   The lateral plates not connected between them at base; spiracles elongated; caudal appendage distinctly longer than the lateral plates. *D. NICHOLSONI*, Tonn.

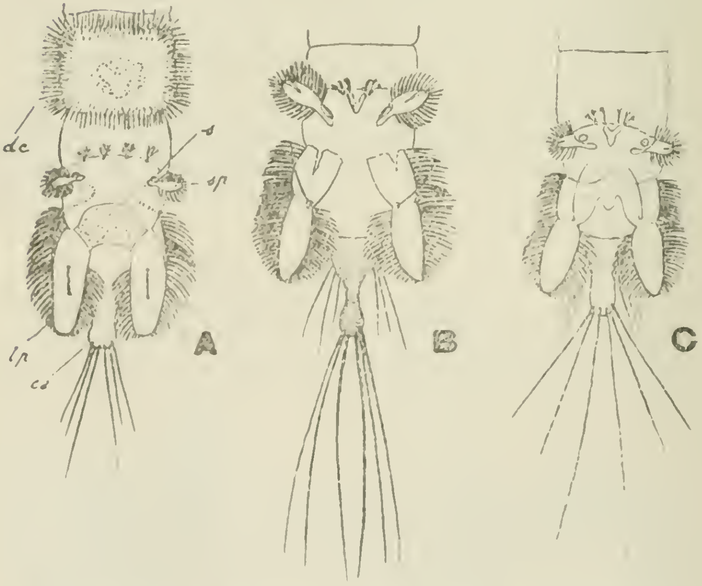


Fig. [illegible]. Extremity of the body of larvæ from above:—A: *D. geniculata*. B: *D. nicholsoni*. C: *D. tasmaniensis*. s: spiracle; sp: spiracular plate; lp: lateral plate; ca: caudal appendage; dc: dorsal crown of hairs.

DIXA NICHOLSONI, Tonn.

The full-grown larva is 8 mm. long, its colour grey with brown diffused markings on the dorsum.

Head black with ferruginous parts chiefly on the sides.

Antennæ with the usual short triangular spines, without hairs, carrying only one small external bristle inserted about one-third before the extremity. Mandibles and maxillæ of the usual type, these last conical and as long as the maxillary palpi. Mentum bluntly conical without any distinct indentation. Labrum with two rather well developed tufts of hairs.

Anterior edge of prothoracic sternite with a row of very long bristles reaching beyond the head; four of them are disposed in a tuft, and are, with the others, in the following order: 1.1.1.1.4.1.-1.4.1.1.1.1. The two pairs of pseudopods of the two first abdominal segments are equally developed. The armature of spines on the sternum of abdominal segments 5-6 are composed of two groups of two juxtaposed rows of spines, containing each 7 spines pointing backwards, the spines of the upper row being much stronger than those of the inferior row; on the 7th segment the groups are composed only of rows of 5 spines; the two groups of rows are separated by a small longitudinal chitinous band. The basal sternal plate of the caudal appendage has two groups of three rather long bristles reaching beyond the end of the caudal appendage, which is black, and carries six long bristles at its extremity.

The structure of the spiracular plates, as in figure 7B; the spiracles themselves elongated; between them there is a chitinous armature in shape of a V surmounted on each side with three tufts of small curved hairs. The lateral plates are not connected at their base by a chitinous structure; their comb, situated on the middle of their inferior side (the lateral side of the body), is formed by a regular row of moderately developed spines, the last of which is stronger than the others.

DIXA TASMANIENSIS, Tonn.

Length of full-grown larva 6 mm.; it is very similar to the larvæ of the preceding species; its colouration is the same, and its whole body is also covered with a microscopical but very dense pubescence. Head mostly ferruginous, blackish above and with a black posterior edge. Antennæ with the usual short spines, and besides the external small bristle, which is nearly median, they carry on the ventral side a number of hairs. Labrum with well-developed dense tufts of hairs. Maxillæ conical as in preceding species, but without hair at its extremity; the palpi with rather larger spines on the internal side. Mentum without distinct indentation.

Anterior border of prothoracic sternum with moderately long black bristles pointing forward and not reaching beyond the head; they are disposed according to the following order, four of them making a tuft on each side: 1.1.1.4.1.-1.4.1.1.1. The two outer ones on each side are only half the size of the others. The armature of spines on the sternum of abdominal segments 5-7 are as in the preceding species as to number and disposition; the spines, however, are relatively longer, and between the two groups there is no chitinous longitudinal small plate.

The sternal basal plates of the caudal appendages with two groups of three moderately long bristles; the caudal appendage, which is testaceous and relatively small, carries six long black bristles about twice as long as the appendage itself.

Spiracular plates according to figure 7C; the spiracles themselves are roundish; the V-shaped structure between them is provided with two groups of three small tufts of curved hair as in preceding species. The bases of the lateral plates are connected with each other by a chitinous formation; their inferior comb is composed of a row of very small spinules which end in a relatively large trifid spine.

DIXA GENICULATA, Tonn.

Length of full-grown larva 6½ mm. Its colour is of a dirty yellowish, the dorsum darker on account of the long hairs of the abdomen; head testaceous with a black anterior and posterior edge above. Antennæ and palpi black; labrum with the usual dense, well-developed tufts of hair; mandibles as usual, maxillæ also, pointed, with only a few hairs at the tip. Antennæ without hairs or bristles, only with the short triangular spinules. Mentum without distinct indentation.

No conspicuous bristles on the anterior edge of the prothoracic sternum; the first pair of abdominal prolegs more developed than the second; armature of hooks present only on the 5th and 6th abdominal segments, and composed of two adjacent groups of spines in two juxtaposed rows, the inferior one being formed of six straight thin spines, the superior one of five closer somewhat falcate spines, no chitinous small plates between the groups of spines. All round the dorsum of abdominal segments 2-7 there is a conspicuous crown of stiff hairs which are more developed on the sides than anteriorly or posteriorly. Basal sternal plate of caudal appendage without conspicuous bristle, the caudal appendage, which is short and testaceous, is provided with six black terminal bristles, only a little longer than the appendage itself; lateral plates connected at their base by a chitinous plate; their median bristle is coarse and branched at the tip.

The spiracular plates according to figure 7A; the spiracles themselves round, separated by a row of four little groups of branched hairs.

NOTES ON AUSTRALIAN *BOMBYLIIDÆ*, MOSTLY FROM THE MANUSCRIPT PAPERS OF THE LATE ARTHUR WHITE.

By G. H. Hardy.

(Read 6th August, 1923.)

The manuscript papers of the late Arthur White are in the possession of Dr. E. W. Ferguson, to whom I am indebted for permission to publish original matter contained therein. These manuscripts consist of (1) contributions that have already been published; (2) a very large mass of compiled notes and descriptions, interspersed amongst which are (3) a few pages of original material that have not been published, and that contain certain information based upon the examination of Walker's types in the British Museum.

Notes on the types of earlier described species are of utmost importance, but White limited his observations almost entirely to those characters that he could use in keys, and often a number of species included by him under a genus also include some he has never seen. It is difficult to judge how much of the keys is based on observation and examination of the type material, and how much on compilations from other works.

Owing to this confusion, White's manuscript cannot be compiled into a condition suitable for publication as an independent paper. I have therefore considered it advisable to publish White's records with my own, and to accept that which appears to me to be original, and within the probability of being correct.

The keys and notes taken from White's manuscript are indicated so that it can be readily understood how much of my paper is to be attributed to White's researches.

So far only manuscript containing *Bombyliidæ* and *Nemestrinida* has been found to contain unpublished matter, and from the information given in the former family, I find it necessary to amend my catalogue on the *Bombyliidæ* which was previously published in these Proceedings; some alterations which are the result of other researches are also included. White's key to the *Nemestrinidæ* is given elsewhere.

ANTHRACINÆ.

Genus HYPERALONIA, Rondani.

White's manuscript.—"Table of the Australian Species of Hyperalonia.

1. Wings not spotted. 2.
   Wings spotted. 3.
2. Abdomen black, apex silvery; wings blackish with base yellow, tips hyaline. *funesta*, Walker.
3. Abdomen black with golden or white bands near the base; wings spotted with foremargins yellow. *bombyliformis*, Macl. =*Exoprosopa punctipennis*, Macq.
   Wings with foremargins brown, with small spots below and towards base. *silvanus*, Fabr.

All the above were described under the genus *Anthrax*. *Hyperalonia argenticincta*, Bigot, is unknown to me. but I suggest that it is probably the same as *H. bombyliformis*, Macleay."

Observations.—H. funesta, Walker, is the same as my *H. satyrus*, Fabricius, but from White's key this is scarcely apparent. Apparently *Bibio sylvanus*, Fabricius, was only known to White from the description, and he followed Walker's identification for this species, or possibly he took his characters in the key from the original description; I have already associated the species with the genus *Comptosia*, and do not see any reason to alter my opinion.

The distinguishing characters of the four described species as recognised by me are as follows:—

H. satyrus, Fabricius. A black species with only three pairs of white spots at the apex of the abdomen. A closely allied species (apparently undescribed) has an extra pair near the base.

H. bombyliformis, Macleay. A species with four fuscous spots on the wing. This is the only large species known to me with this character; the abdomen varies in the amount of silvery tomentum on it so that some unusually light forms may be mistaken for new species.

H. cingulata, v.d. Wulp. A species that has the wings with the anterior border for two-thirds the length, and an isolated blotch at apex of the second basal cell, fuscous.

H. sinuatifasciata, Macquart. A species with the same wing character as *H. cingulata*, v.d. Wulp. except that the whole of the second basal cell and the apex of the discal cell are fused with fuscus.

Genus EXOPROSOPA, Macquart.

White's manuscript.—"*Table of Australian Species of Exoprosopa.*

1. Abdomen shining blue. *marginicollis*, Gray.
   Abdomen black or brown. 2.
2. Wings brown, with tips hyaline. *stellifer*, Walker.
   Wings brown with apex very broadly hyaline and with large hyaline indentations below. *adelaidica*, Macquart.
   Wings hyaline with the base, costa, and two oblique stripes brown. *obliquifasciata*, Macq. (unknown to me).

Exoprosopa laterimbata, Bigot, I cannot at present place. *E. punctipennis*, Macquart, is a *Hyperalonia*. *E. bicellata*, Macquart, is of doubtful position."

Observations.—I am not certain if *E. laterimbata*, Bigot, as identified by myself, is not a colour variation of *E. stellifer*, Walker; I have re-examined the specimens together with the variation of *E. stellifer*, and failed to find a satisfactory character other than the general black and brown abdomens respectively, to distinguish these species.

Exoprosopa marginicollis, Gray.

Anthrax marginicollis, Gray, in Griffith's Animal Kingdom, xv., Ins. ii. 1883, p. 780; pl. cxxv., fig. 6.

This species, new to my list, was described without a locality. Gray states that it "has the thorax green with a "white line on each side; the body blue, the wings diaphanous "with the anterior part and base black." In the Macleay Museum there are several specimens which are undoubtedly this species, but all are entirely metallic blue, except one, and that has a metallic green abdomen showing that either the blue and green are interchangeable, or the latter is a discoloration.

Genus ANTHRAX, Scopoli.

White's manuscript.—"*Table of Australian Species of Anthrax.*

1. Wings at least half brown. 2.
   Wings hyaline with at most the costal margin brown. 5.
2. Wings cut sharply in a nearly straight line into a deep brown basal half, and a hyaline apical half. *incisa*, Macq.

Wings cut sharply into a basal and hyaline half, the dividing line being greatly sinuated so that the prolongations of the brown encroach on the hyaline portion. *concisa*, Macq.

Wings with the base and costal half suffused with brown, which melts gradually into the hyaline portions without any distinct line of demarcation. 3.

3. Scutellum testaceous, abdomen with the sides testaceous. *obscura*, Macq.

Scutellum black. 4.

4. Abdomen with two white bands. *alternans*, Macq.

Abdomen with white spots. *commista*, Macq.

5. Wings completely hyaline, pubescence at sides of thorax yellowish white, small species. *minor*, Macq. = ?*vitrea*, Walk.

Wings practically hyaline, but a little darker along the course of the closely adjacent mediastinal and subcostal veins; pubescence at sides of thorax fulvous, small to middle sized species. *nigricostata*, Macq.

Wings hyaline; yellow haired species; abdomen with black hairs on sides of fourth and fifth segments; large species. *flaveola*, Macq.

Wings hyaline, but largely suffused with brown from the base; large species. *albirufa*, Walk.

Wings hyaline with base and costal margin brown. 6.

6. Large species (usually about 12 mm.) . 7.

Small species (5 to 8 mm.) 8.

7. The brown colouration on the foremargin never descends so far as the bifurcation of the radial and cubital veins, which are always clear; the black pubescence on sides of abdomen is confined to the third and subsequent segments, that on the second basal segment being pale yellow. *marginata*, Walk. = ?*fuscicostata*, Macq.

The brown colouration of the foremargin covers the bifurcation of the radial and cubital veins; the black pubescence on the sides of the abdomen commences on the second segment. *velox*, White.

8. Pubescence at base of abdomen yellowish-white; wings rather dull. *simplex*, Macq.

(*A. pellucida*, Walker, belongs here, but I cannot say whether or not it is distinct.)

Pubescence at base of abdomen bright silvery white; wings bright glistening. *argentipennis*, White.

The type of *A. tasmanica*, Walker, in the British Museum collection is in too bad condition for identification. The types of the following three species are not to be found in the B.M. collection:—

A. alterna, Walker, *A. resurgens*, Walker, and *A. subsenex*, Walker, and it is impossible to say to what genera they belong."

Observations.—In a marginal note of a compiled note on *Anthrax incisa*, White wrote "Doubtfully an *Anthrax*"; in my catalogue I have suggested that it should come under the genus *Argyramœba*. Under this same genus I have placed *A. concisa*, Macquart.

A. tasmanica, Walker, is apparently a manuscript name, as I have failed to find any published reference to it, and White did not include any notes upon it under his compilations.

A. subsenex is referred, in this paper, to the genus *Comptosia*.

Genus CYTHEREA, Fabricius.

Glossita lipposa, Bigot, was placed by White in his manuscript under the genus *Mulio*, Latrielle, but he added in brackets "this species is unknown to me."

Genus ARGYRAMŒBA, Schiner.

White's manuscript.—"*Table of Australian Species of Argyramœba.*

1. Wings mostly deep black. 2.
   Wings mostly hyaline. 3.
2. Abdomen black with apex silvery white. *maculata*, Macq. = *australis*, Walk.
3. Wings with base and basal part of foremargin brown, and three brown spots, there being one at apical end of discal cell. *incompta*, Walk.
   Like *incompta*, only without any spots at apical end of discal cell. *semimacula*, Walk.

(All the above were described under the genus *Anthrax*.)"

LOMATIINÆ.

White's manuscript.—

"Genus Comptosia, Macquart.

This genus was originally described by Macquart as possessing three submarginal cells, the type of the genus being *C. fuscipennis*, Macquart, from Australia, but given in error from Monte Video; afterwards, however, Macquart placed in this genus species possessing only two submarginal cells.

Table of Australian Species of Comptosia.

1. Three submarginal cells. 2.
   Two submarginal cells. 7.
2. Wings brown, but the tips may be hyaline, and some hyaline spots may be present. 3.
   Wings hyaline, with only the costal margin narrowly or broadly brown. 6.
3. Scutellum red. 4.
   Scutellum brown or black. 5.
4. Wings dark brown with very distinct white tip; abdomen long, very large species. *fuscipennis*, Macq.=*insignis*, Walk.
   Wings entirely pale brown, or with tips indistinctly hyaline; abdomen short, large species. *decedens*, Walk.=?*basilis*, Walk.
5. Wings completely brown on which are darker small brown spots; small species. *serpentiger*, Walker.
6. Wings with foremargins very broadly and irregularly brown, narrowest in the middle, and with a long hyaline spot towards the tip; no brown spots present; small species. *dorsalis*, Walk.
   Wings with foremargins brown, and many small brown spots; small species. *plena*, Walker.
   Wings with foremargins broadly and irregularly brown, and four brown spots below; medium sized species. *corculum*, Walk.=?*tricellata*, Macq.
7. Wings entirely brown; large species. *aurifrons*, Macq.=*extensa*, Walk.
   Wings brown with the tips white. 8.
   Wings hyaline with foremargins brown. 9.
8. The brown portions of the wings containing hyaline spots. *maculipennis*, Macq.=*ocellata*, Walk. =*inclusa*, Walk.=*cognata*, Walk.

The brown portion of the wing has the base and band across the middle hyaline. *tendens*, Walk.

The brown portions of the wings contain no band or spots, but the base of the wing is hyaline, and the brown portion pale. *quadripennis*, Walk.

The wings with the exception of the white tips are wholly dark brown; a rather small species. *præargentata*, Macleay.

(*fasciata*, Fabr., according to my description, agrees with *præargentata*, Macl.)

The wings like those of *præargentata*, but not so dark; a much larger species. *stria*, Walk.

9\. Hyaline portion of the wing without any brown spots. 10.

Hyaline portion of the wings with brown spots. 11.

10\. Wings quite hyaline, except for narrowly brown costa. *sobricula*, Walk.

Wings faintly tinged with brown, costa more broadly brown than in *sobricula*; rather large species. *sobria*, Walk.

Costal half of wing suffused with brown; very small species. *partita*, Walk.

11\. Abdomen very broad, with side-tufts of black and white hairs; wings with foremargins brown, and brown diffused spots below; large species. *patula*, Walk.=*plana*, Walk.=*ampla*, Walk.

Abdomen narrow, without side-tufts of black and white hairs; wings with foremargins broadly brown, and four small brown spots below; medium sized species. *geometrica*, Macq.=*obscura*, Walk.

The following species I am not at present able to identify:—*C. bicolor*, Macq., and *C. fulvipes*, Bigot. Bigot's *Lygira rubrifera* is probably a *Comptosia*."

Observations.—This part of White's manuscript is exceedingly valuable in so far as it elucidates various descriptions previously found too inadequate to allow for a determination of the species. White's group *Comptosia* is equivalent to my *Lomatiina*, under which I have placed it. I have divided the group into three genera, all of which need adjusting. My *Lomatia rubescens* is now referred to *Comptosia* proper.

Oncodocera plana, Walker.

Anthrax plana, Walker, List Dipt. B.M., ii., 1849, p. 272 and Ins. Saund. Dipt., 1852, p. 168.

Oncodocera plana, Hardy, Proc. Roy. Soc. Tasm., 1921, p. 54.
Anthrax patula, Walk., *ibidem*, 1849, p. 273; and 1852, p 168.
Oncodocera patula, Hardy, *ibidem*, 1921, p. 53.
Anthrax ampla, Walker, Ins. Saund. Dipt., 1852, pp. 167-185.
Oncodocera ampla, Hardy, *ibidem*, 1921, p. 53; pl. xvii., fig 11.

Synonymy.—The above synonymy is given on the authority of White's manuscript.

Comptosia plena, Walker.

Observation.—If the characters given in White's key are accurate, my determination of *Anthrax plena*, Walker, is wrong, but a further comparison with Walker's description leads me to believe otherwise, and on this account I think it is possible that White extracted his characters from the description, and did not base his remarks upon specimens.

Comptosia fasciata, Fabricius.

Anthrax fasciata, Fabricius, Syst. Antl., 1805, p. 118.
Comptosia fasciata, Hardy, Proc. Roy. Soc. Tasm., 1921, p. 57, which see for further references, and synonymy.
Anthrax præargentata, Macleay, in King's Narr. Surv. Austr., ii., 1832, p. 468. *Id.*, Hardy, Proc. Roy. Soc. Tasm., 1921, p. 60, which see for further references.

Synonymy.—White probably based his identification of *Anthrax præargentata*, Macleay, upon a specimen identified by Walker. The whereabouts of the type is not known, so it seems advisable, for the time being at least, to accept White's statement "*fasciata*, Fabr. according to my description "agrees with *præargentata*, Macl.," to be the probable solution to Macleay's species. *A. fasciata*, Fabr., is not referred to elsewhere in White's manuscript, so the details of White's description are unknown.

Comptosia fascipennis, Macquart.

Comptosia fascipennis, Macquart, Dipt. Exot., ii., 1, 1840, p. 80; pl. fig. *Id.*, Hardy, Proc. Roy. Soc. Tasm., 1921, p. 54.
Neuria lateralis, Newman, Entom., i., 1841, p. 220.
Comptosia lateralis, Hardy, *ibidem*, p. 58, which see for further references and synonymy.

Synonymy.—According to the information given by White in his manuscript, this name, *C. fascipennis*, Macquart, must be given the preference over *C. lateralis*, Newman. I do not know from where White could have secured his information, as apparently Macquart did not correct the original locality which was "? Monte Video."

Comptosia extensa, Walker.

Anthrax extensa, Walker, Ent. Mag., ii., 1835, p. 473; and List Dipt. B.M., ii., 1849, p. 269. *Id.*, Hardy, Proc. Roy. Soc. Tasm., 1921, p. 60.

Neuria extensa, Newman, Entom., i., 1841, p. 221. *Id.*, Walker, Ins. Saund. Dipt., 1852, p. 167.

Comptosia aurifrons, Macquart, Dipt. Exot., suppl. 4, 1850, p. 113; pl. x, fig. 16. *Id.*, Hardy, Proc. Roy Soc. Tasm., 1921, p. 59.

Synonymy.—The above synonymy is probably correct; White stated it to be so in his manuscript, and the descriptions conform rather well.

Correction.—In my catalogue, in the note under *C. aurifrons*, for "front" read "face."

Comptosia basilis, Walker.

Anthrax basilis, Walker, List. Dipt. B.M., ii., 1849, p. 267. *Id.*, Hardy, Proc. Roy. Soc. Tasm., 1921, p. 60.

Neuria basilis, Walker, Ins. Saund. Dipt., 1852, p. 167.

Anthrax decedens, Walker, List Dipt. B.M., ii., 1849, p. 271. *Id.*, Hardy, Proc. Roy. Soc. Tasm., 1921, p. 60.

Neuria decedens, Walker, Ins. Saund. Dipt., 1852, p. 167.

Synonymy.—The above synonymy is given on the authority of White's manuscript.

Note.—From White's key and the descriptions, I am able to recognise as this species three specimens which are from Perth, Western Australia, and which are in my collection; they were captured during November, 1912.

Comptosia subsenex, Walker.

Anthrax, subsenex, Walker, Trans. Ent. Soc. Lon., iv., 1857, p. 144.

Lomatia? subsenex, Hardy, Proc. Roy. Soc. Tasm., 1922, p. 52.

Status.—Previously I had overlooked the line above the description where Walker referred this species to his group 8. This reference places the species amongst the true *Comptosia*, and I am now able to identify it with a common Sydney species which was previously unnamed in collections.

Description.—A rather large uniformly blackish brown species with soft whitish pubescence laterally, and covering the whole ventral surface.

Male.—Eyes approximate; ocellar triangle with some rather long black hairs; antennal triangle black, with black hairs and some light tomentum, especially along the eye margins. The face is covered with shining white tomentum that is slightly stained yellow near the antennæ, which have abundant black hairs on the basal segment. The dorsal surface of the thorax is covered with brown tomentum; there are traces of white tomentum at the sides. About six bristles are situated anteriorly to the insertion of the wings, and a group of about six more are on the postalar callus, but the presence and number of these bristles depend largely upon the condition of the specimen. The abdomen is uniformly brown, with a trace of a margin of white hairs at the apex of each segment, but more intensified on the first. The legs are reddish brown. The wings are uniformly suffused brown with reddish brown costal margin and veins. There are only two submarginal cells, and the upper branch of the cubital vein has a stump-formed appendix.

Female.—The characters of the female are similar to those of the male, from which it differs in the separated eyes; the front is similar to the frontal triangle of the male in colour and pubescence, and the face shows more yellow, tending to golden, hairs below the antennæ.

Length: 12-15 mm.

Hab.—New South Wales; Blackheath, November, 1919, and Como, October, 1921.

Type.—The type, according to White's manuscript, is not to be found in the British Museum, and presumably it is lost. The specimens described above, a pair in my own collection, were taken at Blackheath on the 21st November, 1919. There are four other pairs taken in copula, and a further seventeen specimens in the series examined.

Note.—This species is similar to *C. extensa*, but differs in having white instead of yellow pubescence; the loop of the radial vein is not quite so long, and the presence of the appendix on the cubital vein will also serve as a more or less reliable distinguishing character. From *C. ducens* and *C. sobria*, it differs in the absence of the cross vein between the radial and cubital veins as well as in colour and other details.

SYSTROPINÆ.

Genus SYSTROPUS, Wiedemann.

Note.—Amongst White's manuscript there is the description of a species for which it was intended to give new generic and specific names. I have seen in the Melbourne Museum specimens of the same species and they are closely allied to and certainly cogeneric with my *Systropus clavifemorata.* White's description was based upon two male specimens sent by Mr. F. P. Spry, and were from Belgrave and Gippsland, Victoria. Names were not given in the manuscript, and although White stated "Gen. nov. allied to "*Systropus,*" he did not give particulars of what he considered to be the characters of his proposed new genus whereby it can be distinguished from *Systropus.*

BOMBYLIINÆ.

White's manuscript.— . . . . (Here comes a key to the genera of the *Bombylius sensu lato*, which has already been published by White in these proceedings). . . . .

"Great variation is shown in the amount of curvature "of the radial vein, but this appears to be a specific char- "acter only. I have examined all Walker's type species, ex- "cept *B. areolatus*, but the following four species of Macquart "are unknown to me, and I cannot at present place them:— "*Bombylius consobrinus, penicillatus, pictipennis* (should be "easily identified by the markings of the wings), and *tenui- "cornis*, Macq. Of the two following, I have not the descrip- "tions:—*B. australianus* and *rubriventris*, Bigot.

Genus DISCHISTUS, Loew.

The first posterior cell open; first basal cell much longer than the second basal cell.

Table of Australian Species of Dischistus.

1. Minute species, dark with whitish pubescence; radial vein straight. *antecedens*, Walker.
   Larger species. 2.
2. Broad tawny species; radial vein much upturned; wings tinged yellow. *altus*, Walker = *pinguis*, Walker.
   Yellow species; radial vein moderately upcurved; wings practically hyaline. *immutatus*, Walker.

Observations.—Of Walker's nine species placed by me under the genus *Sisyromyia*, four are placed by White under *Dischistus.*

Dischistus antecedens, Walker.

Bombylius antecedens, Walker, List Dipt. B.M., ii., 1849, p. 293.

Sisyromyia antecedens, Hardy, Proc. Roy. Soc. Tasm., 1921, p. 72.

Dischistus altus, Walker.

Bombylius altus, Walker, List Dipt. B.M., ii., 1849, p. 288.
Sisyromyia altus, Hardy, Proc. Roy. Soc. Tasm., 1921, p. 72.
Bombylius pinguis, Walker, List Dipt. B.M., ii., 1849, p. 290.
Sisyromyia pinguis, Hardy, *ibidem*, 1921, p. 72.

Note.—The species labelled by me *Sisyromyia pinguis* in the Macleay Museum cannot be identical with Walker's species, if the information gathered from White's manuscript is correct.

Dischistus immutatus, Walker.

Bombylius immutatus, Walker, List Dipt. B.M., ii., 1849, p. 292.

Sisyromyia immutatus, Hardy, Proc. Roy. Soc. Tasm., 1921, p. 72.

Genus SYSTŒCHUS, Loew.

White's manuscript.—"First posterior cell closed; first and second basal cells of almost equal length.

Table of Australian Species of Systœchus.

1. Apex of abdomen with a tuft of dark brown pubescence on each side; abdomen with a brown band across the middle. 2.
   Apex of abdomen without side tufts of pubescence; abdomen not banded. 3.
2. Pubescence of abdomen pale brown. *crassus*, Walk. = *platyurus*, Walk.
   Pubescence of abdomen white. *vetustus*, Walk. = ?*sericans*, Macq.
3. Pubescence of abdomen golden. *distinctus*, Walk."

Observations.—It is possible that *Choristus* will have to take the place of *Systœchus*, but as the type species is not known to me, I refrain from changing the names for the present. White seems to have overlooked *Choristus bivious*, Walker, as his manuscript is without reference to it.

Systœchus australis, Guerin.

Bombylius australis, Guerin, Voy. Coq. (2) ii., 1830, p. 294; pl. xx., fig. 4. *Id.*, Hardy, Proc. Roy. Soc. Tasm., 1921, p. 75.

Note.—According to the description and illustration, this species could be either a *Bombylius* or *Systœchus*. Four specimens of the latter genus, from Sydney, agree with the curvature of the radial vein, and with the very long palpi, both of which characters in the illustration are unknown to me within the genus *Bombylius*. Other characters given in the illustration are not reliable, and are due to inferior drawing; even the colour is unsatisfactory, as the copy of the work in the Australian Museum shows the insect to be uniform, and dark in colour, whilst that in the library of the Linnean Society shows a brighter insect, with light stripes at the sides of the thorax.

I propose to utilise the name for four specimens (3 ♂ ♂, 1 ♀) which are in my collection, and were taken in the vicinity of Sydney. These specimens differ from the illustrations in colour, but agree with the description and the illustration moderately well, allowing for the inferior drawing, and they are the only specimens known to me in this or allied genera that have the very long palpi.

Genus Sisyromyia, White.

White's manuscript.—"First posterior cell open; first and second basal cells of almost equal length.

Table of Australian Species of Sisyromyia.

1. Apex of abdomen with a tuft of black pubescence on each side. 2.
   Apex of abdomen without side tufts of black pubescence. 3.
2. Yellow haired species. *tetratrichus*, Walker.
3. Abdomen with a yellow or white centre stripe. 4.
   Abdomen without a centre stripe. 7.
4. Centre stripe bright yellow. *auratus*, Walk. = *crassirostris*, Macq.
   Centre stripe white. 5.
5. Wings with the costal half brown, remainder hyaline; legs altogether red; abdominal pubescence dark tawny. *decoratus*, Walker.
   Wings hyaline, or with only the costa brownish, and not clearly divided as in *decoratus*. 6.

6. Bright red-haired species.

rutilus, Walk.=?*albicinctus*, Macq.

Fulvous haired species. *albivitta*, Macq.

(Position doubtful, but probably belongs here).

7. Yellow haired species.

brevirostris, Macq.=*eulabiatus*, Bigot.

Type denuded, a small species from Swan River, resembling *brevirostris*, but costa more broadly brown, though not extending to the tip.

primogenitus, Walker."

Observations.—Four species, *pinguis*, *altus*, *antecedens*, and *immutatus*, Walker, which were placed in my catalogue under this genus, are now referred to *Dischistus*. White queried *B. albicinctus*, Macquart, to be the same as *B. auratus*, Walker, but Macquart states "abdomine albo fascialio . . . "quatrième segment de ce dernier a longs poils blancs au bord "antérieur . . . première cellule postérieur fermée . . . ," all of which does not agree with White's suggestion.

Sisyromyia auratus, Walker.

Bombylius auratus, Walker, List Dipt. B.M., ii., 1849, p. 289.
Sisyromyia auratus, Hardy, Proc. Roy. Soc. Tasm., 1921, p. 71, which see for further references and synonymy.
Bombylius rutilus, Walker, *ibidem*, p. 289.
Sisyromyia rutilus, Hardy, *ibidem*, p. 72.

Synonymy.—It seems evident from White's description that *B. rutilus*, Walker, is one of the forms placed by me under the name *Sisyromyia auratus*, Walker. Possibly further study will result in the separation of this series into more than one species, but there are no described characters that will enable this to be done at the present time. I have recently detected some differences in the palpi that possibly may be of specific value, but the material available for study is neither sufficient in numbers nor good enough in condition to verify the points.

Genus Bombylius, Linnæus.

White's manuscript.—"First posterior cell closed; first basal cell longer than the second.

Key to the Species of the Genus Bombylius.

1. Abdomen fringed posteriorly with white; wings with costal half brown, remainder hyaline.

hilaris, Walker.

Abdomen not fringed with white. 2.

2. Golden haired, very small species; abdomen without any black hairs. *chrysendetus*, White. *?nanus*, Walker.

Fuscous haired species. 3.

3. Face in male narrow, about the width of one eye; legs pale red. *fuscanus*, Macq.

Face in male broad, about the width of two eyes; legs dark reddish black. *palliolatus*, White.

The type of *B. matutinus*, Walker, is in too bad condition for identification; the face is narrow, and it can possibly be *fuscanus*. Another specimen named *matutinus* in the Museum collection is *B. palliolatus* and quite distinct from the type."

Observations.—White seems to have overlooked *B. viduus*, Walker, and he states that he did not see *B. aureolatus*, Walker. Both species have been recognised from their descriptions, and have been placed suitably in my catalogue.

No alterations can be made under the genus in my catalogue at present, but the discovery of a single specimen of *B. fuscanus*, Macquart, collected in the vicinity of Sydney, makes it desirable that three names of described species should be reconsidered, namely, *B. matutinus* and *tenuicornis*, Walker, and *B. consobrinus*, Macquart. *B. australianus*, Bigot, is undoubtedly the same as my identification of *B. tenuicornis*, Macquart, under which Bigot's name was placed as a synonym.

AN EXPERIMENTAL METHOD OF PRESENTING THE PRINCIPLES DETERMINING THE GENERAL PROPERTIES OF OPTICAL GRATINGS.

By A. L. McAulay, B.Sc., B.A., Ph. D.

(Read 6th August, 1923.)

In a laboratory which is not well equipped with modern optical instruments, the actual appearance and meaning of many of the phenomena whose theory is studied is not in the least appreciated. This seems especially the case in connection with the elements of the more advanced theory of optical gratings, and with the theory of interference spectroscopes.

The following presentation is an attempt to provide a set of experiments, made with fairly cheap and simple apparatus, which shall illustrate the various effects that produce the phenomena exhibited by an optical grating, and includes such simple theoretical discussion as is necessary to understand the experiments.

In the course of the experiments the effects that determine such things as the resolving power of a grating, the intensity of the spectrum of a given order, and so on, are directly observed. At the end of the paper the results obtained in the discussion are applied to the cases of the ordinary plane grating and the Michleson Echelon.

SECTION 1. APPARATUS.

The arrangement of apparatus is shown diagrammatically in Figure 1. G is an ordinary metallic filament electric lamp of about 60 candle power, enclosed in a box which is fairly light tight; a kerosene tin lying on its side, with a black cloth over one end, and a window cut in the other serves the purpose very well. A is a vertical slit placed against the window. It should have good straight jaws, and be adjustable. Considerable use may be made of this adjustment, for some purposes it is convenient to have the slit very much wider than for others. It is best to have a large diameter short focus lens in the box to diffuse the light falling on the slit. B is a short focus lens. It must be well corrected for chromatic aberration, as it must work with a fairly large diaphragm. A symmetrical camera lens by Beck of about 28 cms. focal length, working at F8, proved very satisfactory.

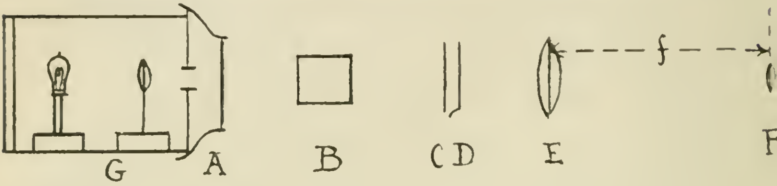


Figure I

C is another vertical slit. Its jaws must be good. and it should be fitted with a micrometer adjustment enabling its width to be measured. Otherwise, some such device as closing it on a piece of metal foil whose thickness is afterwards measured by a micrometer must be employed to determine its width. D is a wire grid, made by soldering together a metal rectangle, two sides of which are screws of fine pitch. Twenty-two gauge copper wire is wound round the rectangle over the screws, thus forming a double grid of the same pitch as the screws. The wire is next fastened to the rectangle with sealing wax, and the strands on one side cut away. In this way a grating of 22 lines, of pitch .76 mm., was made, and proved satisfactory. E is a telescope lens, corrected for chromatic aberration, of about a metre focal length. F is a micremeter eyepiece in whose field the phenomena to be described are observed, and by means of which distances on the diffraction patterns are measured. An ordinary eyepiece and scale could probably be made to serve.

SECTION 2. ADJUSTMENT.

A is opened to about a third of a millimetre, and B adjusted to render light from A parellel. C and D are removed, and E and F so arranged that A is sharply focussed along the vertical crosswire of F. B, E, and F should be sufficiently well corrected to give a brilliant image of A without striking aberrations.

SECTION 3. DIFFRACTION PATTERN DUE TO SINGLE SLIT. VISIBILITY CURVE.

The slit C is first completely closed, and then slowly opened. When its width is about .1 mm. the field of the eyepiece is seen to be slightly illuminated. On increasing its width the illumination increases, and at a certain stage dark vertical bands appear, one from each side of the field, and

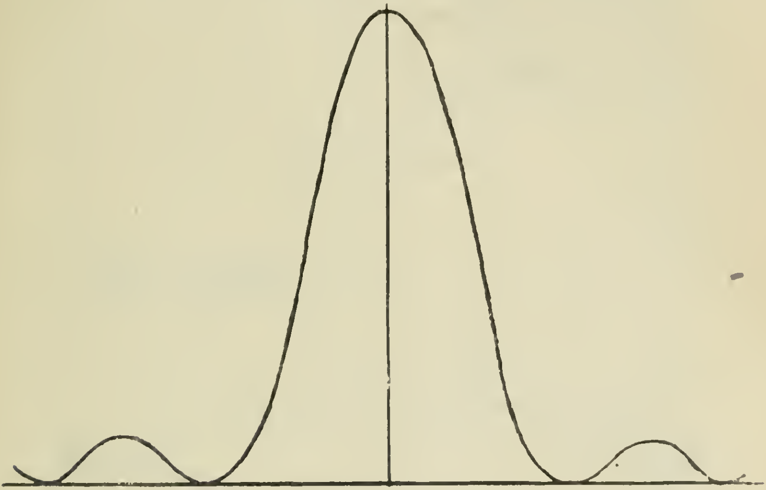


Figure II

move towards the centre. The slit is opened till it completely uncovers one aperture of the grid D, i.e., until its width is about .4 mm. The appearance is now as indicated in Fig. II., where abscissæ represent distances from the cross-wire of F, and ordinates the intensity of the light. This curve in what follows will be referred to as the visibility curve.

Measure the distance, f, from E to F, the width of the slit, e, and with the micrometer eyepiece the corresponding distance, 2d, between the first minima on the visibility curve. Repeat with three different slit widths, ending by opening the slit till one whole aperture of the grid is exposed. Show that in each case $d = \lambda f/e$, where λ is the mean wave length of the light used (about 6×10^{-5} cms.).

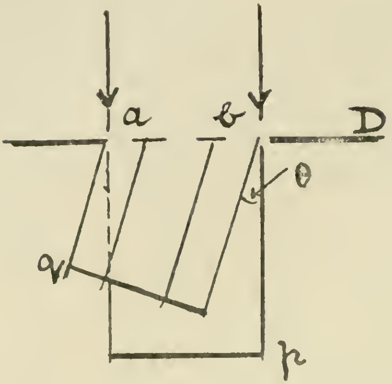
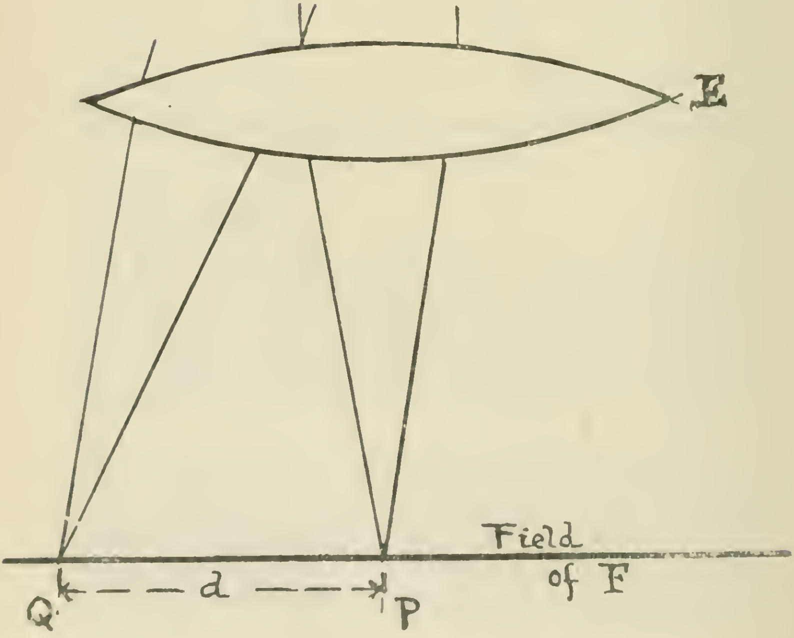


Figure III



SECTION 4. THEORY OF SECTION 3.

Figure III. shows diagrammatically the slit D and the lens E. Light falls on D normally, and therefore leaves every part of it in the same phase. Consider a beam leaving the slit at an angle θ with the direction of the incident light. The disturbances over a plane such as q perpendicular to this direction will be brought together by E at Q, the point at which a wave front at q would be focussed. The disturbances over q at any instant will, however, not be in exactly the same phase, and it is the combined effect of a set of out of phase waves that will produce the illumination at Q. Let p, P be the wave front, and focus for $\theta = 0$. It is obvious that this is the position of the image of the slit, that is, it is on the vertical crosswire as adjusted in section 3.

It is required to investigate the illumination at Q when Q takes up different positions. For this purpose the slit D will be thought of as made up of a large number of elements, and the combined effect of the wave trains from each will be considered. The waves arriving at Q will be represented as vectors in the usual way, and, as there are an equal number of wave lengths between each element of q and Q, a vector drawn for q will equally well stand for the effect of the same wave train at Q. a and b are two adjacent elements of the slit. Then obviously the path difference at q of the light coming from a and b is $ab \sin \theta$, and the phase difference of the wave trains at q (or Q) is $\frac{2\pi}{\lambda} ab \sin \theta$. Now $PQ = f \sin \theta = d$. Therefore, the phase difference between the wave trains is $\frac{2\pi}{\lambda} ab \frac{PQ}{f}$ i.e., it is proportional to the distance of Q from P.

Consider the vectors representing disturbances from successive elements as short rods hinged to each other at the ends (see Figure IV.). Then the line joining the ends of the composite rod will be the vector representing the resultant effect of all the elements. At P the waves are all in the same phase, the jointed rod or chain lies stretched out in a straight line (Figure IV. 1), and the resultant is the arithmetic sum of the components. At Q, from what has been said above, wave trains from adjacent elements will have a phase difference of $\frac{2\pi}{\lambda} ab \frac{d}{f} = d\alpha$ say, i.e., each section of the chain will make an angle of $d\alpha$ with the one next to it. Obviously,

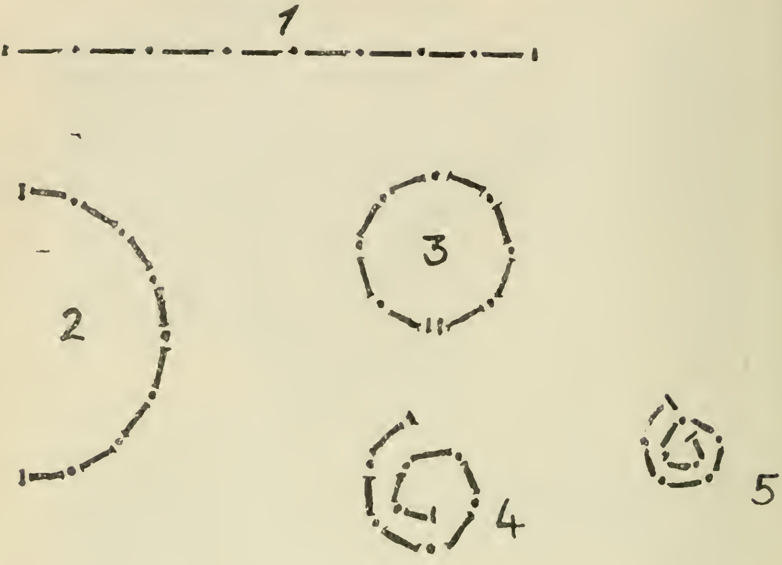


Figure IV

if there are n elements, the angle between the end vectors will be $\frac{2\pi n}{\lambda} ab \frac{d}{f} = n d\alpha = \alpha$ and as n ab = e = the width of the slit $\alpha = \frac{2\pi e}{\lambda} \frac{d}{f}$. Figure IV., 1, 2, 3, 4, and 5, show the chain of vectors for $\alpha = o, \pi, 2\pi, 3\pi, 4\pi$. Remembering that the resultant is the line joining the ends of the chain, it is easy to see that the visibility curve must have the general form found for it in section 3, Figure II. It must not be forgotten that the intensity of the illumination is proportional to the square of the amplitude of the wave, while the vector represents the amplitude. It is evident from a consideration of Figure IV. that the first minimum of the curve will occur when $\alpha = 2\pi$ which gives as found experimentally $d = \frac{f\lambda}{e}$ or $e \sin\theta = \lambda$. A more complete theory (see Schuster, Theory of Optics, p. 99 *et seq.*) shows that the expression giving the form of the visibility curve is $I = I_o \left[\frac{\sin^2(\alpha/2)}{(\alpha/2)^2}\right]$ where I is the intensity, I_o, a constant and $\alpha = \frac{2\pi}{\lambda} e \sin\theta$.

SECTION 5. THE TWO LINE GRATING. POSITION OF SPECTRA FORMED BY A GRATING.

The slit C is widened till a second aperture of the grid begins to be uncovered. When a very narrow strip is uncovered the pattern of section 3 is still clearly seen in the eyepiece F, but it is furrowed by dark lines. A typical curve connecting illumination with distance from the crosswire is shown in Figure V. 1. On further widening the slit till the whole of the second aperture is uncovered, the dark bands deepen, and the pattern splits into bright strips, all but the centre one being coloured at the edges. The colours are dispersed more the further the strips are from the crosswire. These bright strips with coloured edges correspond to the spectra formed by gratings, and are, in fact, the spectra formed by a grating of two lines. Figure V. 2 shows the way in which V. 1 would develop on widening the slit. As will presently be shown, these spectra should be evenly spaced. Measure the distances of their centres from the centre of the central uncoloured strip with the micrometer eyepiece, and calculate the corresponding values of $\sin\theta$, θ having the same meaning as in the last section. It will be noticed that some gaps are double others, indicating that certain spectra are missing. This is due to the fact that they should appear where there is a minimum of the visibility curve, and where consequently there is no light available for their production. c Figure V. 2 represents such a case.

Draw and dimension curves similar to Figures V. 1 and V. 2 from your observations, and compare them with the dimensioned visibility curve you obtained as in section 3. Make a special note of any spectra that are missing. Compare the values you obtain for $\sin\theta$ for the centres of the spectra with $\frac{m\lambda}{l}$ where l is the distance between two successive apertures of the grid, m is an integer, and λ is a mean value for the wave length of white light, say 6×10^{-5} cms.

SECTION 6. THEORY OF SECTION 5.

The case taken for consideration is that observed when the two apertures are equal in width, i.e., when two complete apertures of the grid D are uncovered by the slit C. Consider the illumination at a point on the field of F corresponding to an angle of diffraction θ. Then from what has gone before, the illumination due to each slit separately is that

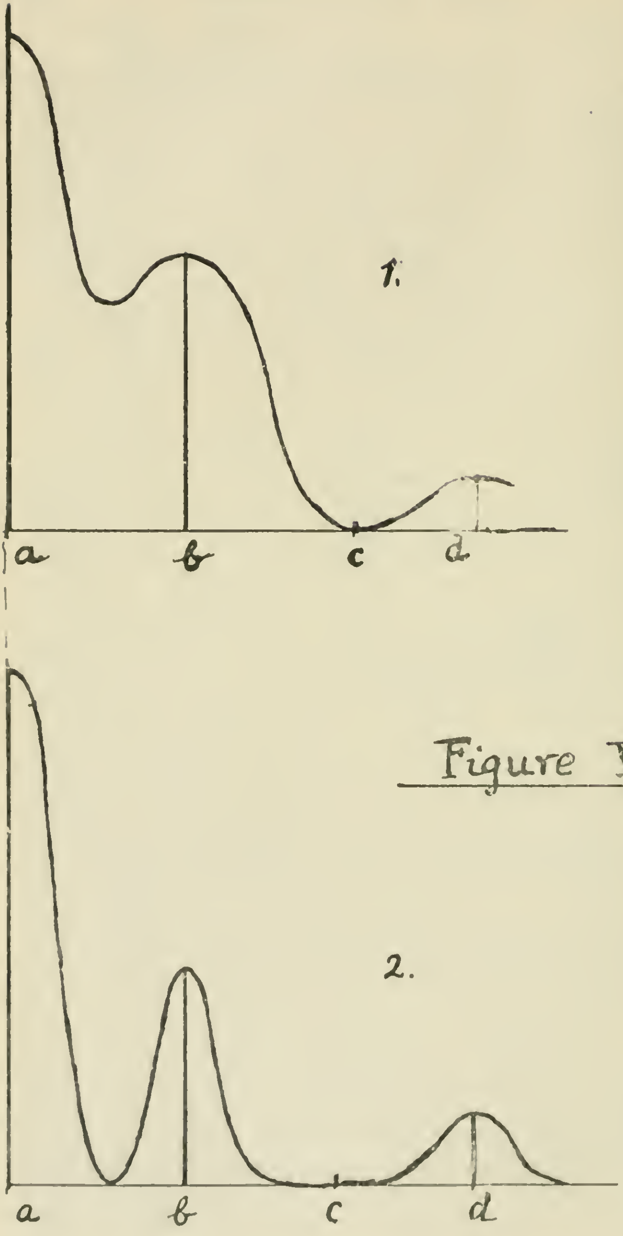


Figure V

given by the ordinate of the visibility curve, and these two beams will combine to produce illumination on the field.

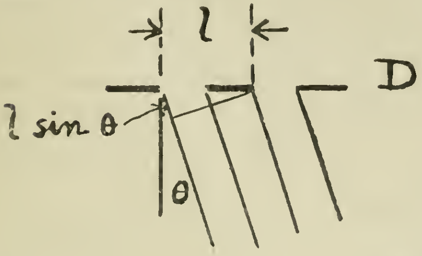


Figure VI

If the distance between corresponding points of the two apertures is l, the phase difference between the two beams is evidently $\frac{2\pi}{\lambda} l \sin\theta$ (see Figure VI.). Thus the two beams will completely interfere when $\frac{2\pi}{\lambda} l \sin\theta = \pi(2m-1)$ where m is an integer, i.e., where $\sin\theta = \frac{\lambda(2m-1)}{2l}$. The centres of the bright bands or spectra evidently come where $2\pi/\lambda \; l \sin\theta = 2m\pi$, i.e., where $\sin\theta = \frac{\lambda}{2l} 2m = \frac{m\lambda}{l}$. The spectra formed for m=1, 2, 3, etc., are called first, second, third, etc., order spectra. If the value of $\sin\theta = \frac{m\lambda}{l}$ is such that it coincides with the value for a minimum of the visibility curve, the spectrum will have zero intensity. Obviously in general, the intensity of the spectra will depend on the position they happen to occupy in the visibility curve, and this depends on the ratio of the pitch of the grating, l, to the width of the aperture, e.

The above discussion has been concerned with homogeneous light. In the case of white light, each colour forms its spectra in a different place, determined by the value of λ; hence the colour effects at the edges of the spectra.

SECTION 7. GRATING WITH MORE THAN TWO LINES. SECONDARY MAXIMA, ETC.

Widen the slit C till three apertures of D are opened and observe the appearance of the pattern in the field of F. Next uncover four apertures, then five and six. Finally, remove the slit C so that the whole of D is effective. D should consist of about twenty apertures. As more slits are uncovered, it will be seen that the spectra, although their centres remain unchanged in position, become narrower and sharper, and the colours purer, and no longer confined to the edges. Also, in the dark regions between the spectra, now wider than before, secondary maxima appear. These are much narrower and fainter than the spectra themselves. It will be found that if N is the number of apertures exposed, the number of secondary maxima is $N-2$. They can readily be counted, for $N=3$, 4 and 5, but after that, become rather too faint and close together. On replacing the white light of the lamp by a sodium flame, it will be seen that the spectra are now quite narrow lines. This was, of course, indicated by the purity of the colours in the white light spectra.

Draw curves as in section 5, Figure V., and dimension them to show the positions of the centres of the spectra, the width of the dark bands separating them, and the positions of the secondary maxima. Verify that the positions of the spectra have not changed on increasing the number of apertures.

SECTION 8. THEORY OF SECTION 7.

For simplicity, the discussion will be confined in the first instance to illumination by homogeneous light. As in section 6, the visibility curves from the different apertures are superimposed, and the illumination at any point is limited by the ordinate of the visibility curve.

Consider first a grating with a large number, N, of lines. Let E be the total width of the grating. It may be looked on as an aperture of width E divided into N elements. Figure III, of section 4, represents this case as well as the case of a slit. The scale is, however, different. The whole discussion of section 4 will also be seen to hold, but instead of there being an infinite number of elements supplying light, there is a large finite number. E is much larger than e, and therefore the distances from P of corresponding parts of the diffraction pattern are much smaller, and instead of a broad central band, there will be a fairly narrow central line flanked by secondary maxima, the whole phenomenon being confined to a very narrow region near P. The first minimum occurs where $d = f\lambda/E$ or calling d/f (the very small angle which separates the maximum from the minimum) $d\theta$ it occurs where $d\theta = \frac{\lambda}{E}$

The essential difference between the two cases lies in the fact that on further increasing θ in the case of the grating, a point is reached where the resultant disturbance from one element differs from that from the one next it by exactly one wave length, i.e., the disturbances over q (Figure III.) are all in phase again. This is evidently where $l \sin \theta = \lambda$ (see Figure VI., section 6), and results in the first order spectrum. This can never occur for the slit, because the elements are infinitely close together, and $l=0$.

Refer to Figure IV., section 4, and consider the illumination at a point Q, as represented by the distance between the ends of the jointed rod or chain. As Q moves away from P, the chain passes through the stages 1, 2, 3, 4, and 5, and then continues coiling up on itself, the successive maxima becoming smaller and smaller. In the case of the grating, there comes a point where one section is turned back completely over the one next it, and a further rotation of the sections begins to uncoil the chain once more, the uncoiling continuing till one section has turned through 360 degrees relatively to the one next it, and the chain is again stretched straight out. It is here that the first order spectrum is found. In the case of the slit the sections being infinitesimal, the chain continues to coil up for ever, degenerating to a point when Q reaches infinity.

The above shows the reason for the existence of the spectra and the secondary maxima near the central line, but a little further consideration is needed to extend the discussion to the region in the neighbourhood of the spectra and to find the position of the first minimum associated with a spectral line.

Referring to Figure VII., p is a wave front of the beam of rays which goes to form the central maximum of a spectrum, and q is the plane normal to the bundle which is united at the first minimum flanking the spectral line. Then the disturbances at C on both p and q are in the same phase, and the disturbances at C and B are in the same phase. Therefore, the phase difference between extreme rays of q is the same as the phase difference between B and D which is evidently $\frac{2\pi}{\lambda}[E \sin (\theta + d\theta) - E \sin \theta]$. $d\theta$ is very small. Identifying $\cos d\theta$ with 1 and $\sin d\theta$ with $d\theta$, this expression becomes $\frac{2\pi}{\lambda} E \cos \theta \, d\theta$. From section 4, Figure IV., the first minimum occurs when the phase difference between extreme rays of q is 2π, i.e., when $\frac{2\pi}{\lambda} E \cos \theta \, d\theta = 2\pi$ or when $d\theta = \frac{\lambda}{E \cos \theta}$.

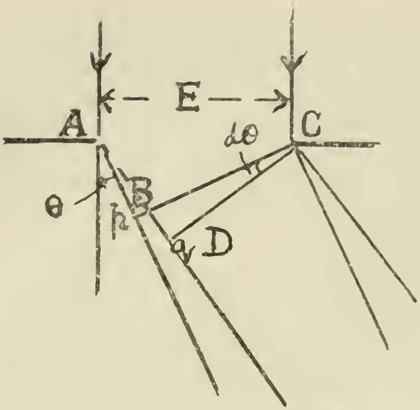


Figure VII

SECTION 9. COMPARISON OF THE EXPERIMENTAL RESULTS OF SECTION 7 WITH THOSE FOUND THEORETICALLY IN SECTION 8.

Using methods similar to those of section 4, and diagrams of the nature of Figure IV., find the number of secondary maxima that should appear between spectra given by gratings of 3, 4, and 5 lines. Roughly estimate their positions with respect to the spectra, and compare your results with those obtained experimentally in section 7.

SECTION 10. APPLICATION OF THE FOREGOING TO THE CASE OF THE ORDINARY TRANSMISSION AND REFLECTION GRATINGS.

The plane transmission grating consists of a transparent surface closely ruled with lines; 15,000 lines to the inch is an average spacing. In such a case, a transparent aperture will have a width of roughly 10^{-4} cms. The light from these apertures passes through a lens, and is focussed, all the individual visibility curves being superimposed. The angle through which the central maximum of the visibility curve extends on one side of the centre is given by $\sin\theta = \frac{\lambda}{e}$ (see sections 3 and 4). Here therefore $\sin\theta = 6 \times 10^{-5}/(1 \times 10^{-4})$, i.e., it extends over more than 30 degrees on either side of the direction of the incident light. The form of the curve will not be exactly that deduced for smaller angles owing to the influence of obliquity, but the error introduced will not be large.

The spectra will appear at positions given by $\sin\theta = \frac{m\lambda}{l}$ (section 6), or if $\frac{N}{E}$ is the number of lines per cm. $\sin\theta = \frac{mN\lambda}{E}$ and their intensities will be as the ordinates of the visibility curve for corresponding values of θ.

The resolving power of a grating is defined as the reciprocal of the fraction of a wave length that separates two spectral lines which the grating can just exhibit as distinct, that is, if the lines have wave lengths λ and $\lambda + d\lambda$ the resolving power is $\frac{\lambda}{d\lambda}$. Experience indicates that if the maximum of one line falls on the first minimum of a line adjacent to it, the two lines can just be recognised as distinct. This, therefore, is taken as the criterion of resolution. Let two lines that a grating just resolves have wave lengths λ and $\lambda + d\lambda$. Then as $\sin\theta = \frac{mN\lambda}{E}$ (section 6) $\cos\theta\, d\theta = \frac{mN\,d\lambda}{E}$, and $d\theta$, the angle by which they are separated is $mN\,d\lambda/E\cos\theta$. Now the angle between the maximum of a line and its first minimum is $d\theta = \frac{\lambda}{E\cos\theta}$ (section 8). Then, as the two lines under consideration are just resolved, these two values of $d\theta$ must be equal, and $\frac{\lambda}{E\cos\theta} = \frac{mN\,d\lambda}{E\cos\theta}$ or $\frac{\lambda}{d\lambda} = mN$, i.e., the resolving power is the product of the order of the spectrum, and the total number of lines in the grating.

The foregoing discussion applies equally well to reflection gratings, and with slight modifications to the case of oblique illumination.

References.

Baly, Spectroscopy, Chap. VI.

Houston, Treatise on Light, p. 171 to p. 180.

Questions.

In a certain transmission grating the transparent spaces are the same width as the opaque spaces. Where on the visibility curve do the second and third order spectra lie?

Why cannot a two line grating resolve two spectral lines for which $\frac{\lambda}{d\lambda}$ is less than 6, although the expression obtained above would give 6 as the resolving power in its third order spectrum?

SECTION 11. APPLICATION TO THE ECHELON.

In this instrument some twenty plates of optically plane parallel slabs of glass, all accurately of the same thickness (about 1 cm.), are piled above one another, each one overlapping the one beneath it by about a millimetre. Light is passed normally through the pile, emerging from the overlapping ledges, which behave as the clear spaces of a grating, the beam coming from one ledge being retarded many thousands of wave lengths behind that from the ledge next it, owing to its passage through a greater thickness of glass. The spectra observed are thus of about the ten thousandth order.

The following brief discussion should be supplemented by reading. Treatments will be found in Schuster, Theory of Optics, p. 116; Baly, Spectroscopy, p. 190; Wood, Physical Optics, p. 274; and in other text books.

Figure VIII. shows two plates of an echelon. HL is a wave front for wave length λ in the m th order.

The Visibility Curve.—The width of the slit is about 1 mm. Thus (sections 3 and 4) the breadth of the central maximum of the visibility curve is given by 2θ where $\sin\theta = \lambda/e = \frac{6 \cdot 10^{-5}}{1 \times 10^{-1}}$ Therefore $2\theta =$ about 4 minutes. Outside this narrow range the spectra have not sufficient intensity to be observed, consequently the echelon is only useful for examining the fine structure of a spectral line or determining the separation of two lines very close together.

Separation of the Orders.—Let HK (Figure VIII.) be a wave front for wave length λ in the $m + 1$ th order, e is about 1 mm. Therefore, $d\theta = LK/HL = \lambda/e =$ the angle between the two orders, is about $\frac{6 \times 10^{-5}}{\cdot 1}$ i.e., is half the breadth of the central maximum of the visibility curve. The result is that there are in general two orders of every wave length in view in the field, and that the different lines are piled on one another in an inextricable jumble. It is, therefore, necessary to use the echelon in conjunction with an ordinary spectrometer or other device for selecting a narrow range of wave length.

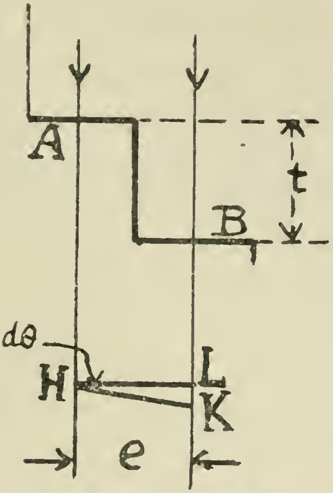


Figure VIII

Dispersion.—Let HK (Figure VIII.) be a wave front of wave length $\lambda + d\lambda$ of the m th order. From general considerations, it is obvious that the dispersion will be large, for if the refractive index of glass were a constant, LK would equal $m\, d\lambda$ [the ray BL would have an optical path $m\lambda$ and the ray BK a path $m(\lambda + d\lambda)$ longer than the ray AH], and thus with m large $d\theta$ must be relatively large. Actually the conditions are complicated by the fact that μ is a function of λ, μ being the refractive index of glass. It can very easily be shown, however (see references above), that the dispersion $d\theta/d\lambda = \frac{m - t\, d\mu/d\lambda}{e}$

Resolving Power.—Evidently to find the angle, $d\theta$, between the maximum of a spectral line and its first minimum, the discussion of section 8 holds without alteration, but with the restriction that θ is always very small, and therefore that $\cos\theta = 1$, very nearly. Therefore, $d\theta = \frac{\lambda}{E\cos\theta} = \frac{\lambda}{E}$

This is also the angle between the maximum of the λ line and the maximum of one of wave length $\lambda + d\lambda$ which is just resolved from it (see section 10), and this is given by the expression for the dispersion obtained in the last paragraph. Equating these two values of $d\theta$, $\frac{m\,d\lambda - t\,d\mu}{e} = \frac{\lambda}{E}$ and E = Ne where N is the number of apertures. Therefore, $\frac{\lambda}{d\lambda} = N\left(m - \frac{d\mu}{d\lambda}t\right)$ Now $t\,d\mu/d\lambda$ is almost always less than .1 of m. Thus the resolving power is given very nearly by Nm, the same expression that holds for the ruled grating.

A NOTE ON THE KING ISLAND EMU.

By H. H. Scott,

Curator of the Launceston Museum.

(Read 8th October, 1923.)

The present note is to be regarded as being strictly additional to the published data of Spencer and Kershaw (1910). To recapitulate, it may be said that the authors quoted describe *Dromæus minor* in the following terms:—"Size varying considerably, but always smaller than that of "*D. novæ-hollandiæ*; not exceeding that of *D. peroni*, but of "more robust build. Tibio-tarsus rarely exceeding 330 mm., "most usually from 270-320 mm., in greatest length. Tarso-"metatarsus rarely exceeding 280 mm., most usually from "220-280 mm. in greatest length. Frontal region of skull "dome-shaped. Length of skull from frontal suture to "occiput not, or only slightly, exceeding 60 mm. Greatest "width of the skull not, or only slightly, exceeding 55 mm. "Habitat: King Island, Bass Strait. Now extinct." The range of measurements here given is wide, and it must be noticed that the exact ratio between the tibio-tarsus and tarso-metatarsus of any single bird is not stated. As a matter of fact, I happen to know that the material Spencer and Kershaw worked upon did not contain any three leg-bones that were beyond all question associates—neither did they hold any two that they could be certain were parts of a single bird. In these circumstances the notes I am here putting upon record should be welcome ones, as they detail the osteology of various bones, found buried in actual position, and beyond all doubt parts of a single individual Emu.

FEMUR.

The total length of the femur is 189 mm., the right being here taken, as it is a shade longer than the left. Both bones are in good order, and could not have exceeded 190 mm. at any time. The proximal width is 48 mm., and the distal 55 mm. It is of interest to note that Spencer and Kershaw place their maximum femur at a total length of 186 mm. We are, therefore, in possession of a maximum test bone upon their scale—a most fortunate circumstance, as it enables us, by a process of comparative ratios, to get a fair idea of the total height of a fully adult and apparently well-developed King Island Emu.

THE TIBIO-TARSUS.

The tibio-tarsus of our bird is only 285 mm. long, with a proximal width of 58 mm., and a distal width of 34 mm. Now, this agrees with number 25 of Spencer and Kershaw's list, whereas the femur practically agreed with no one! Obviously, therefore, either a maximum femur of this King Island Emu has not yet been found, or the ratio of the tibio-tarsus to femur was not constant, and that suggests sub-races, since the actual variation between specimens one and twenty-five is 109 mm.—far too much for sex variation. The actual maximum specimen of the published list is the property of the Launceston Museum (it was lent for descriptive purposes), and is therefore available to me at the present time. This tibio-tarsus has a proximal width of 73 mm., and therefore must have carried a heavier femur, since this is 15 mm. wider than our associate of the femur detailed above. It is not fair to claim the whole of this 15 mm., since the hamular process of the larger specimen is very robust; but at least 10 mm. of articular increase may be fairly assumed to have existed.

TARSO-METATARSI.

Both tarso-metatarsi are present, and, as obtains in the case of the other associates, they are in beautiful order. The greatest length is 237 mm. This falls into Spencer and Kershaw's list at about folio No. 25, and therefore agrees exactly with the tibio-tarsal position. The proximal width is 39 mm., and the distal width, 42 mm.

From these comparisons we are led to infer that our lists of tibio-tarsi and tarso-metatarsi of King Island Emus are more complete than that of the femora, but that, upon the whole, our conceptions of the actual size of the birds are fairly accurate. Spencer and Kershaw's remarks, quoted above, respecting variation in size, are accentuated by these notes; indeed, it is rather hard to account for all the variations among adult specimens by individual and sex-variation alone; and, unless we call in insular environment as a potent factor, we are without a solution of the problem.

THE EXTINCT TASMANIAN EMU.

Of the extinct Tasmanian Emu I have to record the finding of a tibio-tarsus, which was recovered from the Pleistocene swamp at Irish Town, N.W. Tasmania, during some draining operations carried out in 1920. Our

Museum is indebted to Mr. Willes, of this city, and to the finder of the bone—Mr. E. H. Fenton—for this interesting specimen, which, from its long immersion in the swamp, must be, beyond all doubt, the leg-bone of a Tasmanian Emu. Unfortunately, the bone is broken at its proximal end, the shaft terminating 44 mm. below the femoral articular platform. If the amount named be allowed for, it exactly agrees with a second similar-sized bone to be dealt with presently. If allowance is made for the cnemial crest, 75 mm., instead of 40 mm., should be added to the present length. Put into tabular form, we get:—

Total length of the imperfect bone	371 mm.
For restoration to articular platform allow 40 mm., or to the top of the cnemial crest, allow another 35 mm.—total	75 mm.
Total for the greatest length of the bone	446 mm.

This tibial length (446 mm.) gives the Tasmanian Emu exactly the maximum mainland tibial length (as cited by Spencer and Kershaw upon page 21 of their brochure), but, as I shall show presently, the variation incidental to the insular species was more tarso-metatarsal than tibio-tarsal. The point to be noted here is that the bone is beyond all question of Tasmanian origin, since its inclusion into the peaty matrix of the swamp was certainly at a much earlier date than that at which any mainland Emus were imported into Tasmania, and therefore it stands as the earliest known specimen of a Tasmanian tibio-tarsal shaft.

I have next to mention the finding of the leg of a Tasmanian Emu, recorded by Ronald Gunn (1852, p. 170), who says:—"A leg of a Tasmanian Emu is now in my possession, "and as far as I can judge from it, as a very imperfect "specimen, there are differences in the arrangement and "size of the scutes, which may justify the separation of the "Tasmanian Emu from that of New Holland." A footnote supplied by the secretary of the Royal Society—Mr. J. Milligan—says:—"Captain Hepburn, of St. Paul's Plains, "possesses a breed of Tasmanian Emus, which he succeeded "in rearing from eggs found many years ago upon the "high, heathy land in his vicinity. Mr. J. Hepburn informs "me that the booming noise is not peculiar to the female, and "that the male bird does, though not frequently, make the "same sound. The Tasmanian Emus share the toils of "incubation between the sexes, but upon the mother devolves "the care of bringing up the young brood, to which the "male parent, for the most part, displays an unnatural and "most bitter antipathy." After resting in the cellar of Newstead House for some 70 years, this Emu's leg has now come to light again, and is upon the table before me as I write. Gunn's statement that the scutes make a departure from those of the mainland Emu's leg is quite correct, when comparison is made between the dried skin of his specimen and that of a mounted Australian Emu shown in our case. It will be noted, however, that Gunn makes the reservation, "so "far as I can judge from a very imperfect specimen," meaning, obviously, as the specimen still shows, that the outer cuticle has peeled off the scutes, and, in this condition, they appear far less developed than obtains with the Australian Emu. That the scutes should vary upon the tarso-metatarsus, during the creation of a species, and, indeed, that the bone itself should vary more than the other bones of the leg, is not unexpected, since the tarso-metatarsus is a later evolution than either the femur or tibia, and is therefore more plastic, and accordingly responsive to external conditions. Just how much the scutes varied, cannot be accurately stated to-day, any more than it could by an examination of the specimen 70 years ago, so we are restricted to Gunn's statement in his own terms, which personally I am inclined to accept; and I conclude that the cuticle and its under layers may very well, during life, have manifested differences that added to the several specific characters of size and colour. As this leg is beyond all question that of a Tasmanian bird, it supplies us with the following comparison:—

Tibio-tarsus	446 mm.
Tarso-metatarsus	377 mm.

The femur is not present, and may never have been in Gunn's possession, but the central and external toes and part of the internal toe, are still in the skin—the bones being those of a right leg.

When the tibio-tarsus from Newstead House is placed upon the measuring plate, side by side with the sub-fossil bone recovered from the Irish Town swamp—the one being a right, and the other a left—the two bones so exactly agree in every respect that, except for locality and age, they might be selected as associates.

There are thus available to students two tibio-tarsi, one tarso-metatarsus, and a nearly complete foot of a Tasmanian Emu, which are beyond all question correctly named, and which cannot be derived from Australian Emus introduced into Tasmania.

Whatever the variations in colour, plumage, and dermal scuting may have been, it would appear that the tarso-metatarsus was relatively shorter in the Tasmanian, than in the mainland, form. In a specimen of *Dromæus novæ-hollandiæ*, with a tibial length of 446 mm., we should look for a tarso-metatarsus of 411 mm., instead of one of 377 mm., as in Gunn's specimen.

Much historical data have been published by G. M. Mathews in regard to both the Tasmanian and the King Island Emus; and as this work is commonly available, it need not be even quoted here.

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1910. G. Mathews—Birds of Australia, Vol. I.

1910. Spencer and Kershaw—Memoirs National Museum (Melbourne), No. 3.

DESCRIPTION OF TWO UNDERGROUND FUNGI.

By L. Rodway, C.M.G.

(Read 8th October, 1923.)

Tasmania is peculiarly rich in underground fungi belonging to the family *Hymenogastraceæ*, and new members are constantly being found. I wish here to record two such plants. They both belong to the genus *Hydnangium.*

Hydnangium clelandi, n.s. Subglobose without a sterile base, 1-2 cm. diameter. Peridium pale yellow, tough, about one millimetre thick, readily separating. Gleba compact, dark brown, often with a greenish tinge; spore cavities large, isodiametric, as in *H. tasmanicum*, separated by thin tramal plates. Spores pale yellow, globose, smooth, or becoming slightly rough when old, 21 μ. diameter, exospore very thick. It differs from *H. archeri* in the absence of a sterile base and smooth spores.

Underground on hills about Hobart. Rare.

Named in recognition of the work done in mycology by Dr. Cleland of the Adelaide University.

Hydnangium mc'alpinei, n.s. Irregularly globose, without a sterile base, very dark, 1.5 cm. Peridium thin, tough. Tramal plates very thin, gleba dense, nearly black. Spores very dark brown, globose, 9-10 μ., rough, with small warts.

Very similar to *H. tasmanicum*, but the spores much darker, and not echinulate.

South Australia.

Named in honour of D. McAlpine, of Melbourne.

R. M. JOHNSTON MEMORIAL LECTURE.

GEOLOGICAL EVIDENCE OF THE ANTIQUITY OF MAN IN THE COMMONWEALTH, WITH SPECIAL REFERENCE TO THE TASMANIAN ABORIGINES.

By

Professor Sir T. W. Edgeworth David, K.B.E., C.M.G., F.R.S., B.A., F.G.S.

Plates VIII.-XI.

(Read 8th October, 1923.)

CONTENTS.

PART I.

BRIEF SUMMARY OF THE LIFE AND CHARACTER OF R. M. JOHNSTON.

The great honour and privilege has been conferred upon me by the Fellows of the Royal Society of Tasmania of inviting me to deliver the first of the Memorial Lectures to a truly great man, one who always gave of his best, and whose whole life was one of loving and faithful service, the late Robert Mackenzie Johnston. From my heart I thank you for this privilege.

Already a grateful country has published a fine work in "The R. M. Johnston Memorial Volume," embodying his chief papers and pamphlets and giving a summary of his biography, with a foreword from one who perhaps knew him best, the Hon. Sir Elliott Lewis. The Royal Society of Tasmania in its volume for 1918 has also given a short biography and a complete list of his published papers. Under these circumstances, I do not propose to more than very briefly touch upon his life work, but will review briefly some recent geological researches inspired largely and to a great extent built on the foundation which Johnston so well and truly laid.

Though one shrinks from treading on such holy ground as that of the life of a vanished friend, one is nevertheless drawn to do so by the strength of one's love for him, for in the simple phrase of the country of his birth, he was "a lovely man."

Born in 1845 at a little fishing village in the Black Isle, on the shore of the Moray Firth in Scotland, he died in Hobart in 1918 at the age of 73 years. His father had a small croft, on which he owned a humble cottage.

Young Johnston was educated at the village school, and derived much inspiration from the works of the famous stone-mason geologist, Hugh Miller, who lived in the neighbouring town of Cromarty. His early taste for geology may be traced to this source. He left school very young, and for two years was herd laddie and harvest hand on a neighbouring farm. In spite of hard work he found time for some reading, and the ambition grew strong within him to see something of the great world. When only a laddie of 14 years of age he showed the great strength of his character in breaking from all his surroundings. In the long run this break brought him to Hobart. It is a pathetic story. One is tempted here to parody Kipling:—

"How far is Hobart City from a Scottish lad at play!
What makes you want to wander there with all the world between?

Oh mother, call your son again, or else he'll run away."

But young Robert had no mother to call him back. She had died some years before, and so he ran away. How terrible must have been the mental strain and struggle for one so young and so strongly swayed by his affections to break away from his father and sister, and seek his fortunes in the great world beyond his ken!

By the sweat of his brow he earned his daily bread at Edinburgh, but still found time to read. He read poetry, science, fiction, and philosophy. Later he left Edinburgh to do manual work on a railway in the North of Scotland, interesting himself in the geological structure of the country as revealed in the cuttings. His good work won him the position of a ticket clerk, and later he became clerk at a Railway Goods Department, Glasgow. In 1870, at 25 years of age, he once more showed his enterprise, ambition, and tenacity of purpose by selling all his books, and most other belongings, and emigrating to Victoria. He was engaged as a clerk at Colac. While here, when the first railway line in Tasmania—that from Launceston to Deloraine—had been opened, he received the appointment of clerk in charge of the accountant's department, and soon afterwards was promoted to chief clerk in the Auditor-General's Office. In 1881 he was appointed to the newly-created office of Government Statistician and Registrar-General for Tasmania, a position which he held for 37 years until the time of his death.

Others can speak with authority on the great value of his numerous annual volumes of Tasmanian statistics, of the very important work he accomplished in unifying methods of presenting statistics, methods followed later by statisticians in various parts of Australia, on his contributions to economic questions relating to Labour and Capital, to the framing of the *per capita* scheme for the equitable distribution among the States of the Commonwealth (that was being initiated) of the surplus revenues derived from the collection of Customs and excise duties, and the successful advocacy of proportional representation. One who can speak with authority has already spoken of this already in terms of high praise that carry weight, Sir Elliott Lewis, and *laudari a laudatis viris summa laus.*

The above was his chief life work. It is specially his hobbies that claim the attention of his brother scientists.

When at Launceston he became the friend of Mr. Gunn after whom not a few Tasmanian plants have been named, and from him derived a taste for botany. Later he contributed five papers on the flora of Tasmania.

His extraordinary versatility and energy are shown by the fact that he also contributed eight papers on mollusca, sixteen upon fishes, and no less than 56 papers on geological subjects.

He was Royal Commissioner on Fisheries, and I am informed by no less an authority than Mr. C. Hedley, F.L.S., of the Australian Museum, Sydney, that Johnston's work on the fishes was of great value, and, particularly in view of the many limitations in those early days, was most meritorious. The great work which he published in 1888, "The Geology of Tasmania," with an account of the minerals and rocks of Tasmania, has laid a splendid foundation on which future generations may build, and his geological map of Tasmania is a masterpiece. There is, of course, much to be added to it, but little to alter in the main features. But in profiting by the wealth of information in his classic books and papers, one must not lose sight of the tremendous physical effort, hardship, and privation which he, with his stalwart comrades, endured in their quest of the unknown, a quest fraught with difficulties which might well have appalled all but the bravest of the brave. We know that in 1874, in company with the late J. A. Scott, W. C. Piguenit, Lieutenant Burgess, and two others, R. M. Johnston spent six weeks (all of the party laden with knapsacks weighing from 60 to 70lb.) in exploring the whole of the south-western highlands lying between the mouth of the Huon and Macquarie Harbour, and in making collections and observations on the geology and botany of that region.

In 1879 he formed one of a similar party in exploring the northern region of the western highlands, including Gad's Hill, Middlesex Plains, Vale of Belvoir, Valentine's Peak, Mount Bischoff, the headwaters of the Mackintosh Valley, and other tributaries of the Pieman and Arthur Rivers.

Next, in the year 1887, in company with his friend, the late C. P. Sprent, Deputy Surveyor-General, and five others, he traversed on foot and examined the whole of the region lying near to the route across the island by way of the

Ouse, Bronte, Lake St. Clair, Mount King William I., Mount Arrowsmith, Collingwood Valley, King River, Mount Lyell, Queen River, and Macquarie Harbour, thence northward across the Henty, Mount Heemskirk, Corinna, Whyte and Heazlewood Rivers, Magnet Range, and Mount Bischoff, to Emu Bay on the North-West Coast. Only those who have experienced them can realise what terrible barriers to progress are the native scrubs, the "horizontal," the *Bauera*, and the myrtle scrubs, not to mention the dense masses of fern, rotten sassafras, logs, etc., and the swiftly rushing and swollen streams to be crossed, by the slow and tedious process of felling trees to span the rivers. All this would be most trying to the most vigorous and unencumbered of men, but how Johnston and his colleagues and their hardy predecessors wet, cold, weary, and half famished, fought their way through these almost insurmountable obstacles, each with his 60 to 70lb. weight of pack, involved efforts almost superhuman.

We who have entered into their labours and follow now so easily and swiftly in train or car where they so slowly and painfully, but so surely, blazed the trail, must not forget the hardy heroic pioneers who marched ahead of the army of occupation. Who were these heroes? Men such as he who was such an early inspiration to science in this country, the heroic sailor soul, Sir John Franklin, and it should not be forgotten that in his desperate march through scrub and jungle to Port Davey Lady Franklin went with him and shared his hardships; men such as Charles Gould, C. P. Sprent, J. A. Scott, W. C. Piguenit, Lieutenant Burgess, and many another, and last, and not least, the man we to-night specially delight to honour, R. M. Johnston.

And while we honour these leaders among men, let us not forget the pioneer work of the rank and file, that goodly fellowship of prospectors and pathfinders, many of whom perished lonely and unsung. Surely not the least honour is due to the memory of these unknown warriors.

The spirit of these men lives yet, in young explorers of Tasmania to-day, as testified by the recent fine journeys made under the leadership of Major L. F. Giblin and A. V. Giblin, which have led to the conquest of Mount Anne. As one who may be permitted to claim to have attempted some pioneering work in another field, I would offer here a humble and heartfelt tribute to the pioneers of Tasmania, and foremost among them to my old comrade, R. M. Johnston.

PART II.

GEOLOGICAL EVIDENCE OF THE ANTIQUITY OF MAN IN THE COMMONWEALTH, WITH SPECIAL REFERENCE TO THE TASMANIAN ABORIGINES.

One now passes to notes on the special research "Evi-"dence of the Antiquity of Man in the Commonwealth, with "special reference to the Tasmanian aborigines."

This subject would not seem inappropriate to this memorial lecture, as Johnston was no mean authority on the Tasmanian aborigines and their implements, and, moreover, their ancient history, as will presently appear, was intimately linked up with phases of the great ice age through which Tasmania has passed many thousands of years ago, and evidence of the former presence of glaciers and ice sheets in Tasmania was a favourite subject of research for R. M. Johnston. One of his chief scientific papers is wholly devoted to this subject.

Before proceeding to consider the age of the first coming of man into Tasmania and Australia, we must briefly review some time scale, to which we can refer the evidence, a scale which has been made after much toil of many workers in the Northern Hemisphere.

This scale depends on phases of what is known as the Pleistocene Ice age. It is now generally recognised that there were four glaciations, separated from one another by three mild inter-glacial phases.

1. Time Scale Supplied by Pleistocene Glacial Epochs.

a. In the Northern Hemisphere. (24)

These four glacial phases, with their inter-glacial phases, were approximately as follows:—

Post-glacial Time, about 7,000 years, that is, about 5,000 B.C., to present

Würm or Wisconsin Ice Age, 5,000 B.C. to 15,000 B.C. (possibly 50,000 B.C.).

Dürntenian or Sangamon, mild epoch, 15,000 B.C. to 60,000 B.C.

Riss or Illinoian Glaciation, 60,000 B.C. to 80,000 B.C. (possibly 150,000 to 180,000 B.C.).

Helvetian, or Yarmouth, or Tyrolian, mild epoch, 80,000 B.C. to 250,000 B.C. (possibly 180,000 to 350,000 B.C.).

The Mindel or Kansan Glaciation, 250,000 B.C. to 280,000 B.C. (possibly 360,000 to 400,000 B.C.).

Norfolkian, Aftonian, or Cromer, mild epoch, 280,000 B.C. to 350,000 B.C. (possibly 400,000 to 470,000 B.C.).

Günz Glaciation, 350,000 B.C. to 380,000 B.C. (possibly 470,000 to 500,000 B.C.).

The estimates for the last mentioned phases of glaciation, such as the Günz and the Mindel, are necessarily only very approximate. The age of the Günz glaciation, for example, may have been as far back as fully 500,000 years ago.

b. In Tasmania.

In Tasmania there have been many workers who have recorded evidences of the great Pleistocene glaciation of this island, notably R. M. Johnston, C. Gould, C. P. Sprent, T. B. Moore, M. E. J. Dunn, A. Montgomery, Graham Officer, Lewis Balfour, E. G. Hogg, W. H. Twelvetrees, L. K. Ward, Professor J. W. Gregory, Dr. F. Noetling, Dr. W. N. Benson, Professor T. Griffith Taylor, Dr. Loftus Hills, Mr. Mackintosh Reid, and Mr. Arndell Lewis. Professor J. W. Gregory has also given a special account of the area near Queenstown and Mount Lyell, Q.J.G.S. He concludes that the glacier ice in the Linda Valley, near Gormanston, and near Queenstown, came down to within about 900 to 1,100 feet of sea level. Professor W. N. Benson has described in detail the Cradle Mountain area, and concludes his valuable paper with a full bibliography of Tasmanian Pleistocene glacial literature. (1) Professor Griffith Taylor and Mr. Arndell Lewis agree that there are evidences of at least two, if not three, glacial invasions of Tasmania during Pleistocene times. The earliest apparent one "was by far the most considerable, "and was followed by two later phases." This earlier glaciation developed an ice sheet, which actually came down to sea level at Port Davey, extended to below 1,000 feet above sea level, in the neighbourhood of Gormanston and Queenstown, and came down to within 100 feet or less of sea level between the mouth of the Henty River and the Eden Valley. Recent observations by Dr. Loftus Hills and the writer have fully confirmed Mr. T. B. Moore's statement as to the downward limit of the Pleistocene ice sheets, when at their maximum development, in that part of Tasmania. So extensive was this glaciation that fully a third of Tasmania was under a more or less continuous ice sheet, with points like Barn

Bluff, Cradle Mountain, Mt. Pelion, etc., showing as nunatakr. "Outwash apron gravels" deposited by the thaw waters of surface or subglacial streams now cover low-lying strips around Macquarie Harbour, and thence northwards to beyond the mouth of the Henty River. These outwash gravels are separated from one another by deposits of peaty sand and peat. They have previously been described as raised beaches, but the writer would point out that while there is evidence there, as in most parts of Tasmania and Australia, of a raised beach up to 15 feet above high water, accompanied by the presence of marine shells, no trace of post-Tertiary marine shells, as far as the writer is aware, has ever been found in Tasmania at a higher altitude than about 15 feet above high water. The great shingle terraces, on the other hand, in the neighbourhood of Kelly's Basin, Macquarie Harbour, and to the east of Strahan, attain altitudes of from 200 up to over 240 feet above sea level. Close to Strahan railway station the following section was measured by the writer at the lowest terrace there:—

1ft. 3in.	Peaty sand.
6in. to 9in.	Loose grey sand.
2ft. 0in.	Peaty sand. A few pebbles near the top.
2ft. 0in.	Shingle with pebbles mostly 3 to 4 inches in diameter, resting on an eroded surface of peaty shale.
3ft. 0in.	Laminated hard peaty shale, emitting a slightly woody ring when struck.
33ft. 6in.	Mostly coarse shingle, pebbles from 1 inch up to 1 foot in diameter, oval and well rolled. In the lowest 5 to 6 feet of this bed there are numerous disrupted fragments of carbonaceous shale, belonging apparently to slightly older post-Tertiary or late Tertiary formation. These disrupted fragments are on a line of strong erosion.
18ft. 0in.	Sandy clay, carbonaceous, passing almost into peat in places, but the top 5 feet is mostly sandy, weathering yellowish grey. This extends down to sea level.
Total 60ft. 3in.	

There are many hundreds of feet in thickness of soft sandstones and clays below the lowest bed of shingle, but they appear to be pre-glacial.

Mr. Arndell Lewis would ascribe such outwash gravels to the maximum Pleistocene ice-sheet of approximately Riss or Mindel age. Mr. Arndell Lewis appears tentatively to hold the view that the lowest evidence of glaciation in the Broad River Valley at National Park is of about the same age as the outwash gravels of Strahan. Such glaciation at National Park would be approximately at its lower limit about 2,000 feet above sea level, possibly as high as 2,400 feet.

Recently Dr. Loftus Hills has observed evidences of glaciation at Mount Victoria, between St. Helens and Scottsdale, at an altitude of about from 3,964 feet (which is given as the altitude of the summit) for several hundreds of feet downwards.

The question of Pleistocene glaciation and its age in this north-east part of Tasmania is of special importance in regard to a very important piece of evidence about to be detailed presently, by far the oldest as yet recorded on the subject of the antiquity of aboriginal man in Tasmania.

In this part of the island there are widespread sheets of shingle and gravel, with peaty beds intercalated, which have been worked extensively for stream tin between Herrick and Boobyalla. At the Pioneer Mine, to the north of Herrick, these strata attain a thickness of at least 80 feet; they are up to 68 feet in thickness at the Scotia Mine, one mile to the north-west of Gladstone. At the old Doone Mine, about a mile west of the Scotia, the drift was about 15 to 25 feet thick. The drift apparently dips below sea level towards the coast below Boobyalla. It appears to the writer that this old peaty granite sand drift, which the late W. H. Twelvetrees suggested tentatively (35) was raised beach material, is in reality, in view of later evidence now available, outwash apron material, analogous to that of Strahan. In this case it would have been formed by the thaw waters of the last great ice sheet, at newest the Würm ice sheet, dating back to about 17,000 years ago. If this supposition is correct, the deposit would have been laid down by extensive floods coming from the head of the Ringarooma Valley and its numerous tributaries, at a time when Mount Victoria was under ice and the lower spurs of the adjacent ranges supported extensive nevée fields.

An attempt has been made in the table given in the summary of this paper on pages 130, 131, to supply a provisional scheme to show the probable approximate relative ages of the evidences of the presence of early man in Tasmania and Australia. This table is very tentative, and the dates, of course, very approximately assigned, may be much in error, but it is believed, nevertheless, that they are a reasonable approximation. We may now proceed to consider the details with regard to the antiquity of man within the Commonwealth, commencing with Tasmania, and then passing on to Australia. No attempt is made to put forward any case for man having a geological antiquity in New Guinea. Evidence, in the writer's opinion, will be forthcoming later to prove that his first coming into New Guinea dates a long way back into the past.

2. Evidence of the Antiquity of Man.

A. In Tasmania.

i. Geological and Geographical.

- a. Occurrence of aboriginal chalcedonic flake in fluvio-glacial (?) compact drift at the Doone Mine, near Gladstone, North-East Tasmania.
- b. Occurrence of aboriginal chipped pebbles and stone cores at Regatta Point, on right bank of Tamar River, one mile north of Launceston. Numerous specimens of this type were found by the writer last February in the consolidated shingle of a slightly raised beach (3-4 feet above high water).
- c. Occurrence of very numerous aboriginal cherty flakes and other implements in what appears to be an old natural shore-line of the so-called Lake Leake, now an artificial reservoir, 15 miles east of Campbell Town.

ii. Antiquity deduced from distribution of implements.

- a. Wide area over which stone implements are found in Tasmania, and the vast number of such implements.
- b. The thickness and extent of the aboriginal kitchen middens.

iii. Cultural evidence.

- a. Palæolithic or Eolithic stage of culture of the Tasmanian aborigines.

b. Ignorance of making sea-going canoes. This implies that they must have crossed the Bass Strait area at a time when Tasmania was a peninsula of Australia.

iv. Anatomical evidence.

a. Alliance of Tasmanians to the primitive negrito races.
b. Archaic type of their dentition.
c. The Tasmanian a true *homo*, and probably newer than *Pithecanthropus* of Bengawan, Java, or *Eoanthropus dawsoni*, of Piltdown, Sussex.
d. Tasmanian aboriginal, though for long an inhabitant of a cool temperate climate like Tasmania, does not exhibit any tendency towards a whitening of his skin, which appears to have maintained throughout its original blackness.

v. Associated fauna.

a. In this respect the entire absence of the dingo from any human remains in Tasmania corroborates the evidence suggested by the Tasmanian aboriginals' ignorance of the art of making sea-going canoes, that he arrived in Tasmania by a land bridge before the dingo was imported into Australia by the early Australian aboriginal.
b. Evidence is not yet to hand that the Tasmanian aboriginal was contemporaneous with extinct animals such as the marsupial rhinoceros (*Nototherium mitchelli*, *N. tasmanicum*, etc.), and yet the peaty deposits of Mowbray Swamp, near Smithton, appear to belong to an age at least as new as the stream tin deposits of the Gladstone district, in which a human-worked flake has been found. Moreover, Messrs. H. H. Scott and Clive E. Lord describe the femur of the calf of a *Nototherium* from the above swamp which has been damaged by some sharp-cutting tooth or instrument, possibly either the carnassial tooth of a *Thylacoleo* or an aboriginal hache. (20)

We may now review these evidences in detail. In regard to i.a., the late Mr. W. H. Twelvetrees has described this occurrence (Roy. Soc. Tas. Papers and Proceedings, 1916, pp. 48-50, pl. 5). The flake is formed of chalcedony, which, after being struck off by a single blow, has been dressed on one side and retouched later on the same side so as to give a number of small saw-like teeth to the cutting edge, which was evidently used for smoothing down or sharpening spears. Mr. W. H. Twelvetrees submitted the flake, just after its discovery, to the late Mr. R. M. Johnston, who had an exceptionally wide experience in the matter of Tasmanian stone implements. Mr. Johnston was absolutely convinced at once, as indeed anyone must be with any knowledge of the subject, that the flake was of human workmanship. This flake is illustrated on Plate VIII.

It was found at the old Doone Mine, about three miles north-westerly from Gladstone, and under an overburden of about 10 feet of very firmly compacted drift. This drift was formed of granite sand, with a certain amount of interstitial clayey peat. Mr. Twelvetrees was of opinion that the whole deposit was of marine origin. In view of later sections and discoveries, the writer cannot entertain this view, and holds, as the result of a personal examination of the scene of the discovery, and of similar deposits in other parts of Tasmania, that the deposit is to be correlated, as regards origin, though younger in time, with the "out-wash "apron" deposits of Strahan, on the west coast of Tasmania. These consist of gravel with peaty sands, peaty clays, and peat, and lie on the seaward side of the great terminal moraine between Eden and the Henty River, which marks the maximum advance of the old Pleistocene ice-sheet in Tasmania as far as present evidence goes. Certainly the deposit at Gladstone is very wide spread, and at the Pioneer Mine, a few miles to the south, it is over 80 feet in thickness. Obviously, since the deposit was laid down, the Ringarooma River had deepened its channel by at least 60 feet, as shown on the section, Pl. IX. The river did not occupy its present channel, in Mr. Twelvetrees' opinion (in which the writer concurs), at the time when the drift was deposited at the Doone Mine.

The flake was found by Messrs. Richards and Murray at the time when Mr. Richards was using the hydraulic nozzle to wash away the overburden from above the tin gravel. The latter is there about 2½ to 4 feet thick. Mr. Richards had been requested by Mr. Twelvetrees, a day or two before, to be on the look out for possible traces of sea shells in the deposit. Richards's attention was attracted suddenly by the unusual object of this chipped flake, which

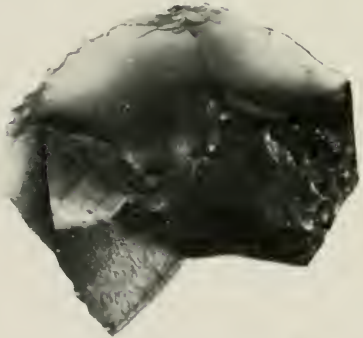


Fig. 1. Obverse (x 1½).

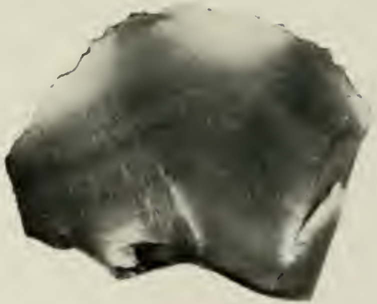


Fig. 2. Reverse (x 1½).

Figs. 1 and 2. Aboriginal chalcedonic flake, found *in situ* at 10ft. below the surface in consolidated fluvio-glacial (?) drift immediately overlying stream tin gravel, Doone Mine, 2½ miles N.W. of Gladstone, N.E. Tasmania.

he thought to be a shell, just exposed to view by the water jet. He immediately went forward, and picked it out of its matrix, to which it was slightly adherent. In doing so, a small piece fell off. This has not been preserved. He called to Mr. H. Harvey, the Government inspector of the Mount Cameron water race, who was close by in the mine at the time, and who informed the writer (last February) that, on hurrying to the spot, he carefully examined the site from which the flake had been picked by Mr. Richards, and distinctly recalled the fact that he noticed at the time of the discovery that there was a well marked impression in the old drift, into which the flake exactly fitted, and from which it had been lifted out by Mr. Richards.

Mr. Murray, a son of a late Government Geologist of Victoria, Reginald Murray, and a partner of Mr. Richards, quite confirms the account originally given by Mr. Richards to Mr. Twelvetrees, and also that now given by Mr. Harvey. They all agree that there is not the slightest possibility of the flake having fallen from above and having been driven by the water from the hydraulic nozzle into the compact drift. The extreme freshness of the chalcedony considered as a mineral specimen (that is, the remarkable absence of weathering) made the writer seriously consider at first the possibility of the flake having been artificially injected, in the manner indicated above, into the drift overlying the stream tin, but he is quite satisfied that some other explanation must be found for its extraordinarily fresh state of preservation. He thinks it is to be attributed to the interstitial peaty clay in the sand having stopped all water circulation and also prevented contact with the air, and so checked weathering. At the same time, the "retouching" on the edges of the flake suggests to him a more modern phase of artefact evolution than that indicated by the specimens about to be described, from a more recent deposit.

The following is a general section at the old Doone Mine southwards to the present channel of the Ringarooma River:—

Surface level, about 100 feet above sea.

6in.	Peaty humus covered with grass
6in.	Grey sand.
6in.	Peaty sand.
4in.	Grey sand.
10in.	Hard ochreous sandy silt.

6ft 0in.	Dark grey fine sandy silt, compact and dark grey, through peaty material. This rests on a slightly eroded surface.
4ft 0in.	Gritty, pebbly sand rock; the aboriginal chalcedonic flake occurred in this layer, immediately overlying the stream tin gravel below.
8ft. to 12ft. 0in. in places thinning to 3ft.	Gravelly consolidated drift, with stream tin and well rolled pebbles of quartz and slate from 1 inch to 3 inches in diameter, and sub-angular reef quartz up to 6 inches in diameter; pot-holes of shingle occur in places about 3 feet in depth. The lower part of this drift yields stream tin at the rate of from 1 to 1½lb. per cubic yard.
	Floor under stream-tin drift fine-grained, greenish felspathic quartzite; dips W. 18 deg. S. at 18 deg. The age of these sedimentary rocks is assumed to be Cambro-Silurian.

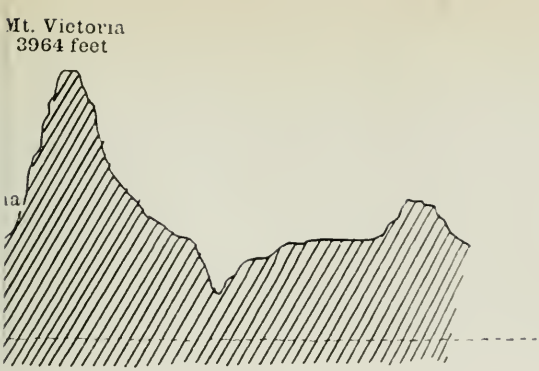
The undulating, but on the whole flattish, floor, on which the drift reposes, is just about 65 feet above the Ringarooma River and 85 feet above sea-level.

At the time these wide-spread gravels and sands were being deposited, the Ringarooma River could not have occupied its present channel, which is about a quarter of a mile to the south, and which has subsequently been deepened in hard rock (partly felspathic quartzite, partly of granite) by about 65 feet. At the rate of erosion determined by C. C. Brittlebank for the Bacchus Marsh district of Victoria, such a work of erosion might have been done by a river like the Ringarooma in a period of time of the order of 100,000 years.

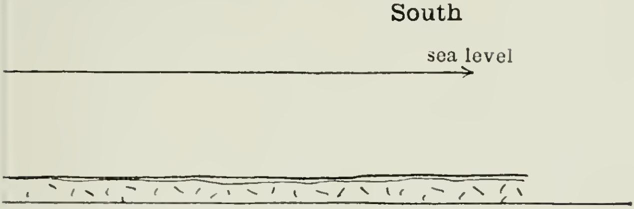
This would surely be older than the Würm glaciation, and would more nearly correspond with that of the Riss.

If, therefore, this flake was really *in situ*, as seems practically certain, it would put back the coming of man into Tasmania into perhaps the time of the Riss glaciation. At the same time, if the early part of the Würm glaciation dates back, as some think, to 50,000 years ago, the excavation of the present Ringarooma valley out of the

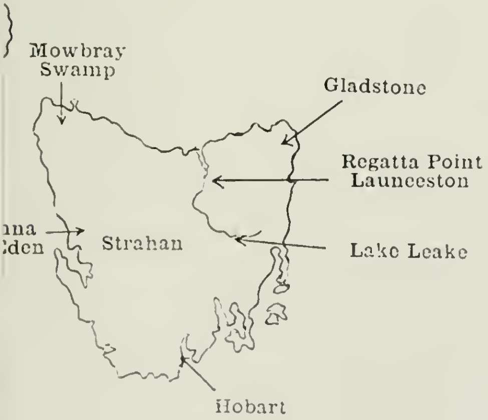
Plate IX.



e found at the Doone Mine at
feet below surface.



ing Island



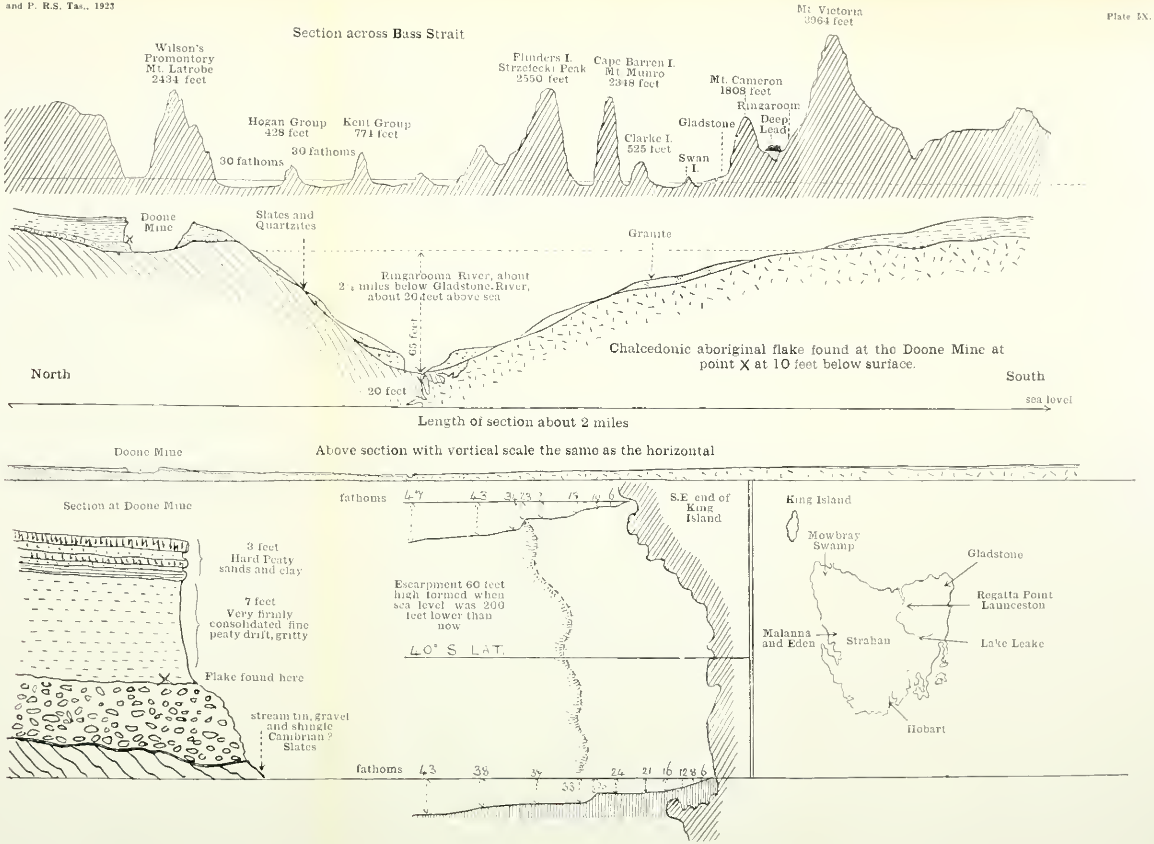

Section across Bass Strait
Wilson's Promontory Mt. Latrobe 2434 feet
Hogan Group 428 feet
Kent Group 771 feet
30 fathoms
30 fathoms
Flinders I. Strzelecki Peak 2550 feet
Cape Barren I. Mt Munro 2348 feet
Clarke I. 525 feet
Swan I.
Gladstone
Mt. Cameron 1808 feet
Ringaroom Deep Lead
Mt Victoria 3964 feet
Doone Mine
Slates and Quartzites
Granite
Ringarooma River, about 2½ miles below Gladstone-River, about 20 feet above sea
65 feet
20 feet
North
South
Chalcedonic aboriginal flake found at the Doone Mine at point X at 10 feet below surface.
sea level
Length of section about 2 miles
Doone Mine
Above section with vertical scale the same as the horizontal
Section at Doone Mine
3 feet Hard Peaty sands and clay
7 feet Very firmly consolidated fine peaty drift, gritty
Flake found here
stream tin, gravel and shingle
Cambrian? Slates
fathoms 47 43 34 23 13 6
S.E end of King Island
Escarpment 60 feet high formed when sea level was 200 feet lower than now
40° S LAT.
fathoms 43 38 34 33 24 21 16 12 8 6
King Island
Mowbray Swamp
Gladstone
Regatta Point Launceston
Malanna and Eden
Strahan
Lake Leake
Hobart

Fig. 1.

Fig. 2.

ARTEFACTS ("TRONATTA") OF PRE-HISTORIC TASMANIAN ABORIGINES.

Fig. 1. Pebble of Pre-Cambrian quartzite chipped by Tasmanian Aborigines to form a scraper. From 3-4 ft. raised beach at Regatta Point, one mile north of Launceston.

Fig. 2. Artefact formed of a pebble of subtranslucent greenish chalcedonic Pre-Cambrian quartzite, from 3-4 ft. raised beach, Regatta Point, Launceston. The artefact has been waterworn subsequent to being left on the beach.

outwash apron material and the undulating peneplain of hard rock on which it reposes, may very well have taken place in post-Würmian time.

Meanwhile this is the most important discovery up to date, as to the high geological antiquity of man within the Commonwealth.

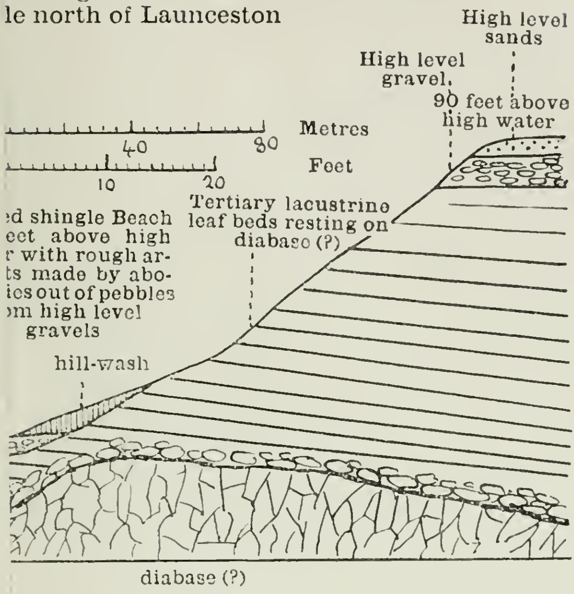
i.b. Last February the writer discovered at Regatta Point, one mile north of Launceston, on the east bank of the Tamar River, a large number (altogether about 100) of specimens of very roughly chipped implements formed out of pebbles embedded in the loosely cemented conglomerate of an old raised beach. So rudely fashioned were some of these implements that at first he doubted whether they were necessarily of human workmanship. The occurrence of these sharp-edged flaked stones alongside of well rolled shingle attracted attention as an anomaly in sedimentation requiring explanation. Eventually he discovered *in situ* a roughly chipped somewhat water-worn implement of subtranslucent chalcedonic quartzite, most obviously of human workmanship. At least 30 definite blows had been struck in order to fashion the implement into its present form. (See fig. 2 of Pl. X.) Unfortunately the original has been temporarily mislaid.

This raised beach is about 4-5 feet thick, and extends to at least 2-3 feet above high water spring tide, and is further covered by an overburden of about 8 feet of talus from the hill slope. The raised beach material is a ferruginous gravel, loosely cemented. The raised beach rests on Tertiary lacustrine leaf beds, perhaps of Miocene or Pliocene age. The raised beach belongs to the period, in the opinion of the writer, of a higher sea-stand, when sea level was perhaps 3-5 feet above what it is now. The maximum sea level of this epoch within the area of the Commonwealth averaged about 15 feet above present sea level, and dated back to a time suggested by R. A. Daly to be about 7,000 years ago. From this an age of perhaps 1,500 to 2,000 years may be deduced for this raised beach on the assumption that the decline in sea level took place at a uniform rate from 7,000 years ago down to the present time. The aborigines preferred a hard laminated pre-Cambrian quartzite for making their rough scrapers there. These were obtained from pebbles, in a gravel bed 8 feet thick and 85 to 110 feet above high water immediately above (to the east) the raised beach. A few scrapers are made of diabase. These are rotted, through weathering, to a depth of from 1/16th to 1/10th of an inch. The writer thinks it would take over 1,000 years for diabase to weather to this extent. Many of the "cores" show discoloration due to the action of fire, which was evidently used to cause the pebbles to exfoliate in curved flakes.

More search in this area is much to be desired, as it might reveal an early stage in the evolution of the fashioning of stone implements by the Tasmanian aborigines. Only one implement formed of chert was found, among the 100 collected, at Regatta Point.

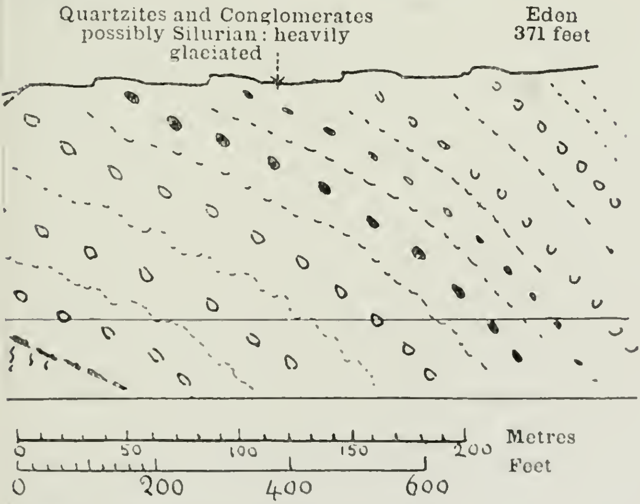
i.c. At Lake Leake last February the writer found over 100 specimens of stone implements of the Tasmanian aborigines in what appears to be the beach of an old lake before it became naturally drained. The site of the old lake has now been used as a reservoir so that the water level, as the result of the damming of the valley forming the present outlet of the reservoir, has now risen about 10 feet, to that of the small terrace where the implements were found. The writer takes this slight terrace to be a relic of an old shore line. It may be mentioned that under two miles to the south-east there is an aboriginal stone quarry, where large numbers of these implements were fashioned, all made from cherts. These cherts were formed by the alteration of Jurassic clay shales along their plane of contact with masses of intrusive diabase. The author would not press for this last piece of evidence proving any special geological antiquity for the "tronattas," but thinks it should be recorded, as the area is worthy of further investigation. Evidence i.b. conclusively proves geological antiquity to be something of the order of perhaps 1,500 years, for within the last 100 years no appreciable alteration has been observed in sea-level anywhere around the shores of Australia or Tasmania. i.a. can prove a far higher geological antiquity for man if the "outwash" apron material dates back to the Riss Pleistocene ice sheet. The locking up of so much ice to form the great Riss ice sheets might have lowered sea level all over the world to the extent of about 200 feet. The levels of the old valley gravels at the Tamar and Mersey Rivers, together with the submerged terraces at about 35 fathoms to the west of King Island, point to the sea level having been lowered in late geological time to the extent of about 200 feet, and to have paused long enough at this low level to enable it to cut back a terrace over 50 feet in

ɔrth, showing occurrence of rough arte-
aborigines in small raised beach at Re-
le north of Launceston



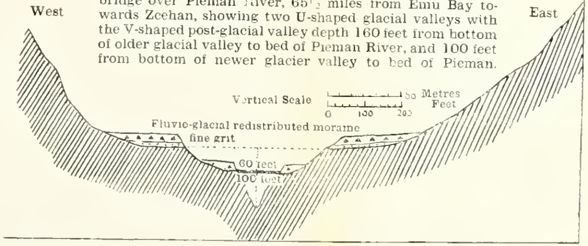
; the terminal moraine marking
ɪron" ("schotter") gravels.

East

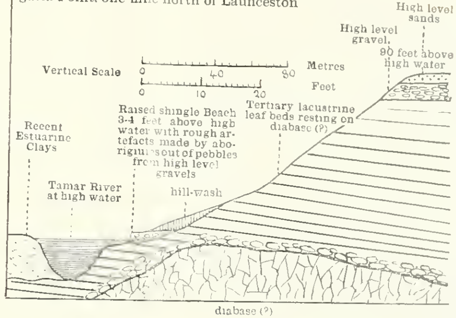


tocene ice sheet with a thickness of

Section, looking north, at Emu Bay Railway Company's bridge over Pieman River, 65½ miles from Emu Bay towards Zeehan, showing two U-shaped glacial valleys with the V-shaped post-glacial valley depth 160 feet from bottom of older glacial valley to bed of Pieman River, and 100 feet from bottom of newer glacier valley to bed of Pieman.



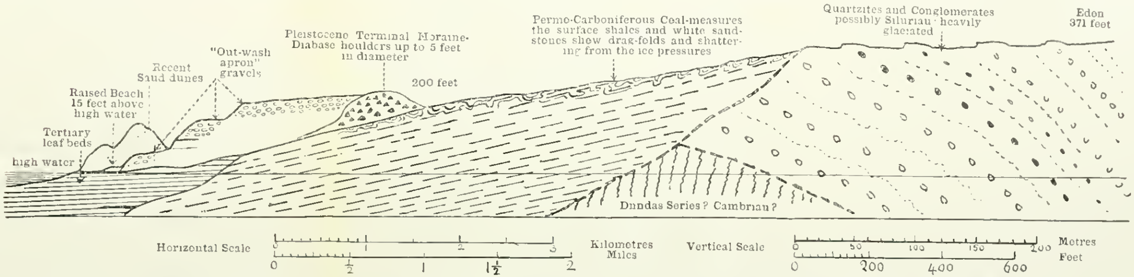
Section, looking north, showing occurrence of rough artefacts of Tasmanian aborigines in small raised beach at Regatta Point, one mile north of Launceston



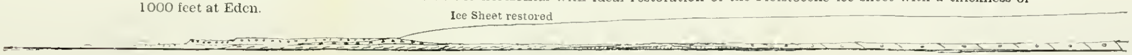
West

Section 7 miles in length, from W. Coast of Tasmania, near mouth of Henty River, to Eden, showing the terminal moraine marking former maximum extension of the Pleistocene ice sheet, near Malanna, together with the "outwash-apron" ("schotter") gravels.

East



Above section with vertical scale the same as the horizontal with ideal restoration of the Pleistocene ice sheet with a thickness of 1000 feet at Eden.



height. The sea would in this case have completely retreated from Bass Strait and Torres Strait, and would have laid bare the bulk of the great Sahul shoal, or bank, and so have admitted of aboriginal Tasmanians migrating more or less dry-shod over the greater portions of the long road from their possible early home in the Malay Peninsula or Netherlands East Indies to Tasmania. The coming of aboriginal man into Tasmania may date back, on the above supposition, to a time of the order of 100,000, or more, years ago.

ii. Distribution and Number.

a. Of Stone Implements.

The stone implements of the aborigines, chiefly of the nature of scrapers for fashioning spears and throwing sticks and notching trees for climbing, are very widely distributed not only around the coast of Tasmania, but inland, particularly in the neighbourhood of the great lakes, such as the Great Lake, Lake St. Clair, etc. Some idea of the numbers may be formed from the fact that the writer last February, as the result of a quarter of an hour's search, picked up about 100 aboriginal chert flakes, almost all of which had been used as scrapers, near the present outlet of the Lake Leake Reservoir. These "tronattas" are strikingly like those found on the horizon of the remains of Piltdown man in Sussex.

b. Based on the Extent and Thickness of the Kitchen-Middens Along the Coast.

Some of the largest of these shell-mounds are to be found at Swanport, on the east coast of Tasmania. According to Mr. Clive Lord, one of these shell-mounds is no less than 10 feet deep in its highest part, and covers an area of several acres. The late Dr. Fritz Noetling attempted to estimate the approximate date of the coming of the first aborigines into Tasmania by the amount of material now to be found in the shell-mounds considered in relation to the average aboriginal population of Tasmania in the past. (1).

The aboriginal population of Tasmania is estimated at 2,000 in 1803. This population, he estimates, would consume shells of oysters, mutton fish (*Haliotis*), *Turbo*, etc., at the rate of about 120 cubic feet a year each. That would be

(1) Proc. Roy. Soc. Tasmania for 1910, pages 231-264. Plates I and II. The Antiquity of Man in Tasmania.

240,000 cubic feet a year, for the average rate of growth of the shell-mounds for a population of 2,000 aborigines. In 5,000 years the shell-mounds would have a capacity of no less than 1,200,000,000 of cubic feet. This would cover a tract of land about half a mile in width and ten miles in length, with kitchen midden to a depth of about 9 feet. Dr. Noetling concludes from this that, as this amount is probably in excess of the aggregate of all the shell material in all the kitchen middens of Tasmania, the first arrival of the Tasmanian aborigines may not have dated back more than 5,000 years from the present. That this is an underestimate would appear from the following:—

Firstly. The aborigines did not subsist on shell-fish alone, but partly on animal and plant food.

Secondly. For some considerable period of time after the coming of the first few individuals into Tasmania the population may have been considerably under 2,000.

Thirdly. The existing kitchen middens have been much reduced through various weathering processes, which have partly dissolved the shells, partly removed them by the mechanical agency of wind, water-floods, waves, etc.

Fourthly. A very important consideration is that as it is highly probable that the first coming into Tasmania of the aborigines took place during a low sea level, coinciding with one of the later Pleistocene glacial phases, the kitchen middens of that age, when sea level was some hundred to two hundred feet lower than it is now, have long since been completely submerged. If the home of the Tasmanian aboriginal was originally somewhere near the Malay Peninsula, some thousands of miles in length of shoreline, with intermittent shell-mounds, have been submerged along this assumed early road of migration. The estimate, therefore, of the date of the first arrival of the Tasmanian aborigines may have to be increased by many times the 5,000 years suggested by Dr. Noetling.

iii. Cultural Evidence.

a. Palæolithic stage of culture of the Tasmanian aborigines.

The Tasmanian aborigines had no shield nor womerah nor boomerang, and had no knowledge of putting a cutting edge on their stone implements by grinding them down on another stone used as a hone stone. Their implements are distinctly of a Palæolithic type, strikingly like those of Piltdown man, but many of them show exquisitely fine finish by the method of re-touching, as proved by many fine specimens in the collections of the Tasmanian Museum, Hobart, as well as in those of Dr. W. L. Crowther, some of the best of which were collected near Ross and Oatlands. Their implements mostly show concave surfaces, evidently used for spokeshaving their spears and shaping their throwing sticks. These throwing sticks (Lughrana) had an effective range up to about 40 yards, and their spears (Perenna) up to about 60 yards. The latter, hardened at the point by fire, would go through the body of a man at a range of 60 yards. The club, waddy, or throwing stick was about 2 feet long, notched or roughened at one end to give a grip; sometimes knobbed at the other end. None of their stone implements was ever hafted. Occasionally in the kitchen middens may be found palettes of the nature of stone dishes, or shallow mortars, in which they ground their hæmatite for raddling their hair. They had no nets nor fish hooks, and do not appear to have eaten fish. The aboriginal women made neat baskets (Tughbrana), or "dilly-bags."

b. Tasmanian aborigines had no knowledge of making large dug-out canoes, or outrigger canoes, such as those used by the Australian aborigines from Hinchinbrook Island northwards to Cape York, or the large dug-out canoes, or the stringy-bark canoes used by the Australian aborigines from Carpentaria to west of Darwin. The canoes of the Tasmanian aborigines had a maximum length of 9 to 10 feet, a width of 3 feet, and a height of 1½ feet, with a depth inside of about 9 inches. They were practically three cigar-shaped bundles of bark tied together with grass string or strips of kangaroo skin so as to form a rough canoe or slightly hollowed float. They were propelled by poles whether in deep or in shallow water. Crude craft as these were, the aborigines nevertheless were able to cross in them from the mainland to Maatsuyker Island and Maria Island; the latter involved a voyage of about 3 miles. The Seri Indians in Sonora (California) in their "balsas" (30 feet long bundles of reeds lashed together) can even cross the Gulf of California in calm weather. This is from 50 to 100 miles in width. (31).

That the formation of Bass Strait, or, at any rate, the western part of it, in which King Island lies, must date back many thousands of years into the past, is suggested by the following consideration, among others:—

The marked differentiation of the Tasmanian emu and the King Island emu (respectively *Dromaius diemensis* and *D. péroni*) from the emu of the mainland, *D. novæ-hollandiæ*, surely demands a period of geological time to be estimated by more than just a few thousands of years, probably something more of the order of 20,000 to 50,000 years. It will be noticed that King Island would have been united to the mainland of Tasmania up to the latest date of the union of Tasmania with the Australian mainland, as the old eastern land bridge by way of Flinders Island and the King Island land bridge would both be restored if the ocean level were dropped by 30 fathoms.

iv. Anatomical and Physiological Evidence.

a. Alliance of Tasmanians to the primitive negrito races.

This matter will be discussed very briefly, the reader being referred to the works of reference by Professor Berry, Dr. S. A. Smith, etc., given in the Bibliography.

The Tasmanians living in the eastern half of the island were mostly of small stature, the average height of the men being 1661 millimetres=5ft. 5½in., that of the women 1503 mm.=4ft. 11¼in. The colour of their skin was rather more black than brown.

b. The mouth was big, and the teeth larger than those of any other existing race. They were ulotrichous. Cephalic index .75.

c. As regards a downward limit to the date of the Tasmanian aborigine, the fact must not be lost sight of that he was essentially *homo*, at all events, as far as relates to the types of him with which we are familiar. He had little special affinities with *Eoanthropus* or with *Pithecanthropus*.

d. Had the Tasmanian aboriginal been resident in a cool temperate climate like that of Tasmania for a vast period of geological time, one would have expected that the primitive blackness of his complexion, so characteristic of tropical peoples, would have shown some signs of passing into paler shades, such as light brown, or even white.

v. Associated Fauna.

a. It will be shown in the next division of this paper that the dingo at the Wellington Caves, in New South Wales, and elsewhere on the mainland, was contemporaneous with extinct marsupials, such as *Thylacoleo*, *Diprotodon*, etc.; also at the Wellington Caves, a human molar tooth was found, apparently *in situ*, in the cave breccia. There can be little doubt that the dingo was brought into Australia by the early emigrating Australian aboriginal. The dingo, therefore, on the mainland, dates back to at any rate late Pleistocene time. The Tasmanian aborigines had no knowledge whatever of the dingo, which evidently was blocked from getting into Tasmania through the flooding of the old isthmus joining Tasmania to the mainland, by the waters of Bass Strait having already become "un fait accompli" before the dingo reached the shore of south-eastern Victoria. If, therefore, the Australian aboriginal dates back to late Pleistocene time, the Tasmanian aboriginal must be relegated to an older period still. Incidentally, it may be remarked that the survival in Tasmania of *Thylacinus* and *Sarcophilus* is directly due, in the opinion of Sir Baldwin Spencer, to the absence from that island of the dingo. *Thylacinus* and *Sarcophilus* ranged over nearly the whole of Australia in late Pleistocene time, but have now become wholly extinct through having been exterminated by the dingo.

b. Reference has already been made to this consideration (b) on page 119, and the reader is referred to the paper by Messrs. H. H. Scott and Clive E. Lord. With the exception of the bones of the extinct emu, *Dromornis australis*, showing evidence of having been hacked by aboriginal implements, according to the Rev. J. E. Tenison Woods, no traces have been found so far of any marks left by aborigines on bones of extinct vertebrates, either in Australia or in Tasmania. The bones of extinct kangaroo now preserved in the Ballarat Museum, and stated to show tomahawk cuts, must be looked upon as doubtful evidence of the contemporaneity of man The observations of Heber Longman, Curator of the Brisbane Museum, show the clearest possible evidence of deeply-cut incisions made by the carnassial teeth of *Thylacoleo* on the bones of his herbivorous contemporaries. It is highly probable that careful search in the future may reveal the presence of some marks left by man on the skeletal remains of extinct marsupials or monotremes. This is a point to which the attention of future observers might well be directed.

TENTATIVE SUMMARY OF PLEISTOCENE AND RECENT DEPOSITS WITHIN THE COMMONWEALTH, SHOWING THE POSITIONS IN THE TIME SCALE OF EVIDENCES OF TASMANIAN AND AUSTRALIAN ABORIGINAL MAN.

Approximate Time in Years ago from Present.	Stage or Formation.	Geological Events.	Sediments.	Fauna and Flora.	Human Remains.
1,500-2,000 (?)		Subsidence of coastal block-faulted area, or eustatic negative movement of ocean? Newer Raised Beaches of Dry Creek near Adelaide, 11 feet above high water.	Sand dunes of Cape Otway, Peat beds of Coorong and Waukwine Range areas, South Australia, etc. Sands and clays. Uppermost beds of Delta deposits. Regatta Point, Launceston, raised beach, 3-5 feet.	*Ampullaria quoyana*, *Risella melanostoma*, *etc.*	Bone needles, stone tomahawks. Primitive types of stone scrapers.
6,000-7,000		Negative eustatic movement of ocean from 10 feet at King and Flinders Island, to 15 feet at W. Maitland, about the same at Townsville, and 23 feet near Fremantle. Seas warmer than now, for *Orbitolites complanata* has retreated equatorwards from Adelaide to Shark's Bay, where the sea water is 7 to 8 deg. Fahr. warmer than near Adelaide. Volcanic eruptions Mt. Gambier, South Australia, Tower Hill, Victoria. Possibly the crater of Lake Eachem, to the west of Cairns, Queensland, may belong to this epoch.	Basic lavas and tuffs. Terrestrial sands capped by fluviatile sediments followed in turn by marine estuarine shell beds.	*Arca trapezia*, *Orbitolites complanata*, *Mytilus menkeanus*, *Siphonalia maxima*.	Aboriginal clay basins and pounding stones at "Reedbeds" near Fulham, South Australia.
7,000 (?) to 12,000 (?)	Post-Würm Mountain glaciation	Deglaciation with rising sea-level. Glaciation of National Park, Tasmania, specially near the 4,000 feet contour, marked by high level tarns at Kosciusko, and moraines near Townsend's Pass, Kosciusko, 6,400-6,700 feet altitude.	Estuarine peat beds, sands, and clays of Shea's Creek, Botany Bay, near Sydney Slits of Lake Colungula, Victoria. Lacustrine clays and silts of Lake Callabonna, South Australia. Cuddie Springs, N.S.W. Wellington Cave Breccias, N.S.W.	Existing species of Mollusca. Remains of Dugong (*Halicore australis*). *Eucalyptus botryoides*, *E. resinifera*, *Banksia serrata* in the peat. *Thylacoleo*, Dingo. Diprotodon, *Genyornis*, Dingo. Diprotodon, Dingo. *Homo* (?)	Four well-ground stone tomahawks at depths varying from 7 feet to 11 feet below high water level. One human molar tooth.

17,000 to 20,000 (?)	Würm Glaciation.	Last severe glaciation of Tasmania. Lakes formed in National Park at the 3,200-3,500 feet altitudes. Glaciation of Blue Lake, Kosciusko, at altitude of 6,150 feet.	Possible "outwash apron" stream tin drifts of the Doone Mine near Gladstone, the Pioneer Mine near Herrick, Tasmania. Torrential gravels (newest) of eastern Gippsland.		Aboriginal chalcedonic flake at 10 feet below surface in firmly compacted "outwash apron" drift? This may belong to the Riss Glaciation. (See below.)
20,000 to possibly 150,000	Riss-Würm Inter-glacial (Durntenian or Sangamon mild epoch).	Erosion. Old U-shaped valley of Pieman River, Tasmania, deepened by V valley which from Riss time to present-day has been deepened 100 to 130 feet in hard rock. Wide flats of Ringarooma Valley between Pioneer Mine and Doone Mine near Gladstone excavated in hard rock from this down to present time to depth of 50-60 feet. U-shaped valley of Snowy River, Kosciusko, below Charlotte's Pass, deepened by V-shaped notch, in hard granite, about 30 feet deep, from this date to the present.	Mowbray Swamp peat deposits.	Trunks of Dicksonia and shells of recent Mollusca and remains of *Nototherium mitchelli* and *N. tasmanicum*, etc. Older portion of the Darling Downs Pleistocene Fauna, *Euryzygoma dunense*, Heber Longman, found at depth of 60 feet.	Talgai Skull of Dalrymple Creek near Warwick, Darling Downs, Queensland.
90,000 possibly to 150,000	Riss Glaciation.	Morainic material of National Park, Tasmania, at altitudes of 2,500 to 2,800 feet.			? Aboriginal chalcedonic flake from near Gladstone, at 10 feet below surface in "outwash apron" drift.
250,000 to possibly 400,000	Riss-Mindel Inter-glacial (mild epoch), Helvetian or Tyrolean or Yarmouth. Mindel Glaciation.	Maximum development of the Tasmanian Pleistocene Ice sheets, and the "calotte" ice of Mt. Kosciusko.	Great terminal moraine with rotted blocks of diabase, 2 feet through, between mouth of Henty River and Lower Eden Valley, Western Tasmania, near Malanna. Out-wash apron gravels of Strahan. Kosciusko-Snowy River moraines at 5,000 feet level.		

B. Evidence of the Antiquity of Aboriginal Man in Australia.

To whatever date the first coming of the Australian aborigines into Australia be assigned, it is obvious that the first arrival of the Tasmanian aborigines in Tasmania antedates it.

It is next important for our inquiry to review any evidence as to the geological antiquity of man in Australia.

Such evidence may be classed as:—

i. Legendary.

ii. Based on the age of the deposits in which remains of man or any of his artefacts, or other traces of his handywork, have been found.

iii. Based on anatomical structure of the human remains.

iv. Based on the age of the dingo on the assumption that the dingo was introduced into Australia by the early Australian aboriginal immigrants.

i. Legendary.

a. James Dawson states, "An intelligent aboriginal "distinctly remembers his grandfather speaking of "fire coming out of Bo'ok (a hill near the town of "Mortlake, in Victoria) when he was a young man."

b. Dawson also states that when volcanic bombs from the extinct volcano of Mt. Leura were shown to an aboriginal native of Colac, Victoria, the aboriginal said that "these were stones, which his forefathers "told him had been thrown out of the hill by the "action of fire."

c. Similar legends of aborigines having seen Mts. Franklin and Buninyong in eruption have been recorded.

Too much reliance cannot be placed on these statements, especially the former, as the aborigines may have been practically repeating what they had picked up earlier from some white people.

ii. Evidence based on the age of the deposits in which remains of man or of his artefacts or other traces of his handywork have been found.

a. Bennett has recorded the finding of grooves made by aborigines honing down or sharpening their tomahawks on sandstone surfaces 30 feet below the surface of the ground, the overlying material being the alluvium of the Hunter River, in the Maitland district, New South Wales.

In view of the rapidity with which the Hunter River changes its channel from time to time, as the result of floods, this evidence must be accepted with caution, as being quite inconclusive, unless supported by other evidence.

b. Gerard Krefft (7), (8), a former curator of the Australian Museum, Sydney, records the finding by himself of the "fractured crown of a human molar "tooth in the same matrix as *Diprotodon* and *Thyla-"coleo* at Wellington, in this colony" (the Wellington Caves of New South Wales).

Commenting on this remarkable discovery, Mr. R. Etheridge, jun. (7), concludes that this would be much the most important evidence up to date as to the geological antiquity of man in Australia, if it were certain that the molar had been found in the same mass of cave breccia as the remains of the extinct marsupials. There is still some of the red cave earth adherent to this tooth, which is preserved at the Australian Museum, but there is no trace of any adherent breccia. At the same time the statement of a scientist like Mr. Krefft, that he actually found the tooth in the breccia, must surely be accepted.

Mr. Etheridge has figured this tooth (*vide* Rec. Aust. Mus., XI., 2, p. 31, and Pl. 12, figs. 3-4, ' Exploration of Caves and Rivers of N.S.W." Parliamentary Paper 1882).

Important confirmatory evidence as to the tooth having been *in situ* in the breccia is supplied by the fact that teeth of dingo (*Canis dingo*) occur *in situ* in the bone breccia of the Wellington Caves, in association with bones of *Thylacoleo, Sarcophilus*, and *Diprotodon*. The value of this evidence rests, of course, on the assumption that the dingo was boated over to Australia by the early Australian aborigines (9).

c. Mr. James Bonwick (7) states, "at Ballarat, a basal-"tic stone weapon or tool-head, was unearthed in "in the process of gold-prospecting, 22 inches below "the surface, in a place which evidently had been "disturbed."

d. The late Rev. J. E. Tenison Woods states that bones of *Dromornis australis* have been found in South Australia, scraped and cut by aborigines. Unfortunately, no figure of these bones has been published, and the bones themselves cannot now be traced.

e. The late C. S. Wilkinson records that (39) in 1864 he found at a spot 2 miles east of the Cape Otway lighthouse, flint chips, and a sharpened stone tomahawk, and several bone needles. Mr. R. Etheridge, jun., has reported (6) that in 1865-66 he found a bone spike in beach material, formed of pebbles and broken shells, and apparently passing under the sand dunes. As the dunes near the scene of Mr. Wilkinson's discovery are 200 feet in height, it is assumed that the deposit is of some antiquity. In view, however, of the speed with which dunes come and go, this evidence seems inconclusive.

f. C. S. Wilkinson states (39) that "a stone hatchet has "been obtained on the Bodalla Estate, in the allu- "vium, at a depth of 14 feet." In the absence of details as to the rate at which this alluvium has accumulated, this evidence is of small value.

g. C. G. W. Officer describes the imprints of human feet and buttocks in the consolidated calcareous dune rock of Warrnambool. These are very possibly genuine human impressions, though some doubt this. In any case, they do not necessarily prove a high geological antiquity for man in that region (23).

h. Messrs. R. Etheridge, jun., T. W. Edgeworth David, and J. W. Grimshaw have placed on record (8) the finding of no less than four stone tomahawks at Shea's Creek, near Botany Bay, in the Sydney District.

In the same paper they describe and figure the remains of a dugong, the bones of which show conclusive evidence of having been hacked by aborigines. The top of the skeleton of the dugong was about 5 feet below mean high tide, and the base of the skeleton about 7 feet below. The skeleton was covered partly by peat, partly by estuarine clays. It is thought that sea level has risen by about 5 feet since the aborigines feasted on the dugong.

As regards the stone tomahawks, two were found at 11 feet below mean high water mark, in a sump hole, and are said to have been found in peat, or on the surface of the peat. Peaty beds were intersected there at various levels, the lowest bed occurring at 10 feet below low water. Numerous stumps of swamp mahogany (*Eucalyptus botryoides*), mahogany (*Eucalyptus resinifera*), honeysuckle (*Banksia serrata*), occurred *in situ* in the peat, representing a submerged forest. One of the banksia stumps at 10 feet below low water level, that is, at about 14 ft. below high water, showed clear evidence of having been burnt off at the top, while *in situ*. The roots were also charred. The burnt stump is not, in itself, conclusive evidence of the presence of man, as the fire may have been due to natural causes. In connection with this, it may be mentioned that in a bore put down by a geological party from the University of Sydney, with the assistance of Mr. G. H. Halligan, charcoal was found, obviously caused by a contemporaneous fire, at about 60 feet below sea level, near the southern end of the bridge over the Narrabeen Lagoon, about 7 miles north of Sydney Heads. Had only one stone tomahawk been found at Shea's Creek, at 10 feet below high water mark, it might have been argued that it was accidentally dropped overboard from a canoe, but the finding of no less than four between 7 and 11 feet below high water mark, taken in conjunction with the fact that the bones of the dugong, now buried to a depth of 7 feet below high water, under estuarine clays and peat, had been hacked by aborigines, is good proof that sea level in that locality has risen considerably to the extent of at least from 7 to 11 feet since the imbedding of the tomahawks. When it is considered that tidal observations in various harbours around Australia and Tasmania show no appreciable variation in sea level for the past fifty years, a variation of sea level, in so relatively stable an area as that of Botany Bay, of from 7 to 11 feet, probably indicates an antiquity of not less than a few thousand years.

i. Captain S. A. White (38) and Professor Walter Howchin (13) state that at the Reedbeds, near Fulham, South Australia, the sands and clays, on being excavated, revealed three aboriginal basins, formed of clay. With these "dipping basins" for holding water on the surface of the sand [as practised now at Kisimayu, on the East Coast of Africa (*f.* S.A. White)] were found six undoubted artefacts, mostly pounding stones, hammer stones, etc. This was at a depth of approximately 8 to 9 feet below high water. Therefore, there has been a positive movement of the sea there, or a negative movement of the land of at least 8½ feet since man made the clay "dipping basins." This evidence, so remarkably in accord with that of Shea's Creek, is suggestive of a eustatic positive movement of the ocean since the occupation of the Adelaide and Sydney areas by aboriginal man.

j. Mr. Walter Enright (5) has recently recorded the occurrence of an aboriginal tomahawk *in situ* at Font Hill, near West Maitland, at 11 feet below the surface. This was found in a bed of clay at the Maitland Colliery Shaft.

iii. Based on anatomical structure of the human remains.

The Talgai Skull.

The state of mineralisation of this skull would not, in itself, be a proof of high antiquity, inasmuch as Dalrymple Creek, near Talgai Station, where it was found, deposits a considerable amount of carbonate of lime in a relatively short space of time. But the dentition is considered to be distinctly archaic. The left canine of the upper jaw is not only unusually large, but is separated from the adjacent tooth by a diastema, and is strongly facetted on the side where the canine of the lower jaw slid past it in such a way as gradually to grind this facet. Such an interlocking of the canine teeth, so characteristic a feature in the Piltdown man (*Eoanthropus dawsoni*) of Sussex, is, of course, a special attribute of the anthropoid apes. It should here be mentioned that Professor Keith considers that this skull has affinities with those of the Tasmanian aborigines, but his opinion is not shared by other anthropologists and anatomists. If, therefore, this skull be that of an Australian aboriginal, a later immigrant than the Tasmanian, the first coming of the Tasmanian into Australia must have been still more remote in time.

iv. Based on the age of the dingo on the assumption that the dingo was introduced into Australia by the early Australian aboriginal immigrants. (9).

Remains of dingo (warrigal) have been recorded at the following:—

a. At a cave in basalt on Toolern-Toolern Creek, 5 miles S.E. of Gisborne, in Victoria, in 1857, C. D'Oyly, H. Alpin, with Dr. A. R. C. Selwyn, found perfect skulls of dingo, of the Devil of Tasmania (*Sarcophilus ursinus*), etc. (2).

b. At Lake Colungulac, near Camperdown, cranial remains of dingo, as well as remains of *Thylacoleo carnifex*, were figured by McCoy from the lake alluvial deposits. (3).

c. From alluvial deposits at Lake Timboon, Co. Heytesbury, Victoria, R. B. Smyth states that remains of *Canis dingo* were found with those of *Sarcophilus ursinus*, Harris, *Macropus titan*, Owen, and *M. atlas*, Owen, and of *Nototherium* and *Diprotodon*. (4).

d. Smyth also states (*op. cit.*, p. 149) that in sinking a well at Tower Hill volcano, near Warrnambool, after penetrating 63 feet of basaltic tuff, dried grass of an old land surface was struck, then blue and yellow clay, and at further depth of 60 feet, that is, 123 feet below the surface, the skull and bones of a dingo were found. Much doubt, however, exists as to the authenticity of this discovery, and the statement is now discredited.

e. The late Professor R. Tate states (5) that the Warrigal and *Diprotodon* "whose remains are found be- "neath the ashes of the Mt. Gambier volcano" were contemporaneous. This statement is also now seriously called in question.

f. Krefft (6) records the occurrence of the first two molars of the lower jaw of a dog in a cave breccia from Wellington, New South Wales, associated with remains of *Thylacinus*, *Sarcophilus*, and *Diprotodon*. Mr. R. Etheridge, jun. (7), verified the occurrence of teeth of *Canis* in the cave-breccia specimens from Wellington, in the collections at the Australian

(2) Selwyn, Q.J.G.S., XVI., 1860, p. 145.
McCoy, Ecol. Sur. Vict. Notes attached to Quarter Sheet, vii., N.W.
(3) McCoy, Prodromus Pal., Vict., Dec. vii., 1882, pp. 8 and 9.
(4) Smyth, Aborigines of Victoria, i., 1878, pp. 149-150.
(5) Trans. Phil. Soc. Adelaide, 1878-79 (1879), p. LXX.
(6) Geol. Mag. ii., 1865, p. 572.
(7) Mem. Geol. Sur. N.S.W., Ethnological Series, No. 2, p. 50.

Museum, Sydney. This evidence is important, as confirming that of the human molar tooth, already quoted.

g. Professor J. W. Gregory (8) records finding remains of *Canis dingo* associated with those of *Thylacinus*, in the N.E. part of the Lake Eyre region, on the Diamantina.

h. Professor Wood Jones (15) states that "the Dingo "falls into line with all the other races of domestic "dogs, in being of the true northern wolf type. "Moreover, in the large size of the carnassial teeth "he approaches nearer to the ancestral type than do "the other races of dogs of which I can obtain speci- "mens or records" (*op. cit.*, p. 258).

Wood Jones concludes that the Dingo, unaided by man, could never have crossed Wallace's Line (the Strait of Bali-Lombok), which is 15 miles in width, or other still wider straits separating Timor from the Sahul Bank, or the nearest other islands of the Netherlands East Indies from New Guinea. He summarises thus:—

"The progenitor of the Talgai man came with "his wife, he came with his dog, and with his dog's "wife, and he must have done the journey in a sea- "worthy boat, capable of traversing this unquiet part "of the ocean, with his considerable cargo. Be- "sides this living freight, and the food and water "necessary for the adventure, he carried other things "—he carried a knowledge of the boomerang, of the "basis of a totem system, and various other cultural "features, all bearing a strange suggestion of very "distinctly western origin" (*op. cit.*, p. 263).

All this evidence combines to show:—

1. That man in Australia was almost certainly contemporaneous:—

(a) with extinct marsupials such as *Diprotodon*, *Thylacoleo carnifex*, etc.

(b) With extinct birds such as *Dromornis australis*.

2. That the Dingo, or Warrigal (*Canis dingo*, or *Canis familiaris dingo*), was certainly contemporaneous with extinct marsupials in Australia, and that he was almost certainly introduced into Australia by aboriginal man.

(8) Dead Heart of Australia, pp. 78 and 152.

PART III.

SUMMARY.

The table herewith is only a very tentative and provisional attempt to approximate to the relative antiquity of the various evidences adduced as to the age of aboriginal man in Tasmania and Australia.

From the arguments already deduced the following conclusions may be provisionally drawn:—

(1) That the limiting of the date of arrival of the first Tasmanian aborigines to some such period as about five thousand to seven thousand years, on the evidence of the size of the refuse mounds or kitchen middens, left by the aborigines, is apt to mislead for the following reasons:—

First, the kitchen middens are liable to be considerably reduced in bulk through being dismantled by floods, winds, etc., as well as solution by rain water, so that they are very much smaller now than they formerly were.

Secondly, a large proportion of the aboriginal inhabitants of the island did not dwell along the coast, but subsisted on animals and plants, which they found useful for food, in the inland areas. Thus out of the total population of aborigines in Tasmania in 1803 of two thousand, as estimated by Dr Noetling, perhaps only one-half inhabited the coastal areas, and so contributed to the kitchen middens. If this has been so in past time, the limit assigned by Dr. Noetling of seven thousand years would have to be doubled.

Thirdly, that while the evidence of aboriginal flaked implements, *in situ*, in the cemented raised beach at Regatta Point, near Launceston, points to the aborigines having inhabited the northern part of Tasmania at a time when sea level was perhaps some three to five feet higher than it is at present (perhaps 1,500 to 2,000 years ago), the remarkable evidence of the Chalcedonic flake (beautifully finished by retouching by the aborigines) *in situ*, in a deposit probably of fluvio-glacial origin, near Gladstone, in N.E. Tasmania, carries the date back probably to an epoch approximately contemporaneous with some important phase of Pleistocene glaciation. If aboriginal man in Tasmania was really contemporaneous with one of the last great ice ages, he must have witnessed a sea level, perhaps no less than 200 feet lower than it is at present. This lowering of sea level was due to the locking up of enormous volumes of sea water which went to form some eleven millions of square miles of Pleistocene ice sheets

Soundings of the sea between the Malay Peninsula and Tasmania show that, but for a few relatively narrow deep straits, such as those of Sunda, of Bali-Lombok, and the trench between Timor and the Sahul bank, the ancestors of the Tasmanian aborigines would have been able to cross over on dry land from that famous tête-du-pont for migrations across the Pacific of early man—the Malay Peninsula (if they ever came from that quarter)—all the way to Tasmania. Obviously, as Torres Strait is not more than sixty feet in depth, and Bass Strait about 180 feet (along the line of shallowest ridge connecting it with the mainland), a fall of sea-level of 200 feet would completely unite Tasmania with New Guinea. If the Tasmanian aborigines arrived by such "strange roads" as now "go down" beneath the sea, and if in the earlier stages of their wanderings they followed the shore lines, and subsisted largely upon shell-fish, the bulk, indeed perhaps by far the greater portion, of their kitchen middens would now be submerged, many of them under Bass Strait. This submergence would result from the gradual rise in sea level, due to the thawing of the huge ice sheets of late Pleistocene geological time.

2. Next, the absence of any knowledge of making sea going canoes on the part of the Tasmanian aborigines, such as would tend to their negotiating safely a strait of the present width of Bass Strait, strengthens the belief that they must have crossed at a time when the straits were either far narrower than now, or did not exist at all. We are now in a position to estimate very approximate date in absolute time for the arrival of our aborigines in Tasmania. The evidence at Launceston pointing to a higher sea level than at present, to the extent of about three to five feet, belongs probably to the epoch of greater warmth than at present (about 4 deg. Fah.), which followed on soon after the final melting away of the last of the great Pleistocene ice sheets. This raised the sea level apparently all over the world by about fifteen feet. Subsequently, possibly through the resorption of sea water by very recently expanding polar ice caps, sea level has since been lowered by fifteen feet. If the maximum sea level, namely fifteen feet above its present level, took place seven thousand years ago, the Regatta Point evidence may indicate an antiquity of about 1,500 to 2,000 years. Obviously, this is an absolute minimum date. Next, it has been shown that the dingo was brought into Australia by the Australian aboriginal, the dingo being a domesticated wolf imported by the Australian aboriginal from Asia. This

evidence suggests that to whatever age the dingo belongs, the Australian aboriginal is equally old. Geological evidence shows that on the mainland the dingo was contemporaneous with some forms of extinct marsupials, such as *Thylacoleo*, *Diprotodon*, etc. This, alone, carries back the coming of the Australian aboriginal into Australia to many thousands of years ago.

3. If the aboriginal flake discovered in the Doone Mine deposit belongs to the Epoch of Würmian Glaciation, it may date back to 20,000 years. If, however, as seems not improbable, it dates back to the time of the Riss Glaciation, then the antiquity would be of the order of about 100,000 years.

4. The Talgai skull of the Darling Downs, near Warwick, in Queensland, although regarded by Professor Keith as essentially that of a Tasmanian aboriginal, is considered by others to be more Australian than Tasmanian. If the latter view is correct, the anthropoid ape characteristic evidenced in the size and facetting of the canines shows again the high geological antiquity of the Australian aboriginal.

5. This is supported by the occurrence of remains of dingo, and of a human molar tooth in the cave breccia at the Wellington Caves, in New South Wales, the dingo remains certainly, the human molar doubtfully, in association with remains of *Thylacoleo*.

6. However far back the date of arrival of the Australian aboriginal is pushed into the past, the coming of the Tasmanian must have been older still, for neither the Australian aboriginal nor the dingo has ever found his way into Tasmania. The obvious explanation is that at some time subsequent to the arrival of the Tasmanian aboriginal in Tasmania, during the low sea level which laid bare Bass Strait, the sea returned in its strength, as the result of the melting of the great Pleistocene ice sheets, and stopped the Australian aboriginal and the dingo from migrating into Tasmania.

7. We have seen that in the Northern Hemisphere the very early men, such as those of Heidelberg in Germany, and Piltdown in Sussex, date back to possibly over a quarter of a million years ago, whilst the ape man of Java, the *Pithecanthropus*, may be fully half a million years old.

Now as regards the backward limit in time for the Tasmanian aboriginal, it may be noted that their anatomical structure shows little approach to *Pithecanthropus*, or to the old men of Heidelberg or Piltdown. Piltdown man, in particular, is considered by Professor Grafton Elliott Smith and John

Hunter to be in the direct line of ascent of man from the ancestral stock from which the modern anthropoid apes diverged. If the age of Piltdown man is to be referred back to Günz-Mindel inter-glacial time, he might be 300,000 to 400,000 years old. The Tasmanian aboriginal would be newer than that.

8. The fact may again be emphasised that whereas there is little doubt that the earliest members of the human family inhabited the tropics, and had black skins, and that the black men slowly became white, as the result of living for thousands of years in cool temperate climates (and so we should expect that the Tasmanian aboriginal, if he had been in occupation of Tasmania for a very long period, would have shown some change in colour of his skin from black towards white), there is no evidence that the skin of the Tasmanian aborigines was other than black, right up to the time of their extinction in 1877.

On the whole, then, the evidence is in favour of the Tasmanian aboriginal having arrived in Tasmania between about twenty thousand and one hundred thousand years ago. As regards their original home, the opinion of the late A. W. Howett, later supported by Professor Griffith Taylor, is that they came from Asia, being closely allied to the negrito type of Semangs, who inhabit the highest ridges of the Malay Peninsula. These peoples have the same strongly curling hair, etc., as the Tasmanian aborigines. In the same region, but at lower levels, are aborigines known as the Sakai. These have many close affinities with the Australian aborigines.

The opinion, however, of Professor Sir Baldwin Spencer is that possibly A. W. Howitt's conclusions will now have to be modified. Spencer states in a letter to the writer: "The "Tasmanians are not now regarded as true Negritos. They "are probably a remnant of a very ancient ulotrichous "(woolly-haired) people, the ancestors alike of the Negritos, "now isolated in the Andaman Islands, Malay Peninsula, "(Semangs), and Philippines (Aetas), and possibly also of "the Tasmanians, but even this is doubtful as the Negritos "were brachycephalic (cephalic index, 80-85), whilst the "Tasmanians were dolichocephalic or mesaticephalic (ceph- "alic index, 75), and seem to represent a distinct offshoot of "these very early ulotrichous people, who may also have "spread beyond New Guinea to the Western Pacific."

In regard to the Australian aboriginal and his origin, Sir Baldwin states (also in a letter to the writer): "The Aus- "tralians of the present day seem to belong to a dolicho-

"cephalic, cymotrichous group, usually now spoken of as pre-"Dravidians, surviving relics of whom elsewhere are possibly "the 'Jungle Tribes' of the Deccan, the Veddas of Ceylon, "and the Sakai of the Malay Peninsula; but the Australians "have developed along various lines, perhaps independently of "contact with other peoples."

While, therefore, the original centre of dispersal of the Tasmanian aborigines is still in doubt, that of the Australian aborigines was probably in Asia, the home, too, of the dingo.

In regard to future geological researches on the antiquity of man within the Commonwealth, and particularly of the Tasmanian aborigines, attention should, in the opinion of the writer, be directed, *inter alia*, to the following:—

1. Systematic exploration of the oldest and largest kitchen middens, like those of Swanport, the Derwent Estuary, Macquarie Harbour, Mussel Roe, etc.

2. Search for aboriginal implements, etc.—
   (a) In the 15 feet (above high water) raised beach deposits of the E., N., and W. coasts of Tasmania, and the islands of Bass Strait.
   (b) In the older dunes, like those of King Island, Flinders Island, etc. Those of King Island have already yielded interesting remains of *Nototherium* and *Zaglossus harrissoni.*
   (c) In peat deposits, like those of Mowbray Swamp.
   (d) In cave deposits, like those of Mole Creek.
   (e) In older terraced river gravels, dating back into the Pleistocene, including fluvio-glacial "out-wash-apron" deposits.
   (f) At aboriginal "quarries" for stone for their stone implements, or at places where they dug out lumps of hæmatite for pounding into raddle for colouring their hair.
   (g) In any dredgings in Bass Strait or adjacent estuaries, or in excavations for harbour works, a very great *desideratum* for the dating of the first coming into Tasmania of the Tasmanian aborigines would be the zoning and correlation of the Pleistocene glacial and inter-glacial deposits of Tasmania, with a view to making a time scale for the Southern Hemisphere for comparing with the standard time scale of the Northern Hemisphere.

What seems to be specially needed is a systematic mapping of all the glacial evidences, beginning with the oldest, those on the West Coast. There the great terminal moraine, so well seen in the railway cuttings in the Lower Eden Valley, can be followed north and south, and the outwash-apron gravels together with their peat beds should be carefully differentiated. The retreat of the great ice sheets, belonging perhaps to Riss or Mindel, or even Günz time, should be carefully followed up, traces of terminal moraines, Kames (osars), drumlins, trend of grooves on pavements, carry of erratics, nature, thickness, and time value of varve clays should be noted, together with positions and boundaries of existing or silted up (most of these older Pleistocene glacial lakes have been silted up), glacial lake basins, often with a great rock bar (or "riegel") helping to form the lake. Then estimates of the former thickness of the ice sheet may be formed from a close study of the height up to which old glacial markings can be traced on "tinds," "horns," or "nunatakr." Afterwards evidences of the later glaciations superimposed on the older can be studied and mapped, culminating in the final small mountain glaciers.

Truly, a fascinating and awe-inspiring quest! Any one familiar with the phenomena of existing Polar ice sheets and Alpine glaciers can visualise the tiers of Tasmania under their snowy mantle with great glittering ice-fields between; can see the glorious sapphire blue of the deep crevasses where the ice sheet plunged down the steep mountain escarpments of the West Coast, and mark the long sinuous lines of moraine streeling away from nearby nunatakr to be lost to sight in the far distance; can hear the harsh roar of the sub-glacial stream rolling its tawny waters past the great terminal moraine, and spreading, far beyond, its alluvial fan of gravel and sand; can follow every phase in the retreat of the ice invader; the ponding back of the glacial streams to form lakes in rear of the terminal moraines, the silting up of the older lakes and their passing into peat swamps and button grass flats. And then, too, he can see all the wonderful phenomena of the re-advance of the ice, as told so well for Switzerland by Nussbaum, and finally view the highlands alone snow-covered, the white of the corrie glaciers, framed in dark rock, while all the rest of the isle is under a living garment of green.

What changes the Tasmanian man must have witnessed. Probably some of these glacial phases with the gradual drowning of the Bass land bridge, which so effectually checked the Australian Pharaoh and his hounds on the Victorian bank. What difference if any, ensued in his culture as the result of this isolation from the mainland?

Then with what animals was the Tasmanian man contemporaneous?

Did he see the marsupial rhinoceros alive, and, if so, did he defend himself against him with his spears and throwing sticks?

The whole problem teems with interest, and is worthy of devoted work from many workers.

Whoever may follow this trail in the future should never forget that the man who blazed it was the man whom we specially delight to honour to-night.

One cannot conclude this memorial lecture on the Geological History of the aborigines of the Commonwealth without some thoughts for the future as well as the past.

Unfortunately, most unfortunately, these most primitive children of men, the genuine Palæolithic type of hunters, the Tasmanian aborigines, are extinct, have been extinct since 1877. Most unfortunately, our remaining Australian aborigines are fast becoming extinct. These people whom we have dispossessed of their hunting grounds, and mostly driven into the most inhospitable and arid areas of the Commonwealth, will soon share the fate of the Tasmanian aborigines, unless we quickly change our method of dealing with them, and cease interfering with their normal mode of life. They must not be allowed to live in houses, they must be discouraged from wearing more than the very minimum of clothing. They must be prohibited from opium, alcohol, and every form of the white man's vices. These conditions can be secured for them if we have the will, in two ways: (1) When they are in actual employment as stockmen, domestic servants, etc., on stations, by treating them firmly, but kindly, as I saw them treated by Mr. and Mrs. E. R. Kempe, on Sir Sidney Kidman's station at Macumba, near Oodnadatta. There they are healthy and happy. (Secondly). Where they are not in the employ of white people, they should have suitable reserves made and maintained for them as has been so eloquently advocated by Sir Baldwin Spencer, of Melbourne, and Captain S. A. White, of Adelaide. The North American Indians were becoming extinct until our American cousins seriously took up the subject of their preservation, and secured for tribes like the Navajo Indians suitable reservations, with proper hygienic regulations. Now the Navajos have ceased to decrease in numbers, and are actually increasing. We could secure surely the same happy state of things for our Australian aborigines if we had the will to do it, and it is part of our solemn duty and service to humanity to have the will and to see that the lot of our aboriginal is made as happy as may reasonably be. This about the Navajos we have learnt through the recent Pan-Pacific Congress, and the Congress has made us realise more than ever before our responsibilities to the native races of the Pacific in our own or in mandated territories and protectorates (9).

Many of these highly interesting peoples have become extinct, many are fast becoming extinct, partly through diseases endemic in the islands, partly through diseases introduced by the white man.

At the Pan-Pacific Congress, Dr. Cumpston, Chief Medical Officer to the Commonwealth, weighed his words well when he said that if half the cost of a modern battleship were expended, over a period of five years, on eliminating diseases and providing proper hygienic conditions for the native races within the shores of the Pacific, all those distressing diseases of tonu (Yaws), filaria, hookworm, and many others which cause so much suffering and premature death, could be completely eradicated.

Surely, surely the great nations around the Pacific should co-operate without delay in setting in hand such a work not only for the sake of our own health, as well as that of the Pacific peoples, but for the sake of that humanity which should raise modern man to heights undreamed of by his Palæolithic ancestor.

Certainly the noble character whose memory we cherish so particularly to-day would, were he among us now, have been foremost in this pleading, for as Sir John Dodds has said of him: "The actions of his life appear to be governed by "those principles of justice and kindness towards others which "God has established as the only true guide to human con-"duct."

Carlyle says truly that man in this life is attended by "the Terrors and the Splendours." Johnston saw much of both, and who does not, but his face was set upon the Splendours, and we are thankful to him, devoutly thankful, for helping us to realise the good and grandeur and the sacred mystery in human life.

(9) The resolution of the Congress urging the need for the establishing of a Chair of Anthropology at an Australian University is to be submitted for, it is hoped, favourable consideration to the Federal Government.

This memorial to him stands for a sign and for a promise. For a sign that we honour him, for a promise that we always will honour duty so well and nobly done.

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TASMANIAN *HYMENOGASTRACEÆ.*

By L. Rodway, C.M.G.,
Government Botanist.

(Read 6th November, 1923.)

In the year 1911 I had the honour of reading to the Society a paper of a similar title. Since then, there have arisen reasons for additions and alterations. Our list of these forms is now so large that there appears little prospect that new species will come to light, wherefore the present appears to be a suitable time to revise the family.

The *Hymenogasters* are small underground tubers which produce their spores on basidia, generally 2, sometimes 4 on each basidium. The characteristic of the family is that the gleba *does not break down into a mass of spores and fibres* as in allied tubers, such as *Mesophellia, Scleroderma, Diploderma, Lycoperdon*, and *Geaster*, but remains as a series of contorted tubes or spaces without change at maturity, till broken up by decay or eaten by an animal. The genus *Secotium*, however, is intermediate between the *Hymenogasters* and the *Agarics*. Formed underground it tends to emerge at maturity, and has a more or less developed sterile portion, often piercing through the gleba to the apex, and the tramal plates approach the appearance of distorted gills. Some plants may equally well be placed in one group or the other.

Of the *Hymenogastraceæ*, we have in Tasmania six genera of more or less artificial grouping. Three of these have spores longer than broad, namely:—

Hymenogaster, with a fleshy gleba and rooting at the base.

Rhizopogon, with a fleshy gleba and strands of mycelium marking the surface.

Hysterangium, with a gelatinous gleba, and thick peeling peridium.

The other three have spherical spores:—

Octaviana, an apparent peridium, and a sterile base.

Hydnangium, an apparent peridium, and no sterile base.

Gymnomyces, no appreciable peridium, nor sterile base

HYMENOGASTER, TULASNE.

Members of this genus are of a dry fleshy character. Peridium from thin and continuous with the trama to thick and almost gelatinous. Gleba fleshy, the hymenial cavities small and very convoluted, trama thin, formed of elongated cells. Not floccose, nor gelatinous. Spores generally elliptic or fusiform, generally rough, papillate or sulcate, rarely smooth. Sterile base present sometimes, piercing the greater part of the gleba.

The following are specific distinctions:—

albellus, spores ellipsoid, pale, rough.
maideni, spores ellipsoid, pale, smooth.
aureus, spores fusiform, allantoid, smooth.
fulvus, spores brown, obtuse, 6 x 3 μ.
violaceous, surface gelatinous, violet. Spores brown, rough, 9 x 7 μ.
nanus, peridium thick, brown.
rodwayi, spores ribbed, gleba dark.
albidus, spores ribbed, gleba pale.

Hymenogaster albellus, Mass. et Rod. Irregularly globose, 1-3 cm., gray. Peridium nearly white, membranous. Gleba brown to ochraceous-brown, canals small, very tortuous. Spores ellipsoid, dark brown, one or both ends rather acute, exospore thick, often inflated into small warts, or into few large warts, or again into small wing-like expansions, 15-18 x 6-7 μ

Common throughout Tasmania. Collected by Dr. Cleland in New South Wales.

Hymenogaster maideni, Rod. Irregularly globose, 1-2 cm. Peridium white, very thin. Gleba white, becoming pale ochre when dry, tough, canals minute, very tortuous. Spores ellipsoid, one or both ends sub-acute, pale brown, smooth, 10-12 x 6 μ.

Rare. Near Hobart. Differing from *H. albellus*, chiefly in paler gleba and spores.

Hymenogaster aureus, n.s. Irregularly subglobose, mostly 1-2 cm., bright golden yellow, surface rugose. Peridium tough, yellow, about 0.5 mm., thick. Gleba compact, pale brown, canals small, numerous, contorted. Spores elliptico-fusiform, quite smooth, allantoid, pale yellow, 15-21 x 6

Differs from *H. albellus* in colour, thickness of peridium, and glabrous, allantoid spores.

Mt. Wellington, 3,000 feet.

Hymenogaster fulvus, Rod. Irregularly globose, 1-4 cm. diameter, pale gray, becoming black with age. Peridium very thin, membranaceous. Gleba dense ochre, becoming dark brown. Canals numerous, tortuous. Spores oblong, brown, obtuse, 6-7 x 3-3.5μ.

West Coast and about Hobart Collected in South Australia by Dr. Cleland.

Hymenogaster violaceus, Mass. et Rod. Globose violet and white, with a viscid surface. Peridium thin, but distinct. Sterile base from obsolete to piercing to the apex, and broken into limbs. Gleba dense, the tortuous canals small, pale, becoming dark brown. Spores broadly ellipsoid, obtuse, brown, verruculose, 9 x 7μ.

Fairly common.

Hymenogaster nanus, Mass. et Rod. Irregularly globose. Often 2-3 cm. diameter. Outer layer of peridium of a firm gelatinous consistency, 1-2 mm. thick, inner layer membranous. Sterile base usually well developed. Gleba fleshy, dark brown, cells wide. Spores dark brown, ellipsoid, minutely verruculose, 15 x 7μ.

Unfortunately the first specimens sent to Massee were very small, hence the inapplicable name.

Cascades, Hobart.

Hymenogaster rodwayi, Mass. Irregularly globose, 1-3 cm. diameter, colour gray-white. Peridium fleshy, about 1 mm. thick. Gleba compact, dull dark brown, sterile base from obsolete to spreading in strands nearly to the surface. Spores ellipsoid, longitudinally furrowed, usually both ends acute. Ochraceous when young, then brown, 18-20 x 9μ.

Fairly common in Tasmania. Collected in New South Wales by Dr. Cleland.

Hymenogaster albidus, Mass. et Rod. Irregularly globose, 1-2 cm., usually clothed with floccose mycelium; white. Peridium membranous, very thin. Sterile base, slight or none. Gleba at first pinkish-white, becoming ochre-brown with age. Cells small, very tortuous. Spores ellipsoid, obtuse, yellowish-brown, longitudinally carinate, 20-25 x 15μ.

Cascades, Hobart. Rare.

RHIZOPOGON, TULASNE.

Peridium thick and persistent or thin and disappearing with strands of mycelium traversing its surface. Cavities distinct at first empty, spores smooth.

rubescens, red externally.
luteolus, white, then brownish-olive.

Rhizopogon luteolus, Tulasne. Irregularly globose, 2-6 cm. diameter; peridium ochre-yellow, very thin. Gleba rather dense, at first pale, smoky, then dark ochre-brown, or greenish. Tubes contorted up to 300μ diameter. Spores oblong, obtuse, smooth, pale olive, 8 x 2μ

Sandy Bay, beneath Pines. Snug Falls track, with no conifers near. Collected in Victoria. Common in Northern Hemisphere.

Rhizopogon rufescens, Tulasne. Subglobose, 2-4 cm. diameter, red-brown; peridium thin, marked with mycelial strands. Gleba white, becoming yellowish with age, sometimes brown when very old, dense, canals minute. Spores narrow oblong, hyaline, or slightly tinted, 11 x 4μ.

Common under Pines. Cosmopolitan.

HYSTERANGIUM, VITTADINI.

Peridium distinct, separable; gleba at first mucilaginous, becoming gelatinous, cavities at first empty; spores smooth.

affine, gleba greenish-blue
barbarianum, gleba brownish-green.
pumilum, dwarf gleba ochraceous.
viscidum, surface red-brown, viscid.
atratum, surface pale purple, viscid.
neglectum, peridium thick, fleshy brown, not viscid
obtusum, peridium thick, violet, not viscid.
clathroides, waxy consistency throughout.
inflatum, exospore inflated.
membranaceum, delicate white to pale brown, turning indigo where bruised.
fusisporium, white, drying ochre, spores fusiform, shining.

Hysterangium affine, Mass et Rod. Globose, seldom exceeding 1 cm. diameter. White to pale brown; peridium white, leathery, 1 mm. thick, readily separating from the gleba. Gleba dense, greenish or bluish, gelatinous. Canals small, not crowded, tortuous. Spores ellipsoid to fusiform, obtuse to sub-acute, smooth, slightly tinted, 11-13 x 5-6 μ.

Common in Tasmania.

Hysterangium burburianum, *Rod.* Globose, 1-2 cm. diameter, pale brown; peridium leathery, easily separating, 1 mm. thick. Gleba gelatinous, pale brownish-green, canals numerous, convoluted, walls thin. Spores oblong, smooth, obtuse, 5 x 3 μ

Differs from *H. affine* by paler gleba, and the smaller obtuse spores.

Collected near Launceston.

Hysterangium pumilum, *Rod.* Globose, pale ochre, cæspitose, 2-3 mm. diameter. Peridium thin, dark, horny. Gleba gelatinous ochre. Canals relatively large, not crowded, little convoluted. Spores smooth, hyaline, fusiform, 12 x 4 μ.

Differs from small specimens of *H. affine* in small size, cæspitose habit, pale gleba, and broader canals.

In heathy soil. Tasman's Peninsula.

Hysterangium viscidum, *Mass. et Rod.* An irregularly globose tuber, mostly 2-3 cm. diameter, viscid, chestnut-brown; peridium rather thick, tough, readily separating from the gleba. Gleba at first pale, but dotted by the minute brown canals, becoming dark brown with age. Spores broadly oblong, very obtuse, dark brown minutely papillate, 12-14 x 8-10 μ

In gullies near Hobart.

Also collected in South Australia by Dr. Cleland.

Hysterangium fusisporum, *Mass. et Rod.* Irregularly globose, mostly 2 cm. broad, white to cream coloured, becoming darker with age, surface very rugose. Peridium very thin, papery, white. Gleba soft dense, but not as gelatinous as that of most members of the genus, white, drying pale yellow, canals small, very convoluted. Spores ellipsoid to fusiform, mostly acute at one or both ends, hyaline, shining, smooth, 20-22 x 8 μ.

Fairly common throughout Tasmania.

Hysterangium clathroides, *Vittadini.* Very irregular in shape, about 2 cm. in diameter; peridium thin, floccose continuous with the surrounding mycelium. Gleba gray-hyaline, soft, almost waxy. Canals free, little tortuous, narrow, pale brown. Spores ellipsoid, acute at both ends, smooth, pale brown, 10 x 5 μ.

Knocklofty, Hobart. Rare.

Hysterangium neglectum, Mass. et Rod. An irregular tuber, 2-3 cm. diameter, ochre coloured; peridium thick, fleshy, not viscid, not readily separating from the gleba. Gleba dark, rich brown, sub-gelatinous, canals minute tortuous. Spores ellipsoid, light yellow-brown, rather obtuse, smooth, 12-8 μ.

Very near *H. viscidum*, only different colour, not viscid, more gelatinous gleba, and distinct spores.

Found in many parts of Tasmania.

Hysterangium inflatum, Rod. Globose, reddish-brown, smooth, about 1 cm. diameter; peridium fleshy, about 1 mm. thick, readily peeling from gleba. Gleba blue-black, very gelatinous, canals not crowded, but very tortuous. Spores almost fusiform, very pale, smooth, 12 x 4 μ, enclosed in a dilated exospore, much inflated above, reducing towards the base.

With a darker gleba than in *H. affine* it has distinct spore structure.

Rare. Mt. Wellington.

Hysterangium atratum, Rod. Subglobose, 1.5-2 cm. diameter, pale purple, smooth, viscid, becoming dark brown when old; peridium thin, gelatinous, readily peeling. Gleba clay-coloured, changing to dark brown, canals small, but numerous. Spores very dark brown, minutely rough, nearly spherical, mostly 11.5-11 μ

Near *H. viscidum.* It differs besides general features by the rounder and even darker spores.

Mt. Nelson.

Hysterangium obtusum, Rod. Irregularly subglobose, pale pink-violet, becoming ochraceous when dry, mostly 2 cm.; peridium thick, deep violet. Gleba pale slatey olive. Spores ellipsoid, very obtuse, smooth, hyaline, 9 x 4 μ.

Differing from *H. affine* by the thick violet peridium and smaller and more obtuse spores.

Mt. Nelson.

Hysterangium membranaceum, Vittadini. Irregularly globose, 1-2 cm., delicate, white, becoming blotched with indigo. Peridium very thin, dry, subtomentose. Gleba white or tinted with indigo, ochraceous with age. Spores ellipsoid, smooth, pale brown, 12 x 6μ.

Not common, but cosmopolitan.

OCTAVIANA, VITTADINI.

Peridium cottony. Sterile base distinct. Trama byssoid. Canals small contorted. Spores spherical.

carnea, pink, spores finely echinulate.
australiense, brownish, spores verruculose.
levispora, pale to light brown, spores glabrous.

Octaviana australiense, Berk. et Br. Subglobose, mostly 2 cm. diameter, smooth, cream coloured to chestnut-brown, according to age. Peridium thin, tough. Gleba cream-coloured, then pink-brown, pierced below more or less by arms from the sterile base, canals about 1 mm., very contorted. Spores globose, with an irregular surface, or smooth, pale yellow, 9-12μ.

When young it will exude white milky fluid when cut.

Common in Tasmania. Widely spread in Australia.

Octaviana carnea, Wallr. Irregularly subglobose, 1-3 cm., smooth, pale-pink. Peridium thin, papery, or cottony, hardly appreciable. Gleba pink and white, cells very numerous and contorted, walls thin, sterile base, well developed. Spores globose, finely echinulate, white, 9-10μ.

Cosmopolitan.

Octaviana levispora, nom. nov. Irregularly globose, 2-3 cm., white, then gray or very pale brown. Peridium thin floccose. Sterile base, sometimes well developed, sometimes obsolete. Gleba white, then pale brown, dense, the canals small and tortuous. Spores spherical, pale brown, smooth, 9-10 μ. Peridium much thinner than in *Octaviana australiense*, and the canals smaller, but the spores similar.

Tasman's Peninsula.

HYDNANGIUM, WALLROTH.

Peridium fleshy or thin, smooth or silky, sterile base absent; cavities minute irregular, or occasionally larger and not contorted. Spores globose or subglobose, seldom smooth.

The genus may readily be divided into two sections:—

Contorta, in which the canals are very small, much contorted and empty.

Compacta, in which the sporogenous cavities are roughly iso-diametric, and crammed with spores.

Of the *Contorta*:—

brisbanensis, yellow, spores verruculose.
hinsbyi, ochre-brown, spores sub-echinulate.
glabrum, spores hyaline, smooth.

Of the *Compacta*:—

Sporogenous cavities about 1 mm. diameter.

tasmanicum, spores 11μ, brown, echinulate.
clelandi, spores 11μ., black verrucose.
mc'alpinei, spores 21μ., yellow verrucose.

Sporogenous cavities much under 1 mm.

alveolatum, spores alveolate.
microsporium, spores 5-6μ., verrucose.
densum, spores brown, echinulate.

Hydnangium brisbanensis, *Berk. et Br.* Irregularly globose, yellow, becoming brown when old, no sterile base, 1-3 cm., surface rugose. Peridium under 1 mm. but tough. Gleba ochre to ochre-brown, tubes numerous, small, very contorted, mostly 0.3 mm. Spores globose, pale-ochre, obscurely verruculose or minutely echinulate, 7-8μ. diameter.

North-East Tasmania. Reported from Queensland and Victoria. Many collections in New South Wales by Dr. Cleland.

Hydnangium hinsbyi, *n.s.* Irregularly globose, rugose, ochre-brown, 1-3 cm. diameter. Peridium thin, hardly apparent. Gleba rather dense, no sterile base, umber, canals small, numerous, contorted. Spores globose, light brown, densely covered with small erect, obtuse asperities, appearing echinulate under a low power, 9-12μ.

West Coast of Tasmania.

Hydnangium glabrum, *Rod.* Irregularly globose to oblong, mostly about 1 cm. diameter, surface smooth, dull chestnut-brown. Peridium thin and continuous with the trama. No sterile base. Gleba at first pale, then brown, tubes convolute very irregular in size. Spores globose, smooth hyaline 6 μ. diameter. Often the exospore dilated and making the spore 8μ., with a double contour.

Distinguished from *H. australiense* by the dense gleba and small hyaline spores.

Cascades, Hobart. Collected in South Australia by Dr. Cleland.

Hydnangium tasmanicum, Kalchbr. Globose, gray, becoming dark with age, 1-2 cm. diameter. Peridium thin, tough, continuous with the pale trama; canals 1-2 mm. diameter, irregular, but little contorted, stuffed full of brown spores, giving the surface a marbled appearance. Spores globose, coarsely echinulate, dark brown, 10-12μ. diameter.

Found occasionally in Tasmania.

Hydnangium mc'alpinei, Rod. Irregularly globose, ochre-coloured, surface rough, 1-3 cm. diameter. Peridium tough, about 0.5 mm., thick, continuous with white trama. Gleba dense, canaliculate spaces, 1-2 mm. broad, not at all contorted, black with dense masses of spores. Spores globose, dark brown to black, rough, with small dark warts, 9-12μ. diameter.

Mt. Nelson, Hobart. Also collected in South Australia by D. McAlpine.

Hydnangium clelandi, Rod. Irregularly globose, whitish ochre, 1-2 cm. diameter. Peridium thin, membranous, white, continuous with the trama. Gleba dull brown-clay to umber, becoming browner with age, cavities about 1 mm., not contorted, but densely crowded with spores. Spores pale yellow, globose, smooth, becoming obscurely verrucose, 20-22 μ. diameter.

Cascade Valley, Hobart.

Hydnangium alveolatum, Cke. et Mass. Globose, 1-1.5 cm., whitish ochre. Peridium distinct, continuous with the trama, becoming dark. Gleba soft, waxy, solid, trama pale, becoming dark, cavities minute, pale, not contorted. Spores globose, hyaline to pale brown, minutely alveolate, 10-12 μ. diameter.

Cascades, Hobart. Also in Victoria.

Hydnangium microsporium, Rod. Globose, white to pale ochre. Peridium rather thick and tough. Gleba dense, orange to raw sienna; cavities round about 0.5 mm. diameter, not contorted, full of spores. Spores hyaline, globose, armed with short spines or warts, 5-6μ. diameter.

Mt. Nelson.

Hydnangium densum, Rod. Globose, 5-8 mm., ochraceous. Peridium 0.5 mm., thick, leathery. Gleba marbled with black from the spore masses; trama white. Canals round, not convoluted, 0.3 mm. diameter, densely packed with spores, black. Spores globose, brown, minutely echinulate. 12μ. diameter.

Mt. Nelson.

In one specimen the base had few small canals, giving the appearance of a sterile base.

GYMNOMYCES, MASS. ET ROD.

Peridium none or rudimentary. Gleba fleshy; hymenial spaces numerous, not much contorted, trama thin. Sterile base absent, except in a few isolated tubers. Spores hyaline, globose, rough or echinulate.

pallidus, white, spores verruculose.

seminudus, white, spores echinulate.

flavus, yellow, spores echinulate.

Gymnomyces pallidus, Mass. et Rod. Subglobose, 2-3 cm. diameter, white, becoming light ochre when old. Peridium obsolete. Gleba dense, fragile white, canals small, very contorted, tramal plates white, very thin. Spores globose, hyaline, verruculose, 9-10μ diameter.

Cascades, Hobart.

Gymnomyces seminudus, Mass. et Rod. Globose white, then tinted with ochre, 2-4 cm. Peridium very thin, continuous with the trama. Gleba white, tougher than in *G. pallidus*, canals minute, very contorted, irregular, tramal plates white, rather firm. Spores hyaline, globose, strongly echinulate, 11-12μ. diameter.

Cascades, Hobart.

Gymnomyces flavus, Rod. Subglobose, but very irregular in shape and size, mostly from 5 to 10 mm. diameter, dull canary yellow when fresh, ochraceous when dry. No peridium; the surface floccose and marked by protruding hymenial canals. Gleba fragile, canals broad, numerous contorted, trama thin, fleshy. Spores globose, hyaline, 10-11 μ. diameter, armed with broad, short spines.

Common in Southern Tasmania.

Gathered in New South Wales by Dr. Cleland.

f. tetraspora. Gleba less compact. Spores armed with longer spines and adhering in fours.

Cascades, Hobart.

The following described species are here suppressed:—

Hymenogaster barnardi, too near *Hys. fusisporum*
Octaviana archeri, no sufficient description.
Gymnomyces solidus, too near *G. pallidus.*
Hymenogaster levisporus, referred to *Octaviana.*

THE ROYAL SOCIETY OF TASMANIA

ABSTRACT OF PROCEEDINGS
1923

26th February, 1923.

Annual Meeting.

The Annual Meeting was held at the Society's Rooms, the Tasmanian Museum, Hobart, on the 26th February, Mr. L. Rodway, C.M.G., Vice-President, presiding. The Annual Report and Statement of Accounts were read and adopted. The following were elected as members of the Council:—Messrs. W. H. Clemes, W. H. Cummins, Dr. W. L. Crowther, Major L. F. Giblin, The Right Reverend Dr. R. S. Hay, Messrs. J. A. Johnson, J. Moore-Robinson, L. Rodway, and Dr. Gregory Sprott. Mr. R. A. Black was appointed Hon. Auditor.

Mr. Rodway exhibited specimens of *Milligania lindoniana.*

Papers.

The following papers by Messrs. H. H. Scott and Clive Lord were read:—

1. Pleistocene Marsupials from King Island.
2. *Nototherium victoriae.*
3. *Macropus anak.*

Illustrated Lecture.

Professor Sir T. W. Edgeworth David delivered an illustrated lecture on "Recent Observations of the Pleistocene Ice-Age and its Relation to the Coming of Man into Tasmania."

Conversazione.

At the conclusion of the meeting a conversazione was held in the Art Gallery.

16th April, 1923.

The Monthly Meeting was held at the Society's Rooms on the 16th April, Mr. L. Rodway, C.M.G., presiding.

The following members were elected:—Drs. A. W. Green and A. L. McAulay, Messrs. J. C. Breaden, J. A. Gorringe, G. H. B. Rogers, and H. C. Webster.

Paper.

The following paper was read:—

"Notes on a Geological Reconnaissance of Mt. Anne and the Weld River Valley, South-Western Tasmania." By A. N. Lewis, M.C., LL.B.

Illustrated Lecture.

Major L. F. Giblin delivered an illustrated lecture on the Mount Anne District.

14th May, 1923.

The Monthly Meeting was held at the Society's Rooms on the 14th May, Mr. L. Rodway, C.M.G., presiding.

The following members were elected:—Captain Bowerman and Mr. F. L. Gunn.

The matter of the Cradle Mountain-Lake St. Clair Reserve was referred to, and it was resolved to communicate with the Government in reference to the matter.

Mr. Rodway drew attention to the need for a Gun Act, and tabled the New South Wales Act.

Illustrated Lecture.

Mr. E. T. Emmett, Director of the Tasmanian Tourist Bureau, delivered a lecture on "The National Parks of the World."

11th June, 1923.

The Monthly Meeting was held at the Society's Rooms on the 11th June, Mr. L. Rodway presiding.

The following members were elected:—Messrs. R. Gibbings, G. A. Purcell, and R. Harley.

Illustrated Lecture.

Mr. L. Rodway delivered a lecture entitled "Studies in Tasmanian Flora," the lecture being illustrated by a large number of lantern slides specially prepared by Mr. J. C. Breaden.

9th July, 1923.

The Monthly Meeting was held at the Society's Rooms on the 9th July, Mr. L. Rodway presiding.

The following members were elected:—Mrs. G. H. Butler and Dr. G. M. Parker.

Papers.

The following papers were read:—

1. *Vinculum sexfasciatum*, an addition to the Fish Fauna of Tasmania. By Clive Lord, F.L.S.
2. A Note on the Burial Customs of the Tasmanian Aborigines. By Clive Lord, F.L.S.
3. Mollusca of King Island. By W. L. May.

Illustrated Lecture.

Mr. Clive Lord delivered an illustrated lecture on "The Economic Importance of the Tasmanian Fauna."

6th August, 1923.

The Monthly Meeting was held at the Society's Rooms on the 6th August, Mr. L. Rodway presiding.

Papers.

The following papers were read:—

1. Australian *Bombyliidæ*. By G. H. Hardy.
2. Australian *Dixidæ*. By A. Tonnoir.
3. Studies in Tasmanian Mammals, Living and Extinct, No. XI. By H. H. Scott and Clive Lord.
4. An Experimental Method for Determining the Properties of Optical Gratings. By Dr. A. L. McAulay.

Mr. J. Moore-Robinson presented a statement dealing with the history of the first clock placed in Old St. David's Church.

Illustrated Lecture.

His Lordship the Bishop of Tasmania, the Rt. Rev. Dr. R. S. Hay, delivered a lecture on "The Historical Associations of the County of Durham."

11th September, 1923.

The Monthly Meeting was held at the Society's Rooms on the 11th September, Mr. L. Rodway presiding.

Reference was made to the death of Mr. Dudley Le Souef, Director of the Melbourne Zoological Gardens.

Mr. P. Thomas gave an interesting note of a graft hybrid apple which was placed on exhibition.

Lecture.

Mr. L. Rodway delivered a lecture entitled "Botanical Notes."

8th OCTOBER, 1923.

The Monthly Meeting was held at the Society's Rooms on the 8th October, Mr. L. Rodway presiding.

The following papers were read:—

1. Description of Two Underground Fungi. By L. Rodway.
2. Notes on the Tasmanian Emu. By H. H. Scott.

R. M. Johnston Memorial Lecture.

Professor Sir T. W. Edgeworth David delivered the first R. M. Johnston Memorial Lecture, and the Chairman presented Professor David with the R. M. Johnston Memorial Medal.

Conversazione.

At the conclusion of the meeting the members adjourned to the Art Gallery of the Museum, where a conversazione was held.

6th NOVEMBER, 1923.

The Monthly Meeting was held at the Society's Rooms on the 6th November, Mr. L. Rodway presiding.

The Chairman extended a welcome to the visiting delegates attending the Royal Australasian Ornithologists' Union Conference.

Paper.

The following paper was read:—

Tasmanian *Hymenogastraceæ*. By L. Rodway.

Mr. Clive Lord drew attention to the fact that a memorial to Tasman had recently been erected, but there existed no memorial to Furneaux, Bligh, Cook, D'Entrecasteaux, Baudin etc., all of whom had visited Adventure Bay, and suggested that the Society might take steps in order to have a memorial erected at Adventure Bay.

Illustrated Lecture.

Dr. J. A. Leach, President of the Royal Australasian Ornithologists' Union, delivered an illustrated lecture on the Birds of Australia.

17th DECEMBER, 1923.

The Monthly Meeting of the Society was held at the Society's Rooms on Monday, 17th December, at 8 p.m., Mr. L. Rodway, C.M.G., presiding.

Mr. Lord reported that he had interviewed certain of the residents of Adventure Bay concerning the proposed memorial to the early navigators, and that the matter was under consideration.

The following members were elected:—Hon. F. B. Edwards, Messrs. E. E. Unwin, M.Sc., W. H. Hudspeth, H. T. Gould, S. E. Shoobridge, Charles Davis, Alfred Davis, Rev. H. B. Atkinson, and Misses A. Wherrett, B.A., Hurst, and Agnew.

A discussion took place with regard to the site of the landing place of Tasman's Carpenter. Mr. Moore-Robinson stated that a party which included himself, Captain Bowerman, Mr. John Kennedy, and others had visited the locality in January last, and, being furnished with certain data and maps, they formed the opinion that they had found the exact spot of the landing, including the four trees mentioned by Tasman. This was at the head of the inner cove of Prince of Wales Bay.

Mr. Clive Lord referred to the fact that the position had been investigated previously, namely by Gell (1845), Walker (1889). He considered the flag was planted on the north side of the bay, as Tasman's sketch definitely showed it there, and not at the head of the inner bay. Moreover, Tasman referred to the trees being on sloping ground, and the northern side of the bay had such ground, whereas the head of the inner cove was flat. Trees could be noted on this site also if need be, but no reliance could be placed on trees. Further, Tasman would never have ventured over the reef into the inner cove.

Mr. John Kennedy questioned whether the sketch referred to by Mr. Lord had been included in Tasman's original journal. He considered that the four trees mentioned were of considerable age—one of them could easily be from 800 to 1,000 years old.

Mr. G. H. Halligan, late Government Hydrographer of New South Wales, gave reasons for his opinion that Tasman's carpenter landed in the centre of North Bay and not in

Tasman's sketch of portion of the S.E. Coast of Tasmania, showing the ships at anchor.
[From Heere's *Tasman.*]

Prince of Wales Bay. As far as the trees in Prince of Wales Bay were concerned, he was of the opinion that not one of them was 100 years old.

Mr. L. Rodway said that the trees in the locality were slow growing, the greater number would not be more than 70 years old, but there was one tree which might be a very considerable age. He considered the trees of no value at all to note the position.

Major L. F. Giblin said that the impression he got was that the problem could not be solved. He had not heard of anything which was in harmony with all the data. Possibly there were mistakes in the journal or the charts. As it stood the evidence before them was not conclusive as to the exact site of the landing.

Captain Bowerman said that Tasman's chart was not as vague as they thought. The anchor was positively shown, and the course could be followed, and any small error of bearings would not affect the result as far as the location of the bay was concerned. A detailed Admiralty chart of that section of the East Coast of Tasmania was badly needed.

Mr. John Reynolds (Honorary Secretary, Historical Section) dwelt upon the need for accuracy in historical matters and also stated his opinion that the bar across the inner cove was at any rate largely of natural formation. Mr. Reynolds moved that the Society alter the inscription on the monument from "At this spot, etc.," to "Near this spot, etc." The motion was carried.

ANNUAL REPORT
1923
The Royal Society of Tasmania

Patron:

HIS MAJESTY THE KING.

President:

HIS EXCELLENCY THE ADMINISTRATOR.

Vice-Presidents:

L. RODWAY, C.M.G.

A. H. CLARKE, M.R.C.S., L.R.C.P.

Council:

(Elected February, 1923).

L. RODWAY, C.M.G. *(Chairman)*

W. H. CLEMES, B.A., B.Sc.

W. E. L. CROWTHER, D.S.O., M.B.

W. H. CUMMINS, A.I.A.C.

L. F. GIBLIN, D.S.O.

RT. REV. R. S. HAY, D.D.

J. A. JOHNSON, M.A.

J. MOORE-ROBINSON, F.R.G.S.

DR. GREGORY SPROTT, M.D., C.M.

Standing Committee:

W. H. CLEMES, L. F. GIBLIN, L. RODWAY.

Hon. Treasurer:

J. MOORE-ROBINSON, F.R.G.S.

Editor:

CLIVE LORD, F.L.S.

Auditor:

R. A. BLACK.

Secretary and Librarian:

CLIVE LORD, F.L.S.

LIST OF MEMBERS

Honorary Members:

David, Sir T. W. Edgeworth, K.B.E., C.M.G., B.A., F.R.S., F.G.S., Professor of Geology and Physical Geography in the University of Sydney. The University, Sydney.

Mawson, Sir Douglas, B.E., D.Sc. Adelaide.

Spencer, Sir W. Baldwin, K.C.M.G., M.A., D.Sc., Litt.D., F.R.S. Melbourne.

Ordinary, Life, and Corresponding Members:

"C," Corresponding Member.

"L," Member who has compounded subscriptions for life.

* Member who has contributed a Paper read before the Society.

† Member who has been elected a member of the Council.

Year of Election.		
1922		Adams, A. W. National Mutual Buildings, Macquarie Street, Hobart.
1921		Anderson, G. M., M.D., C.M. Clare Street, New Town.
1923		Agnew, Miss K. Augusta Road, New Towr.
1921		Allen, D. V., B.Sc. Principal Launceston Technical College.
1923		Atkinson, Rev. H. B. Holy Trinity Rectory, Hobart.
1918	L	Avery, J. 52 Southerland Road, Annandale, Melbourne, Victoria.
1908	L	Baker, Henry D. C/o American Consulate, Hobart.
1921		Baker, H. S., LL.M., M.A. Stanley, Tas.
1922		Bamford, H. Commercial Bank of Australia Chambers, Elizabeth Street, Hobart.
1887		Barclay, David. 143 Hampden Road, Hobart.
1921		Barr, J. Stoddart, M.D., Glas. Lower Sandy Bay.
1890		*Beattie, J. W. 1 Mt. Stuart Road, Hobart.
1918		Bellamy, Herbert, City Engineer. Town Hall, Hobart.
1901	C	Benham, W. B., M.A., D.Sc., F.R.S., F.Z.S. Professor of Biology, University of Otago, Dunedin, N.Z.
1903		Bennett, W. H. Ashby, Ross.

Year of Election.

1921 Bertouch, V. Von, Wellington Square Practising School, Launceston.

1920 Bernacchi, A. G. D. Maria Island.

1921 Bethune, Rev. J. W., B.A. Church Grammar School, Launceston.

1921 Birchall, J. A. 118 Brisbane Street, Launceston.

1922 Biss, F. L. U.S.S. Co., Hobart.

1912 *Black, R. A. Chief Clerk, Department of Agriculture.

1909 *Blackman, A. E. Franklin.

1920 Blaikie, T. W. Practising School, Elizabeth Street, Hobart.

1918 Bowling, J. "Barrington," Tower Road, New Town.

1892 C Bragg, W. H., M.A., F.R.S. Professor of Physics in the University College, London.

1923 Breaden, J. C. 12 Waverley Avenue, New Town.

1923 Brett, R. G. 53a Hill Street, Hobart.

1917 Brettingham-Moore, E., M.B., Ch.M. Macquarie Street.

1911 Brooks, G. V. Director of Education, Education Department, Hobart.

1921 Brown, Mrs. Justin. "Waratah," York Street, Launceston.

1922 Brownell, C. C. 29 Napoleon Street, Battery Point.

1907 Brownell, F. L. "Berwyn," Mercer Street, New Town.

1921 Bruce, L. S. Tourist Bureau, Launceston.

1918 Burbury, Alfred. "Glen Morey," Antill Ponds.

1918 Burbury, Frederick. "Holly Park," Parattah.

1919 Burbury, Charles. "Brookside," Moonah.

1919 Burbury, Gerald. "Syndal," Ross.

1919 Burbury, T. J. "Park Farm," Jericho.

1922 Burrows, Major H. O. A. D. The Barracks, Hobart.

1923 Butler, Mrs. G. H. Augusta Road, New Town.

1909 †*Butler, W. F. D., B.A., M.Sc., LL.B. Bishop Street, New Town.

1921 Butler, Rev. W. Corly. The Parsonage, Melville Street.

Year of Election.

1917 Butters, J. H. Chief Engineer and Manager State Hydro-Electric Department, Hobart.

1921 Camm, Dr. Carlyle. George Street, Launceston.

1920 Cane, F. B. 90 High Street, Sandy Bay.

1919 Chapman, A. D. Collins Street, Hobart.

1912 Chapman, J. R. Holebrook Place, Hobart.

1901 C Chapman, R. W., M.A., B.C.E. Elder Professor of Mathematics and Mechanics in the University of Adelaide. The University, Adelaide.

1913 Chepmell, C. H. D. Clerk of Legislative Council, Hobart.

1920 Clarke, W. L., M.B. Macquarie Street, Hobart.

1896 †*Clarke, A. H., M.R.C.S., L.R.C.P. St. Helens, Tasmania.

1918 Clarke, T. W. H. Quorn Hall, Campbell Town.

1910 †*Clemes, W. H., B.A., B.Sc. Clemes College, New Town.

1922 Collier, J. D. A. Librarian, Tasmanian Public Library.

1917 Copland, D. B., M.A. Professor of Economics. The University, Hobart.

1920 Cranstoun, Mrs. F. A. 6 Gregory Street, Sandy Bay.

1917 Cullen, Rev. John. Macquarie Street, Hobart.

1918 †Cummins, W. H., A.I.A.C. Lindisfarne.

1915 †*Crowther, W. L., M.B., D.S.O. Macquarie Street, Hobart.

1922 Davern, Miss N. St. George's Terrace.

1922 Davidson, R. Huon Timber Company, Hobart.

1919 Davies, H. Warlow, C.E. Abermere, Mt. Stuart.

1923 Davis, Alfred. Lord Street, Sandy Bay.

1923 Davis, Charles. Lindisfarne.

1908 †Dechaineux, Lucien. Principal of Technical School, Hobart.

1903 Delany, Most Rev. Patrick. Archbishop of Hobart. 99 Barrack Street.

1892 C Dendy, A., D.Sc., F.R.S., F.L.S. Professor of Zoology in the University of London (King's College). "Vale Lodge," Hampstead, London, N.W.

Year of Election.		
1921		Douglas, O. Gordon. 27 Patterson Street, Launceston.
1921		Dryden, M. S. 13 Hillside Crescent, Launceston.
1921		Eberhard, E. C. Charles Street, Launceston.
1923		Edwards, Hon. F. B., M.L.C. Ulverstone.
1919		Elliott, E. A., M.B. Main Road, New Town.
1918		Ellis, F. Education Department, Hobart.
1921		Elms, E. A. Post Office, Launceston.
1913		Erwin, H. D., B.A. Hutchins School, Hobart.
1921		Emmett, E. T. Railway Department, Hobart.
1918		Evans, L. Acting Director of Agriculture, Hobart.
1921		Eyre, H. Manual Training School, Launceston.
1902		Finlay, W. A. 11 Secheron Road, Hobart.
1918		Fletcher, C. E. Education Department, Hobart.
1909	†*	Flynn, T. T., D.Sc. Ralston Professor of Biology, University of Tasmania.
1921		Flounders, A. 102 Patterson Street, Launceston.
1921		Forward, J. R. Mechanics' Institute, Launceston.
1890	L	Foster, H., Lt.-Col. Merton Vale, Campbell Town.
1905	L	Foster, J. D. "Fairfield," Epping.
1921		Fox, Miss. Ladies' College, Launceston.
1918		Gatenby, R. L. Campbell Town.
1922		Gatenby, Miss M. 5 Berean Street, Launceston.
1923		Gibbings, R. A. C. 28 Antill Street. Hobart.
1908	†*	Giblin, Major L. F., D.S.O., B.A. Government Statistician, Davey Street.
1922		Giblin, A. V. King Street, Sandy Bay.
1918		Gillett, Henry. "Wetmore," Ross.
1920		Gillies, J. H. Macquarie Street.
1923		Gorringe, J. A. Kempton, Tasmania.
1923		Gould, H. T., J.P. Liverpool Street, Hobart.
1918		Gould, J. W. Tramways Department, Hobart.
1907		Gould, Robert. Longford.
1921		Grace, W. L. 91 High Street, Launceston.
1905	L	Grant, C. W. High Peak, Huon Road.
1923		Green, Dr. A. W. 30 Parliament Street, Sandy Bay.

Year of Election.		
1923		Gunn, F. L. Davey Street, Hobart.
1921		Hall, E. L. 38 Lyttleton Street, Launceston.
1922		Halligan, G. H., F.G.S. 97 Elphin Road, Launceston.
1913		*Hardy, G. H. C/o University, Brisbane, Queensland.
1923		Harley, R. Institution for Blind, Deaf and Dumb, Hobart.
1918		Harrap, Lt.-Colonel G. Launceston.
1921		Harris, Miss Ila. Studio, Findlay's Buildings, Launceston.
1921		Harris, Dr. R. E. 73 Cameron Street, Launceston.
1921	L	Harvey, David Hastie. "Manresa," Lower Sandy Bay, Hobart.
1902	C	Haswell, William, M.A., D.Sc., F.R.S., F.L.S. The University, Sydney, N.S. Wales.
1913		Hawson, Edward. "Remine," 174 Argyle Street, Hobart.
1919		†Hay, Rt. Rev. R. S., D.D., Bishop of Tasmania. Bishopscourt, Hobart.
1921		Heritage, J. E. 76 Frederick Street, Launceston.
1921		Heyward, F., F.R.V.I.A. 43 Lyttleton Street, Launceston.
1915		Hickman, V. V., B.Sc. "Burnham," Mulgrave Crescent, Launceston.
1919		Higgins, Dr. P. Campbell Town.
1921		Hill, A. H. 143 Charles Street, Launceston.
1913		Hills, Loftus, M.B.E., D.Sc.
1914		Hitchcock, W. E. Moina, Tasmania.
1918		Hogg, G. H., M.D., C.M. 37 Brisbane Street, Launceston.
1921		Hogg, W. Public Buildings, Launceston.
1922		Hood, F. W. Customs House, Hobart.
1921		Horne, George, V.D., M.A., M.D., Ch.B. 63 Collins Street, Melbourne, Vic.
1921		Horner, A. G. 16 York Street, Launceston.
1923		Hudspeth, W. H. "The Nook," Lower Sandy Bay.
1922		Hungerford, Mrs. Red House, Fern Tree.
1922		Hungerford, Miss. Red House, Fern Tree.
1923		Hurst, Miss E. R. 39 Bay Road, New Town.

Year of Election.		
1909		*Hutchison, H. R. 1 Barrack Street, Hobart.
1922		Huxley, G. H. Crescent Road, W. Hobart.
1920		Hytten, T. 338 Murray Street, Hobart.
1913		Ife, G. W. R., LL.B. Summerhill Road, Hobart.
1918		Irby, L. G. Conservator of Forests, Forestry Department, Hobart.
1898		*Ireland, E. W. J., M.B., C.M. Launceston General Hospital.
1919		Jackson, George A. 79 Collins Street, Hobart.
1906		*Johnson, J. A., M.A. Principal of Phillip Smith Training College, Hobart.
1921		Johnson, J. D. 142 St. John Street, Launceston.
1922		Johnson, W. Roye. Clemes College, New Town.
1922		Johnston, J. R. Murray Street.
1922	L	Jones, Sir Henry, Kt. Campbell Street, Hobart.
1921		Judd, W., M.A. College Street, Launceston.
1921		Keating, J. H. Melbourne.
1921		Keid, H. G. W. Powelton, via Yarra Junction, Victoria.
1911		Keene, E. H. Douglas, B.A. Burnie.
1922		Kemp, Andrew. Stoke Street, New Town.
1922		Kennedy, J. St. George's Terrace, Battery Point.
1910		Kermode, R. C. Mona Vale, Ross.
1913		Knight, J. C. E. "Windermere," Claremont.
1918		Knight, C. E. L., B.Sc. Claremont.
1919		Knight, H. W. National Mutual Buildings, Macquarie Street, Hobart.
1887		†Lewis, Sir Neil Elliot, K.C.M.G., M.A., B.C.L., LL.B. "Werndee," Augusta Road, Hobart.
1919		*Lewis, A. N., M.C., LL.B. "Werndee," Augusta Road.
1912		†Lindon, L. H., M.A. "The Lodge," Park Street, Hobart.
1900		Lines, D. H. E., M.B., Ch.B. Archer Street, New Town.
1921		Listner, W. Parker, M.A., LL.B. 2 Byron Street, Sandy Bay.
1875	C	Liversidge, Professor Archibald, M.A., LL.D., A.R.S.M., F.R.S., F.I.C., F.C.S., F.G.S., F.R.G.S. "Fieldhead," Coombe Warren, Kingston, Surrey, England.

Year of Election.		
1912		†*Lord, Clive E., F.L.S. Director of the Tasmanian Museum, Hobart. "Cliveden," Sandy Bay.
1921		Lord, Chester. "Mellifont," High Street, Sandy Bay.
1921		Lord, Raymond. "Handroyd," 6 Franklin Street, Hobart.
1922		Lowe, H. M. Hadley's Hotel, Murray Street, Hobart.
1922		Macleod, Mrs. L. H. High Street, Sandy Bay.
1919		Mackay, A. D., B.Sc., M.M.E. 4 Fawkner Street, South Yarra, Vic.
1912		McAlister, Miss M. K. Holebrook Flats, Holebrook Place.
1893		*McAulay, Alexander, M.A., Professor Mathematics in the University of Tasmania. The University, Hobart.
1923		McAulay, A. L., Ph. D. The University, Hobart.
1921		McGowan, W. Superintendent of Reserves, Launceston.
1921		McClinton, Dr. R. 70 St. John Street, Launceston.
1921		McInytre, Dr. W. Keverall. 37 Brisbane Street, Launceston.
1902	C	*Maiden, J. H., I.S.O., F.R.S., F.L.S., Director of the Botanic Gardens, Sydney, & Government Botanist of N.S.W. Botanic Gardens, Sydney.
1918		Mansell, A. E. Melton Mowbray.
1918		Martin, Brig.-General W., V.D. Launceston.
1913		Mather, J. F. 15 Church Street, Hobart.
1921		Masters, A. H. A.M.P. Chambers, Launceston.
1895		*May, W. L. Forest Hill, Sandford.
1909		Millen, Senator J. D. Roxburgh, Newstead.
1907		Miller, Lindsay S., M.B., Ch.B. 156 Macquarie Street, Hobart.
1921		Miller, W., c/o D. & W. Murray Ltd., Launceston.
1921		Miller, R. M. State High School, Launceston.
1894	L	Mitchell, J. G. Parliament Street, Sandy Bay.
1911		Montgomery, R. B. "Astor," Macquarie Street, Hobart.

Year of Election.

1921 Morris, E. Sydney, M.B., Ch.M., D.P.H., Chief Health Officer, Tasmania. 3 Montague Avenue, New Town.

1918 Murdoch, Hon. Thomas, M.L.C. 55 Montpelier Road, Hobart.

1921 Murdoch, Ronald. "Marathon," Lower Sandy Bay.

1921 Muschamp, Rev. E. Holy Trinity Rectory, Launceston.

1882 Nicholas, G. C. "Cawood," Ouse.

1918 Nicholls, Sir Herbert, Kt., Chief Justice of Tasmania. Pillinger Street, Queenborough.

1910 Nicholls, H. Minchin, Government Microbiologist, Dept. of Agriculture, Hobart. Macquarie Street, Hobart.

1921 Nye, P. B. Geological Survey Office, Hobart.

1917 Oldham, N., J.P. New Town.

1921 Oldham, W. C. 39 George Street, Launceston.

1922 Overell, Miss Lilian. Holebrook Place.

1921 Padman, R. S. 56 St. John Street, Launceston

1921 Patten, W. H. 59 Cameron Street, Launceston.

1923 Parker, Dr. G. M. Swansea, Tasmania.

1922 Parker, H. T. Training College, Hobart.

1921 Parker, R. L. 81 St. John Street, Launceston.

1908 Parsons, Cecil J. 190 Davey Street, Hobart.

1888 C Pearson, W. H., M.Sc., A.L.S. 18 Palatine Road, Withington, Manchester, Eng.

1923 Pedder, A. Stoke Street, New Town.

1922 Perrin, Miss K. 16 York Street, Launceston.

1902 †*Piesse, E. L., B.Sc., LL.B. "Merridale," Sackville Street, Kew, Melbourne.

1910 Pillinger, James. 4 Fitzroy Crescent, Hobart.

1918 Pitt, Frank C. K. "Glen Dhu," The Ouse.

1919 Pitt, C. F. Campbell Town.

1908 Pratt, A. W. Courtney. "Athon," Mt. Stuart Road, Hobart.

1922 Pulleine, R., M.B. 163 North Terrace, Adelaide.

1923 Purcell, G. A. Clemes College, Hobart.

1922 Reid, A. R. Curator, Beaumaris Zoo, Domain, Hobart.

Year of Election.		
1921		Reid, A. McIntosh. Geological Survey Office, Hobart.
1921		Reid, W. D. Public Buildings, Launceston.
1921		Reynolds, John. Knocklofty Terrace, Hobart.
1919		Riggall, Captain A. Hortin, D.S.O. Tunbridge.
1912		†*Robinson, J. Moore-. Librarian and Publicity Officer, Chief Secretary's Department, Hobart.
1884		†*Rodway, L., C.M.G., Government Botanist. 77 Federal Street, Hobart.
1923		Rogers, G. H. B., M.A. Royal Exchange Chambers, Collins Street, Hobart.
1921		Rolph, W. R. *Examiner* & *Weekly Courier* Office, Launceston.
1913		Ross, Hector. Cambridge.
1922		Sargison, H. Elizabeth Street, Hobart.
1921		Savigny, J. 21 York Street, Launceston.
1896		Scott, R. G., M.B., Ch.M. 172 Macquarie Street, Hobart.
1921		*Scott, H. H. Curator of the Victoria Museum, Launceston, Tas.
1921		Sharland, M. S. R. C/o *The Mercury* Office, Hobart.
1892	C	*Shirley, John, D.Sc., Principal Teachers' Training College, Queensland. "Cootha," Bowen Hills, Brisbane.
1921		Shields, Hon. Tasman, M.L.C. 13 Patterson Street, Launceston.
1901		Shoobridge, Canon G. W. 3 Molle Street, Hobart.
1921		Shoobridge, Hon. L. M., M.L.C. "Sunnyside," New Town.
1923		Shoobridge, S. E. c/o Messrs. H. Jones and Co., Ltd., Hobart.
1923		Simson, Mrs. L. 3 St. George's Square, Launceston.
1917		Slaytor, C. H., F.I.C. Misterton, Doncaster, England.
1901	C	Smith, R. Greig, D.Sc. Linnean Hall, Elizabeth Bay, Sydney.
1921		Smithies, F. 34 Patterson Street, Launceston.
1919		Snowden, Colonel R. E. "Minallo," West Hobart.

Year of Election.		
1896	L	*Sprott, Gregory, M.D., C.M. Macquarie Street, Hobart.
1921		Spurling, S., Jnr. Brisbane Street, Launceston.
1919		Stevenson, Miss F. "Leith House," New Town.
1920		Swindells, A. W. 141 Campbell Street.
1907		Tarleton, J. W. Sandy Bay.
1918		Taylor, Walter E. Elboden Street, Hobart.
1920		Taylour, W. H. Equitable Buildings, Melbourne.
1920		Taylour, Harold. Equitable Building, Melbourne.
1922		Thomas, Lt.-Colonel L. R., D.S.O. Registrar of the University of Tasmania.
1921		Thomas, P. H. Agricultural Department, Hobart.
1922		Thomson, E. H. Lower Sandy Bay.
1892	C	*Thompson, G. M., F.L.S. Dunedin, N.Z.
1918		†Thorold, C. C., M.A. The Hutchins School, Hobart.
1921		Tymms, Dr. A. O. 18 York Street, Launceston.
1923		Unwin, E. E., M.Sc. Friends' High School, Hobart.
1921		Wakefield, F W
1918		Walch, Percy. King Street, Sandy Bay.
1901	C	Wall, Arnold, M.A. Professor of English Language & Literature in Canterbury College, Christchurch, N.Z.
1913		Wardman, John. Superintendent of the Botanical Gardens, Hobart.
1918		Waterhouse, G. W., B.A., LL.M., Cantab. Messrs. Ritchie & Parker, Alfred Green & Co., Launceston.
1922		Waterworth, E. N. Poet's Road, W. Hobart.
1922		Watson, D. W. Hobart.
1922		Wayn, Miss A. L. Lambert Avenue.
1918		Weber, A. F. Lands Department, Hobart.
1923		Webster, Hugh C. "Greystanes," Lower Sandy Bay.
1923		Wherrett, Miss A., B.A. Florence Street, Moonah.
1920		Williams, Hon. W. M., O.B.E. Augusta Road, Hobart.
1922		Winch, A. A. Huon Road.
1901		Wise, H. J. Lambert Avenue, Sandy Bay.
1921		Wright, W. Invermay State School, Launceston.

ANNUAL REPORT

1923

The Council and Officers.

The Annual Meeting was held at the Society's Rooms, the Tasmanian Museum, on Monday, 26th February, 1923. The following members were elected as the Council for 1923:—Messrs. W. H. Clemes, W. H. Cummins, Dr. W. L. Crowther, Major L. F. Giblin, Rt. Rev. Dr. R. S. Hay, Messrs. J. A. Johnson, J. Moore-Robinson, L. Rodway, and Dr. Sprott.

During the year 12 meetings of the Council were held, and the attendance was as follows:—Dr. Crowther 11, Mr. Rodway 10, Mr. Johnson 9, Mr. Clemes 8, Mr. Moore-Robinson 8, Major Giblin 6, Dr. Sprott 6, Rt. Rev. Dr. Hay 3, Mr. Cummins nil (on leave of absence during part of the year on account of ill health).

The Council at its first meeting made the following appointments:—

Chairman of Council: Mr. L. Rodway, C.M.G.

Standing Committee: Messrs. Rodway, Clemes, and Major Giblin.

Editor of Papers and Proceedings: Mr. Clive Lord

Honorary Treasurer: Mr. J. Moore-Robinson.

Trustees of the Tasmanian Museum and Botanical Gardens: Doctors Crowther and Sprott, Messrs. Clemes, Cummins, Johnson, and Rodway.

Meetings.

During the year ten ordinary meetings of the Society were held, and were well attended. Outlines of the papers read and the lectures delivered will be found in the Abstract of Proceedings.

Membership.

The membership of the Society continues to be satisfactory, and the roll at the end of the year showed three Honorary Members, 12 Corresponding Members, 9 Life Members, and 245 Ordinary Members.

Finance.

The financial position of the Society has received careful consideration throughout the year. Unfortunately, it was not possible to obtain additional assistance from the Government.

Papers and Proceedings.

The Volume of the Papers and Proceedings for the year will be found to compare favourably with previous years, but financial considerations have made it necessary to refuse or postpone papers which would otherwise have been included.

R. M. Johnston Memorial.

The first R. M. Johnston Memorial lecture was delivered by Professor Sir T. W. Edgeworth David on Monday, 8th October; a full report appears in the Papers published for the year.

Tasman Memorial.

At the Annual Meeting of the Society held on 8th March, 1920, Sir Herbert Nicholls drew attention to the need for a memorial to commemorate the visit of Tasman in 1642. At a meeting of the Historical Section held on 26th October, Mr. Lord drew attention to the matter, with the result that the matter was taken up by the Section. The investigations of the Historical Section, however, were not finalised owing to the fact that Mr. J. Moore-Robinson and Mr. John Kennedy arranged a private visit to the site, and made a report direct to the Council of the Society. Acting upon this report the Council authorised the erection of a memorial on the site selected by this expedition. The exact position chosen by this expedition as being in their opinion the landing place of Tasman's carpenter is at the extreme head of the inner cove of Prince of Wales Bay. Later, the Historical Section again took the matter up as reported in the Abstract of Proceedings, 17th December, 1923. The memorial was erected during October by a party acting under the direction of Mr. John Kennedy, and was formally unveiled by Sir Herbert Nicholls on 3rd December. The erection of the memorial was made possible owing to the subscriptions received from members of the Society and others interested.

Obituary.

It is with regret that the Society has to record the death of the following members during the year:—

T. P. Arnold, Hobart, elected a member in 1920.

R. W. Canning, Hobart, elected a member in 1920.

N. Nicolson, Campbell Town, elected a member in 1919.

Miss S. R. Parsons, Hobart, elected a member in 1908.

P. S. Seager, I.S.O., Hobart, elected a member in 1922.

L. Simpson, Launceston, elected a member in 1921.

Dr. L. Grey Thompson, Launceston, elected a member in 1921.

Sir Herbert Nicholls unveiling the Tasman Memorial.

BRANCH REPORTS

NORTHERN BRANCH.

ANNUAL REPORT FOR THE YEAR 1923.

In these days of financial stress, and more or less unstable social conditions, it is satisfactory to be able to report that a scientific society is at least holding its own, and is on firm ground, with room for optimism as regards its future prospects. The Northern Branch has, unfortunately, lost one of its most valuable members in Dr. L. Grey Thompson, who died at Launceston on the 24th of October of this year. His unselfish devotion to the cause of science, and to the advancement of his fellow men, combined with his genial nature and broad outlook, endeared him to all, and his place will not be readily filled. One member has retired owing to absence from the State, and two new members have been elected.

On the 20th of June the following committee was elected:—Chairman, the Honourable Tasman Shields; members, Messrs. H. H. Scott, J. E. Heritage, R. O. M. Miller, F. Smithies, J. R. Forward, W. D. Reid, F. J. Heyward, and G. H. Halligan, L.S., F.G.S., Honorary Secretary and Treasurer.

Four papers were read, and two lectures delivered during the session, as follows:—

31st May—Lecture by Mr. Clive E. Lord, F.L.S., Director of the Tasmanian Museum, on "The Economic Aspects of the Tasmanian Fauna."

12th July—Paper by Mr. G. W. Waterhouse on "The Settlement of the North-West Coast of Tasmania by the Van Diemen's Land Co."

25th July—Paper by Mr. H. H. Scott on "Additional Notes on the Emus of King Island and Tasmania."

28th August—Paper by Mr. L. Rodway, C.M.G., Government Botanist, on "Plant Pathology, with special reference to Fungus Diseases."

15th October—Lecture by Mr. G. H. Halligan, L.S., F.G.S., on "The Doings of the Recent Pan-Pacific Congress at Melbourne and Sydney."

12th November—Paper by Mr. W. H. Reid, A.I.M.M., Lond., A.C.I., Aust., on "Notes on Sampling and the Utilisation of Coal in the Pulverised Form."

REPORTS OF SECTIONS

HISTORICAL AND GEOGRAPHICAL SECTION.

1. *Meetings.*

The Annual Meeting of the Historical Section of the Royal Society was held on 21st June. The resignation of Mr. J. Moore-Robinson from the position of Honorary Secretary was accepted, and Mr. J. Reynolds was elected to the position. It was decided to hold only three more meetings at monthly intervals if possible during the remaining part of the year. The dilapidated state of Old St. David's Burial Ground was brought before the notice of members, and it was decided that the section should actively interest itself in a scheme for preservation. The meeting concluded with an inspection of original sketches of early Tasmania in possession of the Royal Society.

The second meeting of the Section was held on 19th July, 1923. The chief business was the discussion of the measures the section should take regarding the preservation of Old St. David's Burial Ground. A short lecture entitled "The Genesis of Industry in Tasmania," illustrated with lantern slides, was given by Mr. J. Reynolds.

The third meeting was held on 22nd August, and the entire evening was devoted to discussing practical measures for the preservation of Old St. David's Burial Ground. Representatives of the Church authorities and other gentlemen actively interested were present. After discussion two motions were carried. The first, that the Church authorities be requested to confer with the City Council regarding a scheme for preservation, the Historical Section lending them all assistance possible. The second motion embodied the details of a scheme for the City Council to consider, in which it was proposed to reserve only a small area of the Burial Ground and therein suitably arrange all monuments of historic interest.

The last meeting was held on 15th November. A considerable amount of important business was brought before the meeting, including the position of the Tasman memorial, the proposed erection of a memorial to early navigators at Adventure Bay, the commemoration of centenary of constitutional separation from N.S. Wales, and the status of the section. At the termination of the business Mr. W. F. D. Butler read a paper on the Lady Franklin Museum and the Ancanthe estate.

2. *General Remarks on the Activities of the Section.*

1. Old St. David's Burial Ground.—The preservation of monuments of historical interest in this burial ground has greatly interested the Section this year, the chief aim being to raise public opinion in favour of the adoption of some definite and fitting scheme in the near future.

2. Historical Monuments.—Owing to the selection of the site for the Tasman memorial being taken out of its hands, the Section felt that it could not assume any responsibility for the accuracy of the determination of the present site. At the November meeting, the Section, after considering the position and recognising that no small amount of doubt existed, passed a motion recommending that the Council of the Royal Society change the wording on the Memorial from "At this spot" to 'Near this spot." The Section has also interested itself in the proposed erection of one memorial to all the navigators who visited Adventure Bay between 1772 and 1802.

3. Historical Research.—Realising the necessity of making a definite advance in research work and the necessity of establishing its own bureau of information, the Section have voted a small sum of money for the purpose of putting a reference card index system into operation. The importance of collecting historical reference cannot be overestimated, and it is hoped that in the not distant future the Section will possess a both extensive and valuable reference system.

EDUCATIONAL SECTION.

Chairman: T. W. Blaikie.
Secretary: H. T. Parker.

The following meetings were held:—

24th April—Observations made in the Schools and Colleges of New Zealand. Mr. J. A. Johnson.

15th May.—A Historical Résumé of the Development of Educational Measurement. Mr. Parker.

12th June.—Intelligence: Its Measurement and Distribution. Mr. Huxley.

10th July.—Comprehension and Interest as Related to the School Curriculum. Mr. Fletcher.

14th August.—Tests of Scholastic Efficiency: Measurement of the Products of Instruction. Messrs. Johnson and Dechaineux.

11th September.—Rote Learning: Its Place in the Curriculum. Messrs. Clemes and Purcell.

ROYAL SOCIETY OF TASMANIA.

RECEIPTS AND EXPENDITURE, 1923. GENERAL FUND.

RECEIPTS.

		£	s.	d.
Balance brought forward		1	13	6
Government Grant in Aid		100	0	0
Subscriptions, &c.		231	0	0
Sundries		2	5	11
		£334	19	5

I have compared the Receipt Book, Vouchers, and Bank Book with items particularised in the Cash Book, and found them to be correct.

R. A. BLACK.
Hon. Auditor.

23/2/24.

PAYMENTS.

		£	s.	d.
Light and Fuel		1	18	0
Postage and Petty Cash		17	15	5
Salaries		32	10	0
Papers and Proceedings:—				
1922	£72 17 10			
1923	73 3 4			
		146	1	2
Expenses of Meetings, &c.		63	9	8
Refund Northern Branch		15	15	0
Library and Insurance		53	15	1
Lantern Operator		2	14	6
Cheque Book		0	5	0
		334	3	4
Credit Balance		0	16	1
		£334	19	5

J. MOCRE ROBINSON,
Hon. Treasurer.

22/2/24.

R. M. JOHNSTON MEMORIAL FUND, 1923.

RECEIPTS.	£	s.	d.	PAYMENTS.	£	s.	d.
From last balance	13	5	0	By Purchase Memorial Medals	26	6	2
Revenue 1923-24	14	12	0	Credit Balance	1	10	10
	£27	17	0		£27	17	0

MORTON ALLPORT MEMORIAL FUND, 1923.

RECEIPTS.	£	s.	d.	PAYMENTS.	£	s.	d.
From last balance	9	15	0	To Purchase of Books	15	12	0
Revenue 1923-24	9	15	0	Credit Balance	3	18	0
	£19	10	0		£19	10	0

THE ROYAL SOCIETY OF TASMANIA, NORTHERN BRANCH.

STATEMENT OF RECEIPTS AND EXPENDITURE, 31st DECEMBER, 1923.

	£	s.	d.		£	s.	d.
To Balance from last Account	12	13	4	By Advertisements and Printing, &c.	4	19	5
" Subscriptions received	15	15	0	" Lantern Hire	0	17	0
" Interest	0	8	2	" Travelling Expenses	2	0	0
				Balance	21	0	1
	£28	16	6		£28	16	6

Audited and found correct,
J. E. HERITAGE,
Hon. Auditor.

GERALD H. HALLIGAN,
Hon. Secretary and Treasurer.

INDEX

Titles of Papers, and New Genera and Species in **Heavy Type.**

PAPERS & PROCEEDINGS

OF THE

ROYAL SOCIETY OF TASMANIA

FOR THE YEAR

1923

(With 13 Plates and 19 Text Figures)

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of the
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ROYAL SOCIETY OF TASMANIA

PAPERS AND PROCEEDINGS, 1923

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