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

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[PROC. ROY. SOC. VICTORIA, 20 (N.S.), PT. I., 1907.]

ART. I.—*A Living Descendant of an Extinct (Tasmanian) Race.*

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(With Plate I.).

[Read 11th April, 1907].

As in all probability it has not been the lot of any living British anatomist to gaze on a living representative of the extinct native Tasmanian race, the photograph of the half-caste daughter of a member of that race may not be without interest.

The circumstances under which the author was fortunate enough to obtain the photograph were as follows:

At the conclusion of the meeting of the Australian Association for the Advancement of Science, held in January, 1907, the Government of South Australia was good enough to place at the disposal of a limited number of members of the Association, of which I was fortunate enough to be one, the Government steamer, "Governor Musgrave," for a three days' scientific excursion to the various islands and other places of interest in the Spencer and St. Vincent Gulfs. Amongst the various places visited on this interesting excursion was Hog Bay, in Kangaroo Island, at which place the subject of the present photograph is a resident, and where the photograph was taken.

Kangaroo Island receives but scant attention in the majority of modern Geographical Text-books, but the extracts which follow will give some idea of what the Island was, and what it has since become.

An anonymous member of the Royal Geographical Society of London, writing in 1856, says (1):—

"Kangaroo Island, an island off the coast of South Australia, was discovered by Flinders in 1802, and was so named by that navigator from the great number of kangaroos which he found on it. It extends about eighty miles in length from west to east, and is 32 miles broad on the meridian of Cape Gantheaume, or 137 deg. 29 min. East, which is nearly its central meridian. The parallel of 35 deg. 50 min. South intersects it centrally. Its coast line presents numerous headlands and bays. . . . . . The rocks generally are devoid of stratification, and belong to the trap class. Its area has been estimated at 2,500,000 acres. The greater part of the surface is covered with matted bush, which swarms with snakes, tarantulas, scorpions, and mosquitoes. The trees principally belong to the classes of Eucalyptus and Casuarina. The few streamlets which flow north are dried up in summer; but a few on the south side flow permanently. Some patches of grain of good quality are grown, and about 2000 sheep are at present pastured upon it. Stone is occasionally brought from it to Port Adelaide; also fine crayfish, and salt, which is supplied by several extensive lagoons. A lighthouse has been erected on Cape Willoughby, its south-east extremity, which is 16 miles south-south-east of Cape Jervis."

Whatever progress the Island may have made during the latter half of the nineteenth century will be shown by the two descriptions which follow:—

Chisholm, the editor of Longman's "Gazetteer of the World," writing in that work in 1895, says (2):—

"Kangaroo Island, South Australia, is separated by Investigator Strait (at the mouth of Gulf St. Vincent), from Yorke's Peninsula, on the north; and by Backstairs Passage from the mainland of South Australia on the east. Kingscote, on the north-east coast, was the first settlement in South Australia. The area fit for cultivation and pasturage is extremely small, the island being covered with scrub. Discovered by Captain Flinders in 1802; uninhabited up to 1828; from 1877 immigration increased rapidly, but latterly the settlers have been reduced to great distress by the spread of a wild plant. Length, east to west, 87 miles. Average breadth, north to south. 20 miles. Area, 1679 square miles. Population in 1881, 379; in 1891, 599."

In the last edition of the Admiralty sailing directions which is available to me (3) the island is thus described:—

"Kangaroo Island, at the entrance of the Gulf of St. Vincent, is 80 miles long east and west, and about 24 miles broad, resembling in shape the Malay Cris or dagger, with its handle to the eastward. The land is of good elevation and well wooded.

Kangaroo Island is becoming settled as an agricultural area. The farmers are located mostly about the eastern part of the island, at Antechamber Bay, Hog Bay, Eastern Cove, and Kingscote. They are a very orderly and healthy community. Townships are forming at Nepean Bay, and jetties are being constructed.

There is a scattered population settled along the banks of the Three Well or Cygnet River, and some land has been taken up for agricultural purposes along the course of Hog Bay River, on the south coast.

There are settlers at Emm, Smith, Dashwood, and Stokes Bays, and the barley fields at Snellings Beach were conspicuous marks from the sea during the survey (1863-73). There are also settlers at Ling Cove, at D'Estree and Vivonne Bays.

Barley is the staple product of the island, which grows the best in South Australia.

The island is well watered, but from Kingscote westward is mostly covered with thick scrub and unfit for either sheep or wheat farming."

In addition to the foregoing, there have also appeared some very readable articles of a more popular nature in the columns of the morning press of Adelaide, which have since been reproduced in pamphlet form. (4).

Such being Kangaroo Island, it is now necessary to show what connection this island has with the distant land of Tasmania, and how it comes about that a descendant of the original native population of the latter island is now to be found on the former.

Prior to the year 1835, when the colonisation of the island may be said to have commenced with the foundation of the township of Kingscote, "the island was tenanted by a few nomads, who had either deserted from vessels which had previously called there, or had come in boats from Tasmania. Their histories need not here be recounted." The chronicler does well to suppress them. "One of them, who enjoyed the sobriquet of "Wally," was said to have arrived from Tasmania in 1819, bringing with him two aboriginal women named "Puss" and "Bet" (4)."

It is, therefore, obvious that the earliest lawless inhabitants of this lonely island imported native Tasmanian aboriginal women to Kangaroo Island in the capacity of "wives," and hence it comes about that to-day a descendant of such a union between a white man and a female representative of one of the most ancient races in the world, is now to be found in Kangaroo Island, far removed from the land of her ancestors.

Mrs. S., on the spectator's right in the illustration, is a genuine half-caste Tasmanian, who was born on Kangaroo Island some seventy-five years ago, as the result of the union of a white man—the late N.T.—with a native Tasmanian woman. Educated by the wife of the first appointed head-keeper of the Cape Willoughby lighthouse, Miss T. was married to the late Mr. William S. at Antechamber Bay, prior to the death of either of her parents. "Her father died subsequently to her marriage; and her mother, an aboriginal of Tasmania, survived him for ten years, and died at Cape Borda, where she is buried" (4).

Mrs. S. has one son, and two daughters, one of whom, an imbecile, is shown in the photograph, and who is, of course, a quarter-caste Tasmanian.

As at the time of my visit to Adelaide I could not foresee that I should have the opportunity of visiting Kangaroo Island, or even had I known that much, as I could still not have foreseen that I should have been fortunate enough to come across such an interesting anthropological problem as Mrs. S., I was unable to make any craniometrical measurements as I had none of the necessary instruments with me, though it is an open question if it is not worth the two days' journey to make such measurements. As, therefore, it is impossible for me, as yet, at all events, to give any measurements of this half-caste Tasmanian, we may next, perhaps, briefly summarise some of the physical characters of this most ancient race, concluding with a resumé of some of the theories as to the origin of the same.

Notwithstanding that the native Tasmanian race only became finally extinct little more than a generation ago, it will be sufficiently obvious that the date of its extinction, 1868, just about coincides with the birth of anthropology as an exact science, and that our scientific knowledge of this highly interesting, but little known race, cannot, in view of modern methods, be regarded as very accurate.

Bonwick, in his "The Lost Tasmanian Race" (6) thus describes, from personal experience, the physical characteristics of the race:—

The native Tasmanians "were dark in skin, brilliant in eye, with massive jaw, immense teeth, woolly hair, curly beard, bridgeless nose, expanded nostril, scarred body, shapely feet, small hand . . . . Except in colour, they were unlike their neighbours of New Holland (Australia). In hair, in nose, in limb, they differed. . . . . The lowest down the depths of barbarism, they were neither stupid nor miserable . . . , but had sense and feeling."

Bonwick, in his larger work on the "Daily Life and Origin of the Tasmanians" (5) gives some anthropometrical measurements of the race, and also goes, at much greater length, into the physical characteristics of the latter, of which the following is a brief summary:—

Skin, dark brown, or nearly black, but so disguised with pigments as to make it difficult to state exactly what colour.

Hair hangs in corkscrew appendages about the men's faces, is black, and has a crisp, woolly look. The diameters of the hair ellipse are given as 25 is to 15, to which point reference will again be made.

The eyes have the iris always dark coloured, whilst the white of the eye is not so clear as in Europeans.

Mouth, great width; lips, though full, had not the negro dimensions.

Jaws, strongly set; chin, inferior to that of civilised races, and in the women, particularly, very small and retreating.

Nostrils, exceedingly wide and full, but the great peculiarity, though not absolutely confined to this people, lay in the depression at the commencement of the organ, giving the feature much of a pyramidal character.

Teeth, large and powerful, so much so as to constitute a decided peculiarity. On the question of the teeth, Bonwick apparently enlisted the services of a dentist, for he quotes Pardoe, a Melbourne representative of that profession, as follows:—

"The Tasmanian teeth have large crowns, thickly covered by enamel, more so than in Europeans. Fangs are not so deeply seated in alveolar sockets, nor does epiphysis of maxillary bone come so high as in Europe. Gums are much thicker and make up this loss." The colour of the teeth remarkably white. so much so as to have been greatly envied by some of the earliest French voyagers to the island.

Modern methods, with exact measurements and indices, would now enable us by means of Flower's dental index (7) to style these teeth megadont, with an index above 44.

Regarding the relative proportions of the hair ellipse, Bonwick gives the following table:—

Tasmanians -	as	25	is to	15
Negro - -	„	20	„	12
Fiji - -	„	35	„	20
Malay - -	„	22	„	15
New Zealand	„	24	„	18
Chinese - -	„	33	„	24

It is not stated whether these proportions are actual measurements of the hair, as viewed microscopically in transverse section or not, but as it would be difficult to obtain such proportions without actual measurements, we may assume for the moment that they represent actual measurements, and apply thereto the index mentioned by Duckworth (8), thus:—

$$\text{Index} = \frac{\text{Breadth of the Section} \times 100}{\text{Length of the Section}}$$

with the following results:—

Tasmanians -	Index	60
Negro - -	„	60
Fiji - -	„	57
Malay - -	„	68
New Zealand	„	75
Chinese -	„	72

Duckworth says "the numerical value of this index has been found to vary between 28 and 100, the lowest figure being provided by the curly hair of an Oceanic (Papuan) Negro, and the highest by the lank and straight hair of Mongolians." He also gives a figure of the cross sections of the hair of a Negrito Semang from the Malay Peninsula, where the index is in the one 55.2, and in the other 58.9.

As it will be presently shown that the consensus of opinion is apparently in the direction of allying the Tasmanians to the Papuans of New Guinea, the discrepancy in the hair index, as worked out from Bonwick's figures, and of Duckworth's statement regarding the low nature of the genuine Papuan hair index would be somewhat remarkable could we relv absolutely on Bonwick's proportions representing actual measurements, but this, as stated, is only conjectural.

Roth (12) in his "The Aborigines of Tasmania," published in 1890, has presented us with what is, perhaps, the best general description of this race; as, however, Roth's account of the physical characteristics of the native Tasmanian is a compilation from various authors, whilst Bonwick's account is from personal observation, I have preferred to utilise the latter author only, more particularly as, after all, Roth does not, on this question, differ very considerably, if at all, from the earlier writer. Roth, however, being of more recent date than Bonwick, is much more precise in his anthropometrical data, and these data I hope to avail myself of in a future communication on this subject.

The subject of the present paper is, as already mentioned, a Tasmanian half-caste, and a reference to her photograph will show that she bears many striking resemblances to the pen picture quoted from Bonwick, particularly in the colour of the skin, the width of the mouth and nostrils, the weak chin, and the dark eyes. The hair, though distinctly woolly, has departed from the racial type consequent on the admixture of the white blood, though curiously enough, the native type is, on the whole, more marked in the grand-daughter of the aboriginal mother than in the daughter. In this connection, it is interesting to see what has been said of the first Tasmanian half-caste, in contradistinction to this, which is the last of such crosses.

Evans (9), in his "History and Description of the Present State of Van Dieman's Land" (Tasmania), says:—

"The eldest child of this (native Tasmanian) woman, now a fine girl about eleven years old, and the first child born by a native woman to a white man in Van Dieman's Land . . . . is called Miss Dalrymple, and, like all the other children since produced by an intercourse between the natives and the Europeans, is remarkably handsome, of a light copper colour, with rosy cheeks, large black eyes, the whites of which are tinged with blue, and long well-formed eye-lashes, with the teeth uncommonly white, and the limbs admirably formed."

Whatever opinion may be formed as to the good looks of the subject of the present paper there can be no two opinions as to her intelligence. In conversing with her, the two facts which impressed me most strongly were her remarkable intelligence and the absolute purity of her English speech, and had I not actually heard her, I could not have believed that such intelligence could have been derived in one generation from a race, often, but, perhaps, quite erroneously, believed to have been one of the most degraded and brutal in the world's races. That this opinion is in no way exaggerated is shown by Hallack (4), who says:—

"Mrs. William S. is . . . . of a bright and happy disposition, a most entertaining conversationalist, and, withal, extremely apt at repartee."

The records of the deaths of the last pure-bred Tasmanians are as follows:—

"The last Tasmanian man, William Lanney, Lanny, or Lannè, alias King Billy, died on March 3rd, 1869, aged 34. In January of the previous year (1868), he had walked proudly with Prince Alfred; Duke of Edinburgh, on the Hobart Town Regatta ground, conscious that they alone were in possession of royal blood" (6).

Whilst Lanney was the last surviving man of the race, he was outlived by a woman named "Truganini, or Lalla Rookh . . . . who died in May, 1876, and was supposed to be seventy-three years old" (6). With her, the native Tasmanian race became finally extinct, and there now remain but a few half-castes, of whom the subject of this paper forms one of the oldest, if not actually the oldest, now living.

We now pass to the purely controversial side of the question, and though there are many debatable points in connection with the lost Tasmanian race, attention will only be directed to three of these problems. These three are, however, of the very greatest importance, and are as follows:—

1. Is the Tasmanian of remote or recent origin?
2. With what race is the Tasmanian most closely allied?
3. How did the Tasmanian reach Tasmania?

Regarding the first of these questions it may be stated that the few authors who have made any scientific observations whatsoever upon this unhappy race, as well as those, who, from personal contact with its then living representatives have been in the best position to judge, are all agreed as to the great antiquity of the Tasmanian aboriginal.

Bonwick, whose excellent description of the Tasmanian aboriginal has already been quoted, has no doubts upon this point, for he says (5):—

"That the Tasmanians . . . . are of high antiquity, even as regards other inhabitants of the world, can admit of little doubt. A strong argument for their remote age may be gathered from their ignorance of navigation." And, again, the same author says, "No race presents itself to us of a greater relative antiquity (than the Tasmanian). They lived throughout history."

Tylor, in his preface to Roth's "The Aborigines of Tasmania" (12), says:—

"If there have remained anywhere up to modern times men whose condition has changed little since the early stone age, the Tasmanians seem to have been such a people. They stand before us as a branch of the Negroid race, illustrating the condition of man near his lowest known level of culture . . . . it appears that the aborigines of Tasmania . . . . by the workmanship of their stone implements rather represent the condition of Palaeolithic Man." The same author (Tylor 13) has elsewhere pointed out that the Tasmanians were representatives of the stone age development, and were in a stage lower than that of the Quaternary period of Europe, and hence the distinction may be claimed for them of being the lowest of modern nomad tribes.'"

Howitt (14), too, bears witness to the same idea, for he says: —"In considering all the facts before me bearing upon the question of the origin of the Tasmanians and the Australians, I have been much impressed by the immense periods of time which seem to be essential to any solution of the problem," and, again, "I have said before, and desire to repeat, that the conclusions to which I have been led as to the origin of the Tasmanians and Australians necessarily demand a vast antiquity on the

Australian Continent, for the former, and a very long period of at least prehistoric time for the latter."

As examples of scientific evidence the foregoing extracts count for little, but as examples of close scientific reasoning from the known to the unknown they count, or should count, for much, and it seems to me that an antiquity, a great antiquity, must be allowed the now extinct Tasmanian race, for there is no question that the more one examines the problems attaching to the Tasmanian, the more the opinion forces itself upon one's attention.

Concerning the second of these debatable points—"With what race is the Tasmanian most closely allied?" the consensus of opinion appears to be in favour of regarding the Tasmanians as quite distinct from their neighbours of the adjacent Australian mainland, and, second, of allying them to the much more distant Papuans of New Guinea, or, rather, to the primitive stock from which that people may have been derived.

As regards the first point, and, incidentally, the second also, Mr. Protector Parker, quoted by Bonwick (5), says:—

"It is one of the many strange ánomalies of Australian geography that a branch of this Papuan race should have been found in Australia (i.e., Tasmania), whose woolly hair and blacker complexion clearly distinguish them from the Continental Australian, and yet that no branch of the same family should be found on the shores of the mainland nearest the presumed locality where the race originated."

Garson, who contributed the osteological chapters to Roth's work on the Tasmanian aborigines (12), says:—

"The race to which the Tasmanians might naturally be thought most allied from their geographical position is the Australian, but many points in the physical characters of the two races are so totally unlike as to render this relationship problematical."

Topinard, the great French anthropologist (15), stated that the skulls of Australians and Tasmanians examined by him differed considerably, and he gave it as his opinion that these two peoples were distinct races.

Huxley (16) points out that the type of Australian man is quite distinct from that of the Tasmanian.

It would therefore appear that, so far from the Tasmanian being akin to his nearest neighbour, the Australian aboriginal, he is rather to be regarded as being closely allied, as we shall now endeavour to show, to the much more distant Papuan of New Guinea, and the adjacent islands.

At the present day, the region of Melanesia, which includes all the islands from New Guinea in the west to Fiji in the east is inhabited by the black Papuan, or Melanesian race, a race which includes the people of New Guinea, the Bismarck Archipelago, the Admiralty Islands, the Solomon Islands, the New Hebrides, and New Caledonia. All these people have frizzly hair, and it is one of their characteristics that the whole head of hair has much the appearance of a mop (17). It is to these people that the now extinct Tasmanian aboriginal is to be allied, that is if the following testimony is to be relied upon:—

That Prichard (10) held this view as to the identity of the Tasmanian with the Papuan is obvious, for his statement is as follows:—

"From the southern extremity of New Britain and New Ireland, tribes of Pelagian negroes are spread along the chains of Louisiade and Solomon Isles to Santa Cruz, and thence still farther to several of the New Hebrides and to New Caledonia. . . . . Lastly, the Tasmanians . . . . are decidedly of the Pelagian negro stock."

Garson sums up this question admirably in the osteological chapter already referred to (12), for he therein says:—

"In some respects, the Tasmanians resemble very closely the Negrito race, not only in the character of their hair, but in some of their osteological characters. Their relationship to the Polynesians, though suggested, has not received much support. The Melanesian race has, by many persons, been claimed as that to which the Tasmanians are most nearly allied, and many of their physical characters support this hypothesis. . . . . From the osteological characters and those of the hair, skin, etc., it appears as if the Tasmanians were most allied to the Negrito and Melanesian types. In any case, the Tasmanians have remained for a long period isolated from other races, as evidenced by the uniformity of their osteological characters.

It may seem somewhat difficult to relate the Tasmanians to the two races just named, so far separated under the present existing geographical distribution of land and water. The Negritos appear to have been much more widely spread than at present, and give every evidence of being a very primitive type; so that, as Flower has suggested, they may be the primitive stock from which the Melanesians on the one hand, and the African negroes on the other, have been derived. Such an hypothesis of the relationship of the Negrito to the Melanesian would explain, perhaps, the similarity of physical characters found to exist between these races and the Tasmanians. Should this be the case, the Tasmanians would, like the Andamanese, be the remnants of a primitive stock from which the other Melanesians have sprung."

Huxley's opinion on this intricate question is as follows (16):—

"In the Andamanese Islands, in the Peninsula of Malacca, in the Philippines, in the islands which stretch from Wallace's line eastward and southward, nearly parallel with the east coast of Australia to New Caledonia, and finally in Tasmania, men with dark skin and woolly hair occur who constitute a special modification of the Negroid type—the Negritos. Only the Andamanese have presented skulls approaching or exceeding an index of 80, all the other Negritos, the crania of which have been examined, are dolichocephalic. . . . . The best known and most typical of these Eastern Negritos are the inhabitants of Tasmania and of New Caledonia, and those of islands of Torres Straits and of New Guinea. In the outlying islands to the eastward, especially in the Fijis, the Negritos have certainly undergone considerable intermixture with the Polynesians; and it seems probable that a similar crossing with Malays may have occurred in New Guinea."

Flower (18) is brief and to the point. He says:—"The view then that I am most inclined to adopt of the origin of the Tasmanian is that they are derived from the same stock as the Papuans or Melanesians."

Giglioli (19), quoted by Howitt, concludes that the Tasmanians were members of the great Papuan family, and that they owed their inferiority to the complete state of isolation in which they have existed ever since that very remote epoch.

Mathew (20) apparently holds the like view, for he thinks the first occupants of Australia were a pure Papuan family, of which the Tasmanians are the lineal descendants, whilst the Australian aboriginal has resulted from a crossing, on the mainland, of that primitive stock by one, or two, other subsequent invasions.

Howitt, in his "Native Tribes of South-East Australia" (14) does not make it very clear as to whether he holds the Tasmanian as most nearly allied to the Papuan or not. His exact words are that he would suggest the following tentative hypothesis:

"An original Negrito population, as represented by the wild tribes of Malaysia; a subsequent offshoot, represented by the Andamanese and Tasmanians; and another offshoot in a higher state of culture, originating the Melanesians." So far as I can interpret this view, Howitt at all events regards the Papuan as not being farther removed from the Tasmanian than a younger brother is from his elder brother, and if this interpretation be correct, it brings Roth's (12) view that the Tasmanian is most nearly allied to the Andamanese into line with all the other views quoted. An objection to the alliance between the Andamanese and the Tasmanian is Huxley's remark that the Andamanese skull is brachycephalic or mesaticephalic, whilst the Papuan is markedly dolichocephalic.

It is, therefore, perhaps not too much to assume that the native Tasmanian is more nearly allied to the Papuan than to any other race, and in assuming even this much, it must be remembered that nothing more is meant than that the Papuan as we now see him, the Tasmanian as he recently existed, and, possibly, the Andamanese Islander, are not more widely apart than are the sons of one father. In this connection, however, it ought to be possible in a country like Australia, with one of the families actually living in close contact with the mainland, and the other only recently extinct, and equally accessible, to obtain positive proof, for what is necessary is an examination of the skulls and other osteological remains of the two branches of the race. If such an examination be not conducted, and that at once, it will be little short of a national disgrace, whilst for the policy which consists in scattering the most valuable Tasmanian material et hoc genus omne in European and other foreign museums, I have nothing but condemnation. The material having been sown in Australia, let Australians see to it that they reap the harvest.

Pending the arrival of this positive proof as to the relationship between the Papuan and the Tasmanian, we shall assume, on the opinions of those whose works have been quoted, that such is really the case, and now, therefore, we pass to the third and last question, how did the Papuan get to Tasmania?

If the foregoing view as to the identity of the Papuan and the Tasmanian, using the terms "Papuan" and "identity" in their very broadest sense, be correct, it implies that representatives of the same Papuan stock have become widely separated, both geographically and ethnologically; geographically by the separation of the islands of New Guinea and Tasmania from the Continent of Australia; and ethnologically by the interpolation of a distinct race, the Australian aboriginal.

On this point, Bonwick asks the question (5):—"How could the woolly haired Papuans of Tasmania get so far separated from the woolly haired Papuans of New Guinea, New Hebrides, etc., whilst having their cousins of more luxuriant hair occupying the Continent of Australia between the two?" He answers his own question by assuming that "parts of New Holland (Australia) were united to New Guinea, to New Zealand, and to Tasmania," and a little farther on Bonwick adds, "The Australians proper are now confined between the two great seats of the so-called Papuan race, and as there are no evidences of their race dwelling in New Zealand, New Guinea, or in New Caledonia, it is much to be doubted whether their advent in their Australian home was not after the separation of those islands. In the same way, it may be that they came after Tasmania became disconnected."

It is a somewhat remarkable fact that although that part of Bonwick's assumption relative to a primitive land connection between Australia and New Zealand is not capable of geological proof, the land connection between New Guinea, Eastern Australia, and Tasmania, may be regarded as certain from the researches of Wallace (11), Howitt (14), Spencer (22), and many others. Since Bonwick's time, Wallace (11), working out the problems attendant on the distribution of New Zealand flora, has also endeavoured to show that during the early cretaceous period the present continent of Australia was divided into two parts, an Eastern and a Western Australia.

His precise statement is as follows:—

"If we examine the geological map of Australia (given in "Stanford's Compendium of Geography and Travel, volume Australasia), we shall see good reason to conclude that the eastern and the western divisions of the country first existed as separate islands, and only became united at a comparatively recent epoch. This is indicated by an enormous stretch of cretaceous and tertiary formations extending from the Gulf of Carpentaria completely across the Continent to the mouth of the Murray River. . . . . At this epoch then . . . . Australia may not improbably have consisted of a very large and fertile western island, almost or quite extra-tropical, and extending from the silurian rocks of the Flinders Range in South Australia, to about 150 miles west of the present west coast, and southward to about 350 miles south of the Great Australian Bight To the east of this, at a distance of from 250 to 400 miles, extended in a north and south direction, a long, but comparatively narrow island, stretching from far south of Tasmania to New Guinea, while the crystalline and secondary formations of Central North Australia probably indicate the existence of one or more large islands in that direction."

I am informed that Wallace's contention as to complete separation of the Australian Continent into two halves is geologically untenable, although the wide extension of a cretaceous sea over what is now Central Australia, as well as the land connections between New Guinea, Eastern Australia, and Tasmania are admitted.

Notwithstanding that certain parts of Bonwick's assumptions as to land connections have thus been proved to be correct, the theory which he built thereon as to the origin of the Tasmanians cannot, in my opinion, be sustained. Bonwick assumed the presence of a large southern continent, by means of which Australia, Tasmania, and New Zealand were connected together, and he thinks that both the Tasmanians and the Australians emanated primarily from this continent. The submergence of this continent, and the subsequent separation of Tasmania from the Australian mainland resulted in the long isolation of the Tasmanians. Whilst this theory is hardly capable, as stated, of being sustained, it is only fair to mention that in favour of it there is a view that, the aboriginal inhabitants of the southern extremities of the three great continents of Australia, South Africa, and South America, that is the Tasmanians, the Bushmen, and the Fuegians, appear to have some features in common, though even this similarity is much more closely confined to the Tasmanians and the Bushmen than to the Fuegians, the last mentioned of which differ very markedly in stature from the first two mentioned races.

If, however, we reverse Bonwick's theory, and make the Tasmanians emanate from the north instead of from the south, it seems to me that we approach much more nearly to the known facts, and, before broaching this theory, which is no new one, it will be well to state what are the facts, meagre at the best, upon which we have to build.

It is certain that the Tasmanian had no knowledge of navigation; it is almost certain that he is of great antiquity, and that he is closely allied to the Papuan of the New Guinea district; it is further known that the Northern or New Guinea section of the family is, or was, until recently, separated from the Southern or Tasmanian section by the presence of a different race, the Australian aboriginal; whilst, lastly, it may be taken as fully proved that there was once a land connection between New Guinea, Eastern Australia, and Tasmania.

With these, the nearest approaches to facts available to us, and assuming the land connections to have been somewhat as sketched, the distribution of the Papuan race, or the primitive progenitors of that race, would have extended from what is now New Guinea in the north to what is now Tasmania in the south, and this extended range would require no knowledge of navigation. The separation of New Guinea and Tasmania would then have broken up the race into three areas, New Guinea, the narrow belt of Eastern Australia, or more likely the present Australian mainland, and Tasmania. The lack of knowledge of navigation would have confined each section to the area on which it then found itself, whilst the subsequent introduction of a new race into the Australian continent would, on the assumption of those who hold the Australian aboriginal to be a homogeneous race, have resulted in the extermination of the existing Papuan element in the mainland by the new occupants, the Australian aboriginal, or on the view of those who hold the Australian aboriginal to be an admixture of Negro or Papuan stock with some other race or races, would, by cross breeding with the Papuan, form the present aboriginal race. Thus there would be a detached group of Papuans in the North, a detached group of Papuans in the south, and a central group differing from the north and south groups, which is exactly what is found. Further, these races would be of great antiquity, though not necessarily of tertiary times, though even this is not impossible, whilst, lastly, the Tasmanian would have reached Tasmania by land in very distant periods. He would, therefore, be of a most ancient race; he would have no knowledge of navigation; he would differ from the inhabitants of the adjacent mainland of Australia; and also from those of New Zealand. He would be closely allied to the natives of distant New Guinea, but would from his isolation and from the apparent fact that he had not been visited by other and more recent races, retain his primitive manners, and show less signs of advancement than his brothers of New Guinea, all of which coincides in every detail with what we know of this unhappily extinct race, the extinction of which is a blot upon the fair history of British colonisation.

Even though this theory be accepted, the writer has no desire to claim any exclusive rights in, or priority for, the view, for it is merely a revised version of what many anthropologists have already put forward. Howitt (14) has long held the view that the Tasmanians came from the north, and has stated:—"I have long since come to the conclusion that one of the fundamental principles to be adopted in discussing the origin of those (Tasmanian) savages must be, that they reached Tasmania at a time when there was a land communication between it and Australia."

Bonwick (5) has stated that:—"The fact of the crisp-haired Papuans being found in islands all round the New Holland (Australian) coasts, and over so vast an extent of space, ought certainly to indicate their prior migration to that of the Australians."

Flower (18) has, in his usual clear and terse way, summed up the whole theory in the words, "they (the Tasmanians) reached Van Dieman's Land, by way of Australia, long anterior to the commencement of the comparatively high civilisation of those portions of the race still inhabiting New Guinea and the adjacent islands, and also anterior to the advent of the existing native race, characterised by their straight hair and by the possession of such weapons as the boomerang, throwing stick, and shield, quite unknown to the Tasmanian."

De Quatefages (21) says:—In Australia there are two distinct types—Australians proper and Australian Neanderthaloides —the latter a small group occupying the country about Adelaide, and having, among other characteristics, hair which closely resembles the woolly hair of the negro. . . . . This fact can be accounted for by presuming that true negroes formerly occupied the whole or a part of Australia; that they were invaded by a black race with straight hair; and that it is to a blood mixture that the differences in the hair must be attributed. It is probable that the Tasmanians furnished this negritic element. Their former existence in Australia has nothing about it which may not be very natural, and their facial characteristics occasionally approximate closely enough to those of the Australians to allow of the probability of this hypothesis. An examination of the skulls of Australians with woolly hair from the Southern tribes would probably solve the question. Finally, if my conjecture be well founded, we must admit that the crossing must have taken place at a very remote period, and that the woolly hair could only reappear more or less modified by atavistic phenomena."

Of the objectors to an essential part of the theory, namely, that the Tasmanian ancestry first inhabited, or passed through the Australian continent on their way to Tasmania, Huxley (16) is the most important. He considers that it is "physically impossible that the Tasmanian could have come from Australia, and apparently the only way of accounting for the presence of the Tasmanian was to assume his migration from New Caledonia and the neighbouring islands. It would appear that at one time a low negrito type spread eastwards, and reached Tasmania, not by means of direct and uninterrupted land communication between New Caledonia and Tasmania, but rather by means of broken land in the form of a chain of islands now submerged, similar to that which at present extends between New Caledonia and New Guinea."

In view of Howitt's subsequent work, to which reference has already been made, it does not appear to me that Huxley's objection to the land theory of the Tasmanian migration can any longer be regarded as tenable, and whether the present theory be upheld, or whether it be replaced by some other theory based on a surer foundation of fact than is as yet possible, I am convinced that Howitt's view as to the migration by land will eventually be found to be the correct foundation on which that theory will be built.

I can, therefore, only conclude by expressing the hope that this epitome of so much that is at present mere visionary theory will lead to the accumulation of such a collection of material as will enable us to ascertain the true facts of the case, and that the credit of the discovery will belong, as it ought to do, to Australia and Australian scientists.

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DESCRIPTION OF PLATE I.

Photograph of half-caste Tasmanian woman from Kangaroo Island (on right) and her daughter, a quarter-caste Tasmanian (on left).

[PROC. ROY. SOC. VICTORIA, 20 (N.S.), PT. 1., 1907]

ART II.—*Note on the Deposition of Bedded Tuffs.*

BY T. S. HALL, M.A.

Melbourne University.

(With Plate II.).

[Read 11th April, 1907].

In many, if not most, of the places in South-western Victoria where tuffs are displayed they are well stratified. These tuffs are associated with the basaltic lavas which form such a feature of the geology of the State, and are referable to various parts of the tertiary period. The volcanic rocks cover, according to Selwyn, somewhere about 9000 square miles, or about a tenth of the total area of Victoria.

The tuffs with which we are at present concerned are usually fawn-coloured, and vary with considerable irregularity in the size of their constituent grains. They show a tendency to split into flags along their bedding planes, and are fairly coherent, so that they are used, as in the neighbourhood of Camperdown, as a rough building stone.

The decomposition of the tuffs and of the coarser scoria yields a remarkably rich soil, and the porous subsoil affords both natural drainage and a capacity for storing up water. The tuffs are then commonly tree-clad.

Among the places which have come under my notice where well bedded tuffs are to be seen are two belonging to the older volcanic series, which is here seen to underlie the marine Barwonian beds. One of these is at Curlewis, about eight miles east of Geelong, where on the beach platform a continuously dipping series is seen extending for about four miles. The basalt of similar age at Airey's Inlet is also associated with well bedded tuffs which dip inland from the shore, pointing to the old vent having been out at sea.

Among the more recent tuffs which also show this character may be enumerated those of Mount Leura and Bullenmerri, near Camperdown. These beds cover a very large area. On the flanks of Tower Hill, as the railway runs down through cuttings towards Warrnambool, well stratified tuffs are extensively displayed. There is a similar well bedded tuff, though only a few feet in thickness, overlying the Kalimnan at "McDonald's" on Muddy Creek, near Hamilton. Quite recently I have seen many square miles of equally well bedded tuffs about Mount Gambier in the south-east corner of South Australia, and to these attention will be more fully directed later.

Similar, though usually obscure, bedding is shown in the scoria on the flanks of Mount Leura. The great banks have been extensively worked for many years for railway ballast and for covering footpaths, so that ever changing sections were displayed.

Though bedding appears extremely common in the tuffs, it is not universal, and I call to mind a section shown in a road cutting near the Park gates at Camperdown where bedded tuffs show a faulted contact with unstratified ones.

The bedding is generally of such a well marked character that rough flags can be quarried almost everywhere.

The question arises, To what is this bedding due? Was the deposition subaqueous or merely subaerial? Till recently I never thought of the possibility of anything but subaerial deposition being suggested in most of the places mentioned. Professor J. W. Gregory[1] holds that the beds round Camperdown are of subaqueous origin, and that the stratification is due to sorting by water. Of the correctness of this view I have doubts, and I have lately found evidence at Mount Gambier which shows that well bedded tuffs may owe their stratification to subaerial sorting, and hence no reason exists for calling on large lakes or the sea to explain their character.

The assertion of subaqueous deposition for all these tuffs would demand the existence of large bodies of water, either marine or fresh water, extending over very wide areas and at various periods. The well-bedded tuffs of Curlewis and Airey's Inlet are older tertiary age. Those of Koroit, Muddy Creek and Mount Gambier are recent. The Bullenmerri tuffs may be pleistocene. The supposed subaqueous deposition of the tuffs of

1 Geography of Victoria, p. 128.

various ages and localities is the only evidence in favour of the former existence of these seas or lakes, and that, too, at times in peculiar positions in reference to the modern surface drainage.

Then, again, the tuffs, though stratified and very evenly bedded, are not of uniform grain. Taking a small piece, stratification is not evident. Dust and small scoriaceous fragments seem mingled in confusion. It is the fine matter which brings about the fissility, and yet the amount of commingled larger material is considerable. There are, of course, well marked beds of dust, and equally well marked ones of coarse grain, but to my mind the sorting is not as thourogh as it would have been had water—that is, standing water—been the cause of the bedding.

Mud torrents have been suggested, but they also are, I think, out of the question. Such torrents would, if they formed stratified deposits at all, show false bedding, and not layer after layer through a thickness of many feet, and a lateral measurement of scores of yards.

However, apart from this, we have at Mount Gambier evidence which, I think, shows clearly that tuffs, as well stratified as any of those of the Camperdown district, may occur under conditions which forbid aqueous action.

A brief sketch of the geology of the district is necessary to enable this evidence to be properly weighed.

The bed-rock over hundreds of square miles is a white limestone mainly composed of polyzoal remains. This is of Barwonian age (? Eocene), and is, as far as can be seen, quite horizontal. It is extremely porous, and water-courses are absent. There are, of course, many swallow holes, caves and underground drainage channels, so that many of the irregularities of the surface are undoubtedly due to subterranean solution. This point may be considered unfavourable to my view, so that I wish to be properly considered. The general surface of the country is slightly undulating, and the hills to the north of the town are, for the most part, sandy. They are, in fact, sand dunes of pleistocene or recent age, and vary somewhat in the amount of lime they contain, and consequently in the amount of consolidation they have undergone. In places they are loose yellow sands, and in other places consist of the ordinary cross-bedded dune-rock. A few miles to the south of the town similar dune-rock forms the surface, and the typical form of the cups so characteristic of dunes is easily traced. In other places we find long, branching and anastomosing ridges, the dune-rock being frequently capped by the white so-called travertine, the residue of evaporated ground water.

We thus have two limestones, the lower one a marine, polyzoal-rock, and the upper an aeolian one. The marine limestone affords a richer soil, and at the same time flints are commonly scattered on the surface, while they are not found in the dune-rock. So that the presence of flints is a key to the underlying rock.

It will be seen that a large number of the low ridges and hills cannot be ascribed to subterranean denudation, for in the flats and valleys between them flints often occur, and swallow holes and caves are common. The hills are isolated, or practically isolated ridges of calcareous, wind-borne sand. It is essential that this fact be insisted on, and I paid attention to it in several places in the district. The dunes extend inland for many miles, and probably lose their marine origin as they pass north through the mallee country.

A mile to the south of the town of Mount Gambier occurs the mount itself, a volcanic pile. There has been practically no effusion of lava. A sheet of it is seen inside the shattered crater walls, and was the first material ejected. The tuffs extend for two or three miles round the foot of the mount, and are of no great thickness.

A little more than a mile south of the mount is a long east and west ridge of dune rock. This rises some fifty feet above the surrounding country, and is crossed by two roads, one going south to Port Macdonnell, and the other a couple miles east of it, leading to Nelson at the mouth of the Glenelg river. Both these roads pass through cuttings about twelve feet deep and show dune rock capped by tuffs. The tuffs are well-bedded, quite as distinctly and as evenly as anything shown about Camperdown. They, moreover, show a marked peculiarity in that they follow the contour of the ground closely. It is not a case of a tuff capping the hill and being missing on the flanks. The bedding planes are parallel to the present surface. They rise from the north, cross the ridge and sink down towards the south, forming a blanket-like covering of even thickness, which is quite unbroken.

This feature is diagrammatically shown on the two roads mentioned, and, after noting them from the coach, I walked out to the "Corkscrew," as the winding road over the ridge on the Port road is called, and examined the section with care.

The same feature is shown in the town itself. Gray-street, at about a hundred yards north of Commercial-road, crosses a dune ridge about thirty or forty feet high. A thin tuff-sheet follows the contour exactly as in the cases just mentioned. West of this point, about a quarter of a mile, in a street running north from the State school, well-bedded tuffs dip east off an eastward facing slope of dune rock, their dip agreeing with the slope. In this case I did not attempt to trace them over the hill and down the counter slope to the west. In Gray-street, a thin layer of old soil intervenes between the dune-rock and the tuff. Three of these sections are, I think, crucial, and the fourth appears similar to them. It is surely impossible for material to have been deposited from water in this way. At the "Corkscrew," the stratification lines can be traced for a hundred yards, the beds are but the fraction of an inch thick, and there is no thickening of the deposit on the flanks. The whole is perfectly regular. Had the Gray-street hill been under water, the old soil, at any rate, must have been swept away.

Hitherto no reference has been made to the tuffs of other countries. My aim has been to show that the tuffs of south-western Victoria exhibit no characters inconsistent with aerial deposition, and by this, I do not mean that a strong wind-drift took place, for this would produce cross-bedding, a thing I have not seen, but merely a sorting of material raised into the atmosphere, not by wind, but by volcanic explosion.

Professor Judd says[1] :—"Thus the tuffs covering the city of Pompeii are found to consist of numerous thin layers of lapilli and volcanic dust, prefectly distinct from one another, and assuming even the arrangement which we usually regard as characteristic of materials that have been deposited from suspension in water. The fragmentary materials in falling through the air are sorted. . . . ."

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1 "Volcanoes," p. 117.

What is true of these Vesuvian tuffs is true of our Victorian ones, and there is no need to call the agency of water to account for their stratification.

SUMMARY.

1. The well-stratified tuffs of Mount Gambier closely follow the contour of hill and valley, and so could not have been deposited from water.
2. There is no evidence of large bodies of water occurring at different ages throughout Western Victoria, which would be required if the tuffs were subaqueous deposits.
3. Consequently, all our stratified tuffs may be subaerial, and not subaqueous formations.

DESCRIPTION OF PLATE II.

Cutting on road to Port Macdonnell, three miles south of Mt. Gambier. The arch in the bedding of the tuffs on the crown of the hill is clearly visible. The small caves under the tuffs are caused by the removal of the old surface soil by wind. The core of the arch is formed of dune-rock.

ART. III.—*New Species of Australian Chiton from Queensland, Enoplochiton torri.*

BY R. A. BASTOW AND J. H. GATLIFF.

(With Plates III. and IV.).

[Read 11th April, 1907].

We have received from W. G. Torr, LL.D., of Adelaide, an interesting form of Chiton, which has been obtained on the coast of Queensland, and have placed it, provisionally, in the genus Enoplochiton of Pilsbry's Chitonidae,[1] as that appears to be the best fitted for its reception.

Only one species has been hitherto described, Enoplochiton niger, Barnes, which occurs on the coast of Peru. It is very interesting to find that we have a representative of this rare genus in Australian waters.

The following is the original description of the genus:—

ENOPLOCHITON, Gray.

P.Z.S., 1847, pp. 65, 69, 169.

Valves exposed, of a uniform dark brown or chocolate colour outside and within; the lateral areas and head-valve irregularly studded with extremely minute eyes. Interior minutely laminated and punctate in a peculiar pattern; sinus deep, denticulate. Insertion plate of anterior and median valves slit into teeth and sharply pectinated outside. Tail valve having the mucro posterior and terminal, and inside with a flat ledge of callus in place of the lacking insertion plate. Girdle fleshy, bearing extremely broad and short, blunt, separated, striated scales.

Enoplochiton torri, sp. nov. (Pl. III. and IV., Fig. 1-12).

Description.—Shell oblong, convex, dorsal angle rounded. The whole surface finely pustulated. Colour blackish brown, with

1 Tryon's Manual of Conchology, vol. xiv., pp. viii. and 252.

creamy angular markings at each side of the dark well-defined dorsal triangular area. Girdle alternating blackish brown and creamy, with radiating separated scales.

In perfect specimens the median valves are beaked, and are covered over their whole surfaces with small granulated pustules, for the most part in longitudinal and transverse lines, the diagonal rib not showing very plainly. The triangular patch of colour on the dorsal ridge is evident on all the specimens examined. The anterior valve is pustulated over the whole surface in a concentric manner; the anterior portion of the posterior valve is radially pustulated, and the posterior part is similar to the median valves.

The interior is considerably coloured brownish purple, and the surface finely laminated; the sinus is broad and denticulate; the anterior valve has ten slits, the teeth are long, deep, sharply and closely pectinated outside; the median valves have one slit; there are no slits in the posterior valve, but the posterior edge is strongly denticulate.

The girdle is tough and fleshy, difficult to remove, bearing numerous wide, blunt, striated, separated scales; in the interstices are a few scattered spines.

The head-valve is studded with numerous bright, clear, amber eyes, not ocelli, but real and very human-looking eyes; these also occur on the lateral areas and on the posterior valve. They have optic nerves which can be traced by slightly decalcifying the valve and thus making bare the eye orbit; the nerve threads pass from the eyes to the mantle of the animal, as may be detected by breaking away the teeth from the ventral surface of the anterior valve, the outlets of the nerve threads are then revealed in the caves, just under the tegmentum, and from thence, Mr. Pilsbry informs us, they are connected to the central ganglion. There are also numerous punctures on the ventral sides of the valves, and a multitude of megalopores and micropores visible as very narrow granulated striations over the pustules of the dorsal areas (Fig. 3) with chambers embedded in the shell; these are all similarly connected; it is probable that these latter are also nerve channels for tactile, auditory, or other sense organs. The girdle, with its radially striated scales, is unmistakably well secured to the very numerous and deeply-cleft teeth in the insertion plates.

Dimensions.—Length, 13.20 mm.; breadth, 10.15 mm.

Locality.—Queensland (Dr. Torr).

Observations.—The genus Enoplochiton, probably the highest form of Chiton life (excepting perhaps Tonicia and Acanthopleura) is new to Australia, and it is one of the most interesting objects in Molluscan development.

The new species is not a typical form, and we have placed it in this genus provisionally, as it has the characteristics of numerous oval eyes and a scaled girdle, but these girdle scales in the Australian species are smaller, much more numerous and closely compacted; and the whole of the dorsal sculpture is granulate; whereas in E. niger the sculpture is incised. The eyes in our species are very much larger.

EXPLANATION OF PLATES III. AND IV.

The following figures of details are from another specimen slightly varying in colouration:—

Fig. 1.—Enoplochiton torri, Bastow and Gatliff.

Fig. 2.—Girdle, dorsal aspect.

Fig. 3.—An enlarged view of one of the eye orbits shown in Fig. 2, also very fine granulation which extends over the whole of the pustules on the valves.

Fig. 4.—Dorsal aspect of portion of anterior valve, tilted up so as to show the teeth. The eyes are .075 x .050 mm.

Fig. 5.—Partially decalcified anterior valve, dorsal aspect, showing eye orbits and optic nerves, also partly eroded teeth.

Fig. 6.—Anterior valve, dorsal aspect, in natural state, showing arrangements of pustules.

Fig. 7.—Anterior valve ventral aspect, showing teeth punctures, slits; part of the teeth are broken away to show the ends of nerve channels, where they connect with the nerve system of mantle.

Fig. 8.—Median valve, dorsal aspect.

Fig. 9.—Median valve, ventral aspect, showing grooves and punctures, also the jagged denticulation of slit and insertion plate.

Fig. 10.—Posterior valve, dorsal aspect.

Fig. 11.—Posterior valve, ventral aspect, with peculiar grooves in eaves, and denticulation.

Fig. 12.—Anterior and aspect of median valve, showing dorsal angle and pectination of sinus.

All the figures are considerably enlarged.

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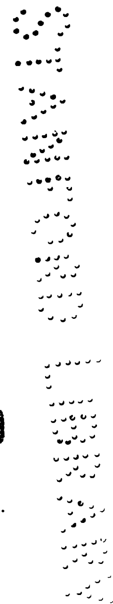

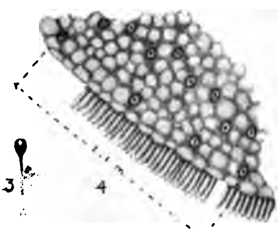

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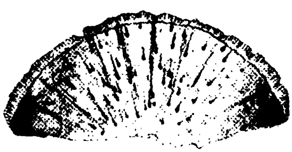

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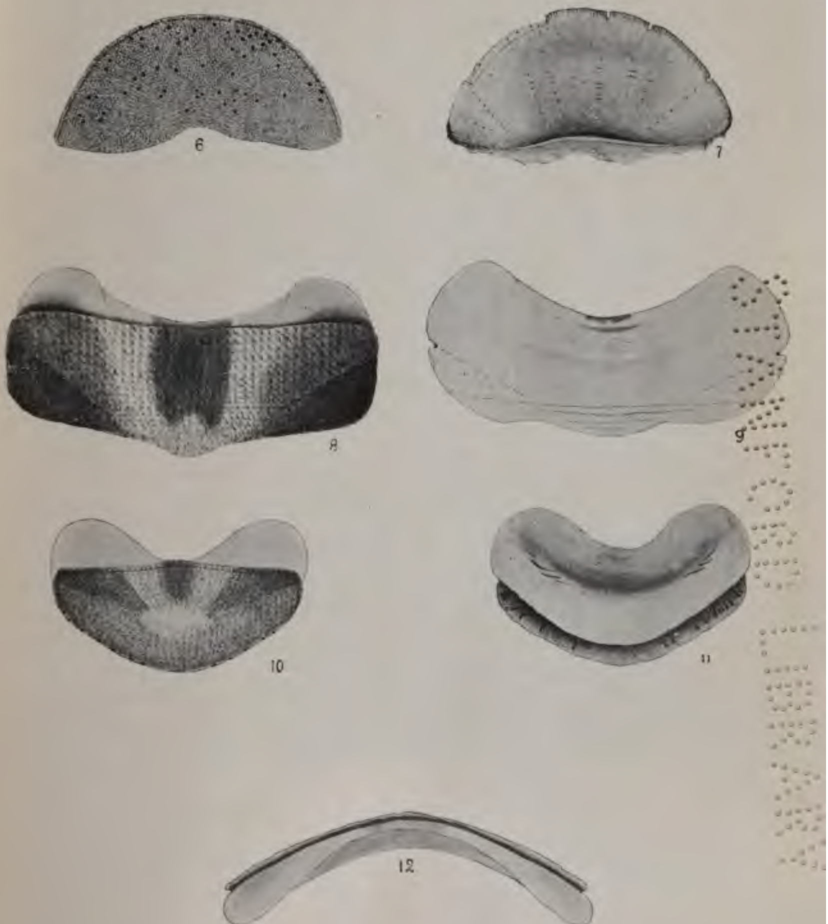
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[Proc. Roy. Soc. Victoria, 20 (N.S.), Pt. I., 1907.]

Art. IV.—*Additions to the Catalogue of the Marine Shells of Victoria.*

By J. H. GATLIFF.

[Read 11th April, 1907.]

Since the Catalogue was compiled, new species have been found and described, and others obtained here that have been named previously.

The following list records 18 species of univalves and 10 species of bivalves. Some changes in nomenclature have also been made, and they will probably be given on a future occasion.

Mitra cineracea, Reeve.

1845. Mitra cineracea, Reeve. P.Z.S. Lond., p. 57.
1845. Mitra cineracea, Reeve, Conch. Icon., vol. ii., pl. 37, f. 311.
1874. Mitra cineracea, Sowerby. Thes. Conch., vol iv., p. 32, pl. 373, f. 494, 495.
1882. Turricula (Costellaria) cineracea, Tryon. Man. Conch., vol. iv., p. 175, pl 52, f. 492.
1886. Mitra (Pusia) cineracea, Watson. Chall. Zool., vol. xv., p. 251.

Hab.—Off East Moncœur Island, Bass Straits (Challenger).

Obs.—I have not yet found this species; the shell is about 16 mm. in length and about 7 mm. in breadth, it is turreted, color ashy grey and white, sculpture strong.

Mangilia delicatula, T. Woods.

1879. Mangelia delicatula, T. Woods. P.R.S. Tas., p. 37.
1884. Daphnella delicatula, Tryon. Man. Conch., vol. vi., p. 332, pl. 32, f. 29.
1901. Mangelia delicatula, Tate and May. P.L.S. N.S.W. vol. xxvi., p. 369, pl. 24, f. 35.

Hab.—Dredged 6 to 8 fathoms off Phillip Island, Western Port.

Obs.—Similiar in size and general habit to M. alucinans, Sowerby.

Mangilia granulosissima, T. Woods.

1879. Clathurella granulosissima, T. Woods. P.R.S. Tas., p. 37.
1884. Clathurella granulosissima, Tryon. Man. Conch., vol. vi., p. 282, pl. 32, f. 20.
1901. Clathurella granulosissima, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 370, pl. 24, f. 34.
1903. Mangelia granulossisima, Hedley. Mem. Aust. Mus., vol. iv., part vi., p. 393.

Hab.—Dredged 6 to 8 fathoms off Phillip Island, Western Port.

Obs.—Much resembles the preceding species.

Mitromorpha pallidula, Hedley.

1906. Mitromorpha pallidula, Hedley. P.L.S. N.S.W. for 1905, p. 534, pl. 32, f. 26.

Hab.—Port Albert (T. Worcester).

Obs.—The columella lacks the tranverse lirations found in most of the members of this genus.

Daphnella excavata, Gatliff.

1906. Daphnella excavata, Gatliff. P.R.S. Vic., vol. xix. (n. s.), part i., p. 1, pl. 1, f. 1, 2.

Hab.—Portsea, Port Phillip; Ocean Beach, Point Nepean.

Scala tenella, Hutton.

1876. Scala lineolata, T. Woods (non Kiener). P.R.S. Tas., p. 33.
1885. Scalaria tenella, Hutton. P.L.S. N.S.W., vol. ix., p. 943.
1901. Scalaria tenella, Tate and May. Id., vol. xxvi., p. 379.

Hab.—Dredged 6 to 8 fathoms off Phillip Island, Western Port; Port Albert (T. Worcester).

Obs.—Also found in New South Wales, Tasmania, and New Zealand. Length about 12 mm., breadth about 6 mm., has a narrow brown encircling band. Varices numerous.

Scala nepeanensis, Gatliff.

1906. Scala nepeanensis, Gatliff. P.R.S. Vic., vol. xix. (n. s.), part i., p. 1, pl. 1, f. 5.

Hab.—Shell sand Ocean beach, Point Nepean; and Portsea, Port Phillip.

Scala translucida, Gatliff.

1906. Scala translucida, Gatliff. P.R.S. Vic., vol. xix. (n. s.), part i., p. 2, pl. 1, f. 34.
1906. Scala translucida, Verco. T.R.S. S.A., vol. xxx., p. 219.

Hab.—Shell sand Portsea, Port Phillip; dredged 6 to 8 fathoms off Phillip Island, Western Port.

Scala invalida, Verco.

1906. Scala invalida, Verco. T.R.S. S.A. vol. xxx., p. 148, pl. 4, f. 9, 10.

Hab.—Dredged in about 8 fathoms off Phillip Island, Western Port; Shoreham, Western Port.

Crossea labiata, T. Woods.

1876. Crossea labiata, T. Woods. P.R.S. Tas., p. 151.
1900. Crosseia labiata, Hedley. P.L.S. N.S.W., p. 500, pl. 26, f. 18.
1901. Crosseia labiata, Tate and May. Id., vol. xxvi., p. 379.
1906. Crossea labiata, Verco. T.R.S. S.A., vol. xxx., p. 149.

Hab.—Dredged 6 to 8 fathoms, off Phillip Island, Western Port.

Cingulina diaphana, Verco.

1906. Cingulina diaphana, Verco. T.R.S. S.A., vol. xxx., p. 143, pl. 4, f. 11.

Hab.—Shell sand, Ocean Beach, Point Nepean.

Cerithiopsis marmorata, Tate.

1893. Cerithiopsis marmorata, Tate. T.R.S. S.A., p. 190.

Hab.—Shell sand, Ocean Beach, Point Nepean.

Styliferina translucida, Hedley.

1906. Diala translucida, Hedley. P.L.S. N.S.W., p. 522, pl. 33, f. 35.

Hab.—Dredged off Phillip Island, Western Port, about 7 fathoms.

Obs.—This is the species referred to p. 61, vol. xviii. (n. s.), of these Proceedings.

Cyclostrema bastowi, Gatliff.

1906. Cyclostrema bastowi, Gatliff. P.R.S. Vic., vol. xix. (n. s.), pt. i., p. 3, pl. 2, f. 8-10.

Hab.—Dredged in about 9 fathoms off Phillip Island, Western Port.

Nacella stowae, Verco.

1906. Nacella stowae, Verco. T.R.S. S.A., vol. xxx., p. 209, pl. 10, f. 4 and 5.

Hab.—Shell sand Shoreham, Western Port; Torquay.

Obs.—A small translucent species with about 16 pink radial lines. Apex at the anterior sixth. The specimens from Torquay are more solid and the apex is nearer to the anterior. This is the first record of the genus occurring in Victorian waters.

Ischnochiton resplendens, Bednall and Matthews.

1906. Ischnochiton resplendens, Bednall and Matthews. P. Malac. Soc. Lond., vol. vii., p. 91, pl. 9, f. 4-4f.

Hab.—Shoreham, Western Port; Port Fairy.

Acanthochites (Meturoplax) retrojectus, Pilsbry.

1894. Acanthochites (Meturoplax) retrojectus, Pilsbry. Nautilus, vol. vii., p. 107.

1894. Acanthochites (Meturoplax) retrojectus, Pilsbry. P. Acad. Nat. Sci. Philad., p. 78, pl. 2, f. 12-15.

Hab.—Ocean beach, Point Nepean.

Siphonaria stowae, Verco.

1906. Siphonaria stowae, Verco. T.R.S. S.A., vol. xxx., p. 223, pl. 8, f. 3-8.

Hab.—Portsea, Port Phillip.

Obs.—A small species described as length, 7.5 m.m.; breadth, 5.9 m.m.; height, 3.25 m.m. The only two specimens I have found are much smaller. White, with brown specks and blotches.

Thraciopsis angustata, Angas.

1867. Alicia angustata, Angas. P.Z.S. Lond., p. 908, pl. 44, f. 1.

1901. Thraciopsis angustata, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 422.

Hab.—Dredged in 6 to 8 fathoms off Phillip Island, Western Port, odd valves only obtained.

Thraciopsis elegantula, Angas.

1867. Alicia elegantula, Angas. P.Z.S. Lond., p. 908, pl. 44, f. 2.

Hab.—Same as preceding species.

Choristodon rubiginosus, Adams and Angas.

1863. Naranio rubiginosum, Adams and Angas. P.Z.S. Lond., p. 245, pl. 37, f. 17.

1884. Clementia tasmanica, Petterd. Jour. of Conch., p. 145.

1901. Choristodon rubiginosus, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 426.

Hab.—Two odd valves only, dredged in about 8 fathoms off Phillip Island, Western Port; and two odd valves dredged off Portsea, Port Phillip.

Cryptodon globosum, Forskal.

1775. Lucina globosum, Forskal. Descript. Anim. Egypte.

1850. Lucina ovum, Reeve. Conch. Icon., vol. vi., pl. 5, f. 21.

1899. Oryptodon globosum, Hedley. Mem. Aust. Mus., vol. iii., p. 498.

1901. Cryptodon globosum, Tate and May. P.L.S. N.S.W., vol. xxvi., p. 432.

Hab.—Port Fairy, odd valves only.

Obs.—I have been unable to consult the original description and am not sure in what genus it was classed by Forskal.

Rochefortia lactea, Hedley.

1902. Rochefortia lactea, Hedley. Mem. Aust. Mus., vol. iv., p. 320, f. 59 in text.

Diplodonta zealandica, Gray.

1843. Diplodonta zealandica, Gray. Dieffenbach's New Zealand, vol. ii., p. 256.

1852. Lucina inculta, Gould. U. S. Exploring Expedition, Moll., vol. xii., p. 417, Atlas, f. 524.

1874. Diplodonta zealandica, E. A. Smith. Voy. Erebus and Terror, Moll. pl. 3, f. 8.

1880. Diplodonta zealandica, Hutton. Man. N. Z. Moll., p. 156.

Hab.—Lakes Entrance, Gippsland. (C. J. Gabriel).

Kellia jacksoniensis, E. A. Smith.

1884. Kellia jacksoniensis, E. A. Smith. Zool. "Alert," p. 105, pl. 7, f. F, F. 1.

Hab.—Dredged about 10 fathoms off Phillip Island, Western Port.

Kellia solida, Angas.

1877. Kellia solida, Angas. P.Z.S. Lond., p. 176, pl. 26, f. 25.

Hab.—Same as the preceding species.

Carditella elegantula, Tate and May.

1901. Carditella elegantula, Tate and May. P.L.S. N.S.W., vol. xvvi., pp. 434 and 463 f. 14, in text.

Hab.—Shell sand, Ocean beach, Flinders. One valve only.

Lima angulata, Sowerby.

1843. Lima angulata, Sowerby. Thes. Conch., vol. i., p. 86, pl. 22, f. 39, 40.

1872. Lima angulata, Reeve. Conch. Icon., vol. xviii., pl. 3, f. 13.

Hab.—Portland.

[PROC. ROY. SOC. VICTORIA, 20 (N.S.), PT. I., 1907.]

ART. V.—*The Movements of the Soluble Constituents in fine Alluvial Soil.*

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[Read 13th June.]

One of the faults of the chemical analysis of the soil, as carried out by the latest methods, is that it pays far too little attention to the soil as a changeable matrix, and attaches too much importance to analyses made usually from samples of soil taken at one time of the year only, and sometimes only from one, or at most two, layers of the soil. This applies even to those analyses where the water-soluble and acid-soluble constituents are separately distinguished. As to the so-called "complete" soil analyses formerly so common, and still in favour in some quarters, these have about as much value to the agriculturist as the destructive analysis of a pair of boots would have to a shoemaker.

In the soil, the constituents of plant food consist (a) of the water-soluble constituents immediately available for use; (b) of the acid (hydrochloric)-soluble ones, representing plant food, which may become gradually available in one to several years. The rest of the soil may practically be regarded as a mere matrix, whose physical properties are of great importance, but whose chemical properties have little or no immediate concern to the plant. The water soluble constituents are concentrated in the surface-adhesion films of water around the solid particles and air bubbles in the soil, so that prolonged washing is needed to remove them completely. The plant, on the other hand, in case of need, can concentrate the dissolved salts in the process of absorption, although when actively transpiring, it usually absorbs them in more dilute form than they exist in the soil.

In any case, every shower of rain falling on the land must tend to lower the percentage of dissolved matter in the surface layers, and will actually do so if no causes are at work in the opposite direction. When evaporation is going on the reverse takes place, the dilute solutions drawn up by capillarity concentrating at the surface. The purpose of the following research has been to determine how pronounced these movements are during an ordinary season, whether they are shown when the land is growing a crop, how manuring affects them, and whether any changes are also shown in the percentage of acid-soluble constituents, and of humus at different depths throughout the year. For this purpose, Mr. Luffmann was so good as to allow Mr. A. G. Campbell to start a series of experimental plots at the Burnley Gardens. These were selected and made up so as to be as uniform as possible throughout each of the two sets of series, one being composed of a fine alluvial sandy soil, the other a rather fine clay, and both having a subsoil nearly sixteen inches below the surface, as will be seen by reference to the following report by Mr. Campbell:—

The soils selected were:—(I) A leached basalt clay, shallow, overlying a very tough clay subsoil; and (II.) deep sand of alluvial nature, overlying white sandy subsoil, with some clay. By preparing the beds well, the subsoil in the first instance was put about 12 inches below the surface, and in the second 15 inches. The elevated beds remained high and dry all the winter, even in series I., which was on quite flat land. The sandy lot sloped very slightly southward. The plots in each series were each 1 square pole in area (30¼ square yards), and treated as follows, the quantities per acre being given in the table of results. The manures were applied in quantities much above ordinary agricultural practice, although the land was already in good heart, since otherwise the amounts in the soil would be almost imperceptible.

Plot 0	-	Unmanured	
„ 1	-	Air-slaked Lime - - -	28lbs.
„ 2	-	Nitrate of Soda (N = 15.5%) -	12oz.
„ 3	-	Star Phosphate (P = 18%) -	2lb. 12.8oz.
„ 4	-	Gypsum - - - - -	14lb.
„ 5	-	Bone Dust (N 2.5, P 21%) -	2lb. 12.8oz.
„ 6	-	Sulphate of Ammonia (N 20) -	8oz.
„ 7	-	Blood Manure - - - -	1lb. 6.4.oz.
„ 8	-	Conc. Superphosphate (P 43) -	1lb 6.4oz.
„ 9	-	Quicklime - - - - -	28lb.

The two series were ploughed and harrowed on 16th May, 1906, then sown with a mixture of rye and oats sown broadcast, The manure was sprinkled evenly on the surface of each plot, and the harrow run over again; both grain and manure being buried 1 inch to 1½ inches. The last plot, however, quicklime, was not sown till a week later, until the lime had slaked and its alkalinity had been reduced.

Growth.—Germination was very good and quick, the weather being favourable. The growth was good in the sand series especially, and continued without a check during winter, there being no noticeable difference between the manured plots and unmanured lands alongside until late in September, when they mostly shot ahead. However, in the clay series, the contrast between raised beds and unformed lands was very great all along, and though growth slackened in very cold weather, it never went yellow like unmanured parts. Representative soil samples were taken about 20th of each month in each plot (a) of surface soil, (b) 8 inches deep, and (c) 16 inches deep. The samples from each plot were bulked to the amount of 1 kilogram of air-dried soil from each depth, which was used for the extraction of food salts. The sixth set of monthly samples was taken in December, three months after the fifth. The crop was harvested green late in October, and gave the following returns:—

Plot	Clay	Sand	Per acre
0	129lb.	120lb.	Unmanured
1	156lb.	140lb.	2 tons Slaked Lime
2	144lb.	139lb.	120lb. Nitrate Soda
3	154lb.	122lb.	4cwt. Star Phosphate
4	121lb.	104lb.	1 ton Gypsum
5	147lb.	121lb.	4cwt. Bone Dust
6	132lb.	132lb.	80lb. Sulphate Amm.
7	136lb.	138lb.	2cwt. Blood Manure
8	143lb.	141lb.	2cwt. Superphosphate
9	72lb.	149lb.	2 tons Quicklime

The injurious action of the quicklime on the crop from plot 9 (clay) was partly due to the seed being sown before the alkalinity was fully neutralised, partly to the binding action of the quicklime on the clay soil. Owing to the fact that the soils were not at all impoverished, the effect of the manuring is not as pronounced as it might otherwise have been, but on the sandy soil the quicklime produced a heavier crop than any other manure, probably because of its solvent chemical action on the mineral constituents of the soil. The superphosphate, slaked lime, nitrate of soda and blood manure seemed to be equivalent as regards the sandy soil, but the two former were more efficient in the clay soil. The star phosphate and bone-dust exercised a strong action on the clay soil, but none on the sandy soil, while the gypsum reduced the yield on both. The order of value for the manures, in the proportions given, are as follows:—For the sandy soil—(1) Quicklime; (2) superphosphate, slaked lime, nitrate of soda, blood manure; (3) ammonium sulphate; (4) star phosphate, bone dust, and no manure; (5) gypsum; For the clay soil—(1) Slaked lime, star prosphate; (2) bone dust, nitrate of soda, superphosphate; (3) blood manure, sulphate of ammonia; (4) unmanured and gypsum; (5) quicklime.

In such cases as these no analyses of the soil, of the crop, or of the manure would enable the results of the application of the latter to be predicted, hence it is essential that the farmer should be guided by local tests rather than by general principles, which are often misleading if improperly applied. Herein lies one of the chief justifications for the existence of experimental plots on farming land throughout the State, and one of the reasons for the avoidance of too much centralisation of experimental field-work in one locality.

A point of great interest is to compare the above data with the fluctuations in the soluble water, and of the humus in the soil. The soil samples were taken from the surface and from depths of 8 and 16 inches, weighed, dried, weighed again, and soaked in 2 litres of distilled water per kilogram of soil. In the first experiments, the clear filtered liquid was boiled down to a small bulk at Burnley, and sent to the University for final testing. The escape of the dissolved carbon dioxide, and the concentration caused, however, a considerable loss, so that all the soil samples were sent to the University, there extracted and filtered. One-half of the liquid added to the soil was evaporated in the same vessel in which the residues were weighed. The total number of soil samples exceeded 400, and the weight nearly half a ton.

Some idea as to the prevailing conditions in regard to moisture and temperature is presented by the following data, giving the percentage of water and the temperatures at different depths during the median portion of the year. From September onwards the temperature became higher, and the percentage of soil water decreased, especially in the upper layers of the soil. Both soils were wettest in July, driest in December.

PERCENTAGE OF WATER.

Date	Clay Soil				Fine Sandy Soil		
	Top	8in.	16in.		Top	8in.	16in.
May 18 -	18.2	17.5	17.2	-	11.85	11.85	8.85
June 20 -	7.75	12.2	11.1	-	6.5	7.75	8.6
July 20 -	44.5	42.5	44.5	-	51.0	54.0	55.5
Aug. 25 -	24.25	25.25	23.5	-	17.5	16.5	12.5
Sept. 25 -	19.0	20.5	22.5	-	14.0	17.0	19.5

TEMPERATURE (FAHR.) OF EACH IN SITU.

	Clay Soil				Fine Sandy Soil		
	Top	8in.	16in.		Top	8in.	16in.
June 20 -	50 deg.	49.5 deg.	47 deg.	-	51 deg.	50 deg.	51 deg.
July 20 -	46 „	45 „	45 „	-	41 „	43 „	43 „
Aug. 25 -	50 „	49.5 „	51 „	-	51 „	50 „	51 „
Sept. 25 -	66 „	61 „	60 „	-	65 „	60 „	56 „

Great difficulty was found in obtaining clear watery filtrates from the clay soil without filtering through biscuit porcelain, which is tedious with large bulks, and is apt to cause the loss of some of the materials really held, originally, in solution. The acid extracts filter readily, but this part of the work was confined to the sandy soils, since the residues from the watery extracts of the clay soil are not at all reliable.

The following are two sets of data from the clay soils in May and September, i.e., before and after the main rainfall, the numbers giving the amount of matter dissolved by 2 litres of water from 1 kilogram of dry soil, plus the amount of non-settling suspended matter able to pass through doubled filter-paper:

	Top		8in.		16in.	
	May 5.	Sept. 25.	May 5.	Sept. 25.	May 5.	Sept. 25.
Plot 0 -	0.99	0.72	0.88	0.69	0.76	0.98
„ 1 -	0.76	0.61	0.45	1.16	0.49	1.11
„ 2 -	0.56	1.12	1.11	1.23	1.25	1.21
„ 3 -	1.28	1.24	1.31	1.13	1.28	1.15
„ 4 -	0.81	0.92	1.32	1.38	1.41	1.18
„ 5 -	0.72	0.64	0.85	1.14	1.25	1.28
„ 6 -	1.25	1.28	1.11	0.72	1.37	1.38
„ 7 -	1.2	0.72	1.21	1.28	1.28	1.12
„ 8 -	1.15	1.28	1.16	0.76	0.96	0.92
„ 9 -	0.89	0.52	1.13	1.18	1.19	0.81
Average	0.96	0.90	1.05	1.07	1.12	1.11

The data are of value simply as showing the coagulating action of slaked and quicklime, and to a less extent of bone dust and gypsum upon the surface layers of clay soil, while all the other manures appear to have either the opposite effect or only a temporary coagulating action. There is, however, no apparent relation between this action and the crop yield. In addition the surface average falls distinctly after the winter rains.

The sandy soil proved to be more amenable to treatment, and samples were taken from the plots, not only while the crop was growing, but also in December, a month after it had been harvested. The first sets of samples were taken practically simultaneously with the planting of the crop, and shortly after manuring. The manures were applied in the same quantity and order as in the clay plots. The sandy soil was of such density that one acre 1 foot deep would weigh approximately 4,800,000 lb., so that 18 inches deep would weigh 7,200,000 lb., and 2 inches deep, 800,000 lb. In the following table the amount of manure applied per acre is given in the first column, in the second column is the amount per kilogram in the superficial 2 inches, as when first applied, and in the third column the amount per kilogram when spread through the superficial 16 inches, assuming that none had been washed lower down.

		Manure	Amount per acre	Amount in superficial 2 inches. Grms. per Kilogram.	In Upper 16 inches
Plot 1	-	Slaked Lime	2 tons	5.6	0.70
„ 2	-	Nitrate of Soda	120lb.	0.148	0.016
„ 3	-	Star Phosphate	4cwt.	0.56	0.07
„ 4	-	Gypsum	1 ton	2.8	0.35
„ 5	-	Bone Dust	4cwt.	0.56	0.07
„ 6	-	Ammonium Sulphate	80lb.	0.1	0.012
„ 7	-	Blood Manure	2cwt.	0.28	0.035
„ 8	-	Superphosphate	2cwt.	0.28	0.035
„ 9	-	Quicklime	2 tons	5.6	0.7

Although the manures were, on the whole, applied in more than the customary concentrations, the usual application of star phosphate being, for instance, ½ cwt. per acre, it is evident that by the time the manures are distributed through the upper 18 inches of soil the amounts per kilogram will be too small to perceptibly affect the amount of the water-soluble, and still less of the acid-soluble residues per kilogram. Fluctuations in these of less than 0.02 to 0.01 of a gram appear to be meaningless, or, at least, to result from fluctuations or conditions beyond control, such as slight differences in the drainage, in the fineness of the soil, and in the slight unevenness in the distribution of the vital, physical and meterological conditions which affect it during the period of observation. Even when first applied, and distributed at a depth of 2 inches, the nitrate of soda and ammonium sulphate are barely present in sufficient amount to appreciably affect the soluble extractions from the soil by the method of partial lixiviation (2 litres of water to 1 kilogram) employed. By this method is determined merely the amount of soluble material immediately available for absorption, and which can be readily washed from the soil by rain. The blood manure and superphosphate might be expected to produce a distinct temporary rise of concentration in the superficial layers, whereas the relative insolubility of the star phosphate and bone dust would prevent them from producing any direct effect upon the superficial concentration. In the case of plots 2, 3, 5 and 6, any rise of concentration is either the result of a secondary action of the manure on the soil, or to the ascent and concentration by evaporation of the dissolved matter from the deeper layers of the soil. An apparent decrease of concentration may represent either an actual loss or a lessened solubility of certain constituents.

The following table gives the amounts of soluble matter extracted from a kilogram of dry soil by two litres of water, as calculated by the evaporation of one litre of the clear filtrate, the samples of soil taken in May, September, and December of 1906 being tested, and those of intermediate months used for control. The manuring took place in the month previous to the taking of the first samples (and the planting of the crop), while the last set of soil samples were taken the month after harvesting:—

		May 18	Sept. 25	Dec. 20
Plot 0—Unmanured	Top	0.31	0.18	0.49
	8 inches	0.48	0.35	0.48
	16 inches	0.48	0.68	0.41
	Average	0.42	0.40	0.46

The effect of the heavy rains of July, August, and partly of September, in washing the soluble constituents downwards is well shown, and the upward flow of the soluble constituents and their accumulation at the surface is well shown in the December result. The increased average probably partly results from the attraction of soluble matter from still deeper layers, and partly from nitrification in the soil during warm dry weather, after the removal of the crop and the absence of rain allowed the nitrates to accumulate.

		May 18	Sept. 25	Dec. 20
Plot 1.—Air-slaked Lime	Surface	0.53	0.41	0.48
(Two tons per acre)	8 inches	0.32	0.40	0.40
	16 inches	0.12	0.48	0.52
	Average	0.32	0.43	0.47

This plot was obviously poorer originally than the unmanured one, the high value for the top layer on May 18 being directly due to the addition of lime. This appears to keep the soluble matter more uniformly distributed in the upper layers of the soil, and also to cause a greater increase in the December average than occurs in the unmanured plot. The September average also shows a strong increase, in spite of the presence of a growing crop.

		May 18	Sept. 25	Dec. 20
Plot 9.—Quicklime	Surface	0.94	0.64	0.4
(Two tons per acre)	8 inches	0.42	0.5	0.4
	16 inches	0.36	0.4	0.46
	Average	0.57	0.51	0.42

The chemical action of the quicklime results in a liberation of soluble constituents (potash, etc.) in the superficial layers, but so much of this is ultimately washed away that the December average is below that for the preceding plots. The soluble matter is, however, kept evenly distributed, as in the case of the previous limed plots. The use of powdered quicklime for direct application to the soil is coming into vogue in English agriculture, a Birmingham firm manufacturing large quantities of a phosphatic and magnesian powdered lime for agricultural purposes. The lime needs to be drilled in as though it were so much seed, some time before the crop is planted, and its purpose is obviously to render a large amount of soluble matter immediately available for the use of young seedings. It is evident, however, that the quicklime will be apt to exercise an exhausting action on the fertility of the soil, especially in regions with a high rainfall.

Quicklime is often stated to have a special power of burning out humus from the soil, especially if applied at the rate of one or more tons per acre. This is quite incorrect as regards the ordinary mode of application of lime in Agriculture. Quicklime from the kilns, if directly put into the soil, would be rather injurious than useful, since all lumps of any size would retain their causticity in the soil long enough to delay seeding, and by their local action would result in very patchy cultivation. In ordinary practice, to secure fine subdivision and even distribution, lump lime must be allowed to slake in heaps on the surface, which, when the lime has crumbled down, can be scattered and harrowed in. During this process the whole or the greater part of the lime is converted into carbonate of calcium by the carbon dioxide of the air and soil. The presence of a carbonate of an alkaline base or alkaline earth is one of the conditions for the continuance of the nitrification of humus in the soil, the nitrous and nitric acids produced displacing the carbon dioxide from the carbonates in the soil. In this way the accumulation of acid, which is fatal to further nitrification, is prevented, but it must be remembered that strong alkalies like quicklime are very nearly as injurious to the nitrifying and other soil bacteria as are free mineral acids. Hence we should expect to find that the direct application of quicklime would, for a time at least, result in a lessened bacterial oxidation of the humus in the soil, as is in fact shown by the following results, giving the percentages of humus by weight in the dried soil of the various plots at three depths, at the beginning and close of the experiments:—

Percentages of Humus (fine sandy soil).

		May 5	Sept. 17	Dec. 20
Plot 0—Unmanured	Surface	1.6	1.85	1.8
	8 inches	1.6	1.7	1.75
	16 inches	1.4	1.41	1.3
	Average	1.53	1.65	1.62
Plot 1—Air-slaked Lime	Surface	1.55	—	1.55
(Two tons per acre)	8 inches	1.15	—	0.9
	16 inches	1.3	—	0.65
	Average	1.33	—	1.03

Plot 9—Quicklime	Surface	2.0	—	2.4
(Two tons per acre)	8 inches	1.35	—	1.75
	16 inches	1.5	—	1.45
	Average	1.62	—	1.87
Plots 2, 3, 5, 7, 8	Surface	1.8	—	1.85
(Bulked Average)	8 inches	1.9	—	1.8
	16 inches	1.9	—	1.8
	Average	1.87	—	1.82

In all the plots, the fallen *dejecta membra* of the crop tend to raise the percentage of humus in the surface layers. The air-slaked lime produced a pronounced fall in the percentage of humus, which, however, increased at a depth of 8 inches with the quicklime, and to a slight extent also in the unmanured plots. At 18 inches, the humus decreased in all cases, though only to a slight extent, except where air-slaked lime was applied. It must be remembered that the quicklime plot produced the heaviest crop, so that the increase in the percentage of humus is, to a slight extent, due to the greater development of the root system, and not entirely to the lessened oxidation. The air-slaked lime produced less crop, and caused a great waste of humus. The averages for the other manured plots show that, as compared with the unmanured plot, the rate of oxidation of the humus was increased disproportionately to its heightened production by the manured crop.

WATER-SOLUBLE CONSTITUENTS (continued).

		May 18	Sept. 25	Dec. 20
Plot 4—Gypsum	Surface	1.12	0.36	0.54
(One ton per acre)	8 inches	0.73	0.72	0.72
	16 inches	0.59	1.11	0.91
	Average	0.81	0.73	0.72

The gypsum is comparatively readily soluble, and comes readily away in the filtrate. It is easily washed downwards by rain, a very large part being lost during the rainy season, but is drawn to a certain extent up to the surface again in dry weather. The manurial value of this substance is commonly greatly exaggerated. It has but little of the favourable mechanical action of lime, it does not favour nitrification, and is a poor and expensive way of adding calcium to the soil. The unduly high manurial value attached to it may possibly arise from the fact that, when plants are grown in nutrient solutions, the calcium is often for convenience supplied in the form of the sulphate, which is more soluble than the carbonate, not poisonous like the chloride, and less liable to contamination with injurious impurities than the nitrate. Gypsum exercises, however, a feeble action in freeing potash in soils containing this substance in an insoluble form, but it is much less active than quicklime. It also neutralises alkaline soil or alkaline irrigation water. Thus—

Neutral soluble gypsum		Alkaline soluble sodium carbonate		Neutral air-slaked lime		Soluble neutral sodium sulphate
$CaSO_4$	and	Na_2CO_3	form	$CaCO_3$	and	Na_2SO_4

No action of this kind took place, however, in the soil under examination, and in both the clay and sandy soils the gypsum reduced the yield below that for the unmanured plot. Gypsum is, in fact, a substance which has crept into agricultural use as a manure largely under false pretences. Even its action on manure heaps in preventing the loss of ammonia is largely exaggerated, and the same end is far better and more cheaply attained by packing the manure tightly in walled enclosures or in pits shielded from the weather.

		May 18	Sept. 25	Dec. 20
Plot 2—Nitrate of Soda	Surface	0.48	0.29	0.40
(120lb. per acre)	8 inches	0.32	0.37	0.41
	16 inches	0.32	0.58	0.40
	Average	0.37	0.41	0.40
Plot 6—Sulph. of Ammonia	Surface	0.43	0.405	0.34
(80lb. per acre)	8 inches	0.53	0.49	0.44
	16 inches	0.55	0.41	0.36
	Average	0.5	0.435	0.38

Both these manures are highly soluble, and since they represent in the case of the nitrate of soda 0.148 gram per kilogram of the superficial 2 inches, and in the case of the ammonium sulphate 0.1 gram per kilogram, it is evident that the movements of the added salts are not solely responsible for the results, which are partly due to an indirect action, or to the absorptive action of the crop. The latter probably explains the steady decrease in plot VI., which appears to be less affected by rain than usual, and to show no increase in the superficial layer after drought. The plot II. shows the usual movements of the soluble matter, though these are not very pronounced, and the slight increase in the average shows that the solvent actions in the soil more than balanced the loss by drainage and by the crop.

		May 18	Sept. 25	Dec. 20
Plot 3—Star Phosphate (4cwt. per acre)	Surface	0.59	0.37	0.36
	8 inches	0.34	0.53	0.44
	16 inches	0.48	0.42	0.44
	Average	0.47	0.43	0.41

The manure being only sparingly soluble, the steady decrease of the averages probably represents soil constituents previously present. These show the usual drop after rain in the surface layer, and no absolute, but only a relative increase or lessened decrease on the surface after dry weather.

		May 18	Sept. 25	Dec. 20
Plot 5—Done Dust (4cwt. per acre)	Surface	0.51	0.32	0.44
	8 inches	0.50	0.43	0.41
	16 inches	0.63	0.52	0.38
	Average	0.55	0.42	0.41

This resembles the preceding closely, except that the concentration on the surface in December is better shown. Both cases indicate an exhaustion of the soluble soil constituents by the crop or by drainage, for if the manures fixed or precipitated the soluble constituents, the first surface estimation in May would be a low instead of a high one.

		May 18	Sept. 25	Dec. 20
Plot 8—Calcium Superphosphate (2cwt. per acre)	Surface	0.54	0.36	0.46
	8 inches	0.57	0.51	0.40
	16 inches	0.56	0.52	0.44
	Average	0.55	0.46	0.43

Although the manure is highly soluble, and the amount of it not too small (0.28 gram per kilogram of upper 2 inches when first applied), it does not seem to produce any pronounced direct effect upon the changes in the distribution of the soluble matter in the soil, which resemble those in the preceding plot.

		May 18	Sept. 25	Dec. 20
Plot 7—Blood Manure (2cwt. per acre)	Surface	0.64	0.61	0.42
	8 inches	0.67	0.6	0.41
	16 inches	0.55	0.56	0.54
	Average	0.62	0.59	0.46

The blood manure apparently exercises an important indirect action on the soil, increasing the amount of soluble matter present in it. The action apparently continues for some time, and suffices to maintain a high percentage in the surface soil of September, in spite of the previous rains. Even in December the average is higher than in any of the three preceding plots. Presumably the blood-manure sets up active nitrification in the soil, and this involves a considerable conversion of difficultly soluble or insoluble earthy and alkaline bases into readily soluble nitrates. One part by weight of the nitrogen of the blood-manure is capable of producing 6 parts of calcium nitrate, or 10½ parts of potassium nitrate. The effect on the crop was similar to that of the nitrate of soda on plot II.

If stock owners would abandon the practice common in certain parts of allowing dead stock to rot in creeks by running water, or to decay where they fall, and instead to bury all dead animals so that they are covered by at least a foot of soil, the nitrogen and phosphates of the carcase will enrich the soil, instead of being wasted, and the land-owner will benefit instead of the streams being polluted, or the land disfigured. The benefits of burying do not merely consist in the saving of nitrogen for the soil, but also apply to the phosphates of the bones which become much sooner available for plant use when the carcase is buried than when the bones left on the surface to bleach and weather quite hard. Bare bones when buried rot slowly, especially in calcareous soil, but if surrounded by flesh their disintegration is hastened. Hence the carcase should be buried while still fresh for practical, as well as for æsthetical, reasons.

Changes in the Acid-Soluble Constituents.—For complete comparison, a knowledge of the changes in the acid-soluble constituents of the soil is necessary, for these are in a continual process of solution, absorption, and reprecipitation, and undergo an increase during the slow disintegration of the soil, as well as being liable to decreases of chemical or physical origin (precipitation, formation of double or dehydrated salts, allotropic changes, etc.). The use of drastic solvent agencies is inadvisable, since these could quite readily give a false impression as to the condition of the soil. Hence for the extraction, 2 litres of very dilute hydrochloric acid of approximately decinormal strength were added to each kilogram of dry soil. One litre of the clear filtered liquid was evaporated to dryness, and the weight of residue doubled. The values obtained may be taken as giving the amount of mineral matter in the soil capable for the most part of solution and absorption under exhaustive conditions in from one to several years.

The acid extracts filtered readily and came through quite clear with a single filtering. This is mainly the result of the coagulating action of the acid, which, by lowering the surface tension of the finely divided particles, causes them to coalesce and then settle rapidly. To a slight extent it is due to the solution of some of the finer particles, for on adding acid to a turbid watery filtrate it cleared to a slight extent by solution, the remaining suspended particles then settling. Throughout the following tables the numbers in brackets give the acid soluble less the water-soluble matter.

		May 5	Sept. 25	Dec. 20
Plot 7—Blood Manure	Surface	5.08 (4.44)	4.25 (3.64)	3.68 (3.26)
(2cwt. per acre)	8 inches	5.74 (5.07)	4.41 (3.81)	3.96 (3.55)
	16 inches	5.64 (5.09)	5.4 (4.84)	3.76 (3.22)
	Average	5.49 (4.87)	4.69 (4.1)	3.8 (3.34)

If these figures are reliable, they indicate that blood manure causes a liberation and loss of the reserve plant-food which is altogether out of proportion to the amount removed by the crop. By itself, therefore, blood manure should seem to have a very exhausting action on the soil, and there is no evidence to show that the materials rendered soluble are drawn up to the surface again to any appreciable extent from the deeper layers of the soil. Instead, being mainly nitrates, they readily wash out of it and are lost.

		May 18	Sept. 25	Dec. 20
Plot 2—Nitrate of Soda	Surface	5.02 (4.54)	4.58 (4.29)	5.68 (5.28)
(120lb. per acre)	8 inches	4.72 (4.38)	4.50 (4.13)	4.1 (3.69)
	16 inches	4.8 (4.48)	5.02 (4.44)	3.68 (3.28)
	Average	4.84 (4.50)	4.70 (4.29)	4.48 (4.08)

The fluctuations at different depths might possibly be the result of imperfect sampling, which is always of great importance, however homogeneous the soil may appear to be. The averages, however, show a steady decrease. It is always possible that soluble material from one layer may continually diffuse towards another layer in which it is deposited by some kind of chemical precipitation, or as a result of evaporation, or the loss of a solvent gas. This may be the case here, although the fluctuations in the percentage of acid-soluble and water-soluble matter show no apparent relationship. The latter represents, however, merely the condition at the time of taking, whereas the former results from cumulative action prior to sampling.

		May 18	Sept. 25	Dec. 30
Plot 6—Ammonium sulphate	Surface	6.55(6.12)	5.64(5.24)	6.16(5.82)
(80lb. per acre)	8 inches	6.34(5.81)	5.7 (5.21)	5.7 (5.34)
	16 inches	6.25(5.7)	6.32(5.91)	4.8 (4.56)
	Average	6.38(5.88)	5.89(5.45)	5.55(5.24)

Here the acid-soluble matter undergoes on the average a distinctly greater reduction than in the previous plot, in spite of its lesser yield of crop. The variations closely follow those in plot II., so that it appears as though acid-soluble matter passes downwards to some extent after prolonged rain, and is slowly drawn upwards during prolonged drought.

		May 18	Sept. 25	Dec. 30
Plot 8—Star Phosphate	Surface	5.36 (4.77)	5.06 (4.69)	4.36 (4.0)
(4cwt. per acre)	8 inches	4.98 (4.64)	4.76 (4.23)	4.8 (4.36)
	16 inches	5.40 (4.92)	5.18 (4.76)	4.72 (4.28)
	Average	5.25 (4.78)	5.0 (4.56)	4.63 (4.21)

		May 18	Sept. 25	Dec. 30
Plot 5—Bone Dust	Surface	5.3 (4.79)	5.2 (4.68)	5.7 (4.26)
(4cwt. per acre)	8 inches	4.92 (4.35)	4.86 (4.43)	4.58 (3.87)
	16 inches	4.96 (4.33)	4.82 (4.3)	4.04 (3.66)
	Average	5.06 (4.36)	4.96 (4.47)	4.67 (3.93)

In plots III. and V. the amounts of manure added represent 0.56 gram per kilogram of the surface 2 inches, and 0.07 per 18 inches depth. Since only a portion of each is soluble in the the dilute acid used, it is evident that the steady fall represents mainly materials previously present in the soil. In the star phosphate plot no superficial accumulation of acid-soluble materials takes place in December, but this phenomenon is shown with the bone dust plot, possibly because of secondary reactions excited by the organic material of the bone dust.

		May 18	Sept. 25	Dec. 30
Plot 8.—Calcium Superphosph.	Surface	6.08(5.24)	5.61(5.25)	4.1(3.62)
(2cwt. per acre)	8 inches	7.96(7.39)	7.2 (6.69)	4.4(4.0)
	16 inches	5.86(4.66)	5.22(4.5)	4.2(3.74)
	Average	6.63(5.76)	6.01(5.58)	4.2(3.79)

The amount of manure added represents 0.28 gram per kilogram of the superficial 2 inches, and the high solubility explains the high amount of water-soluble matter in the superficial layers on May 18. At the same time the superphosphate seems to exercise a strong solvent action on the soil itself, of such character as to strongly increase the amount of matter soluble in dilute acid. The net result is to leave the soil distinctly poorer in matter soluble in dilute acid than any of the previous plots, but if this matter is utilised by the crop it represents an increased yield and profit instead of so much inert material. Unfortunately but little appeared in the crop as ash, so that superphosphates by themselves appear to be highly wasteful and exhausting. If these facts hold good for soils in general, the exclusive use of phosphates in Victorian agriculture is likely to rapidly exhaust the fertility of the soil, not only because of the greater demands of the increased crop, but also because the superphosphate exercises a secondary action on the soil, temporarily increasing the amount of water-soluble matter and also that of materials soluble in very dilute acid. The former are rapidly and the latter slowly removed from the soil by the action of rain water charged with carbon dioxide as well as by the crop.

		May 18	Sept. 25	Dec. 20
Plot 4—Gypsum	Surface	5.2 (4.08)	4.04 (3.68)	4.2 (3.66)
(One ton per acre)	8 inches	4.4 (3.67)	3.9 (3.18)	3.5 (2.78)
	16 inches	4.15 (3.56)	3.4 (2.29)	3.1 (2.19)
	Average	4.58 (3.77)	3.78 (3.05)	3.6 (2.88)

		May 18	Sept. 25	Dec. 20
Plot 0—No Manure	Surface	3.32 (3.01)	3.9 (3.72)	4.58 (4.09)
	8 inches	3.90 (3.42)	3.4 (3.05)	3.44 (2.96)
	16 inches	3.82 (3.34)	3.7 (3.02)	3.06 (2.65)
	Average	3.68 (3.26)	3.7 (3.26)	3.69 (3.23)

Not only did the gypsum produce a less crop yield than the unmanured plot and unduly increase the amount of water-soluble material liable to waste by drainage, but it also caused a pronounced decrease in the amount of acid-soluble material by the end of the year. In the unmanured plot the averages remain very nearly constant in spite of an increase towards the surface and a decrease in the deeper layers.

		May 18	Sept. 25	Dec. 20
Plot 1—Air-slaked Lime	Surface	6.3 (5.77)	5.08 (4.67)	5.44 (4.96)
(Two tons per acre)	8 inches	4.6 (4.18)	4.68 (4.28)	5.12 (4.72)
	16 inches	4.88 (4.76)	4.46 (3.98)	4.0 (4.48)
	Average	5.23 (4.9)	4.74 (4.31)	4.85 (4.72)
Plot 9—Quicklime	Surface	7.38 (5.44)	7.66 (7.02)	7.08 (6.68)
(Two tons per acre)	8 inches	6.34 (5.92)	6.7 (6.2)	5.52 (5.12)
	16 inches	6.38 (6.02)	6.5 (6.1)	5.6 (5.54)
	Average	6.7 (6.13)	6.95 (6.44)	6.07 (5.78)

The acid-soluble materials appear to increase in the quicklime plot in September, and are throughout high. This is undoubtedly due to the chemical action of the quicklime on the soil, and this action involves a considerable waste of food materials by the end of the year. This waste is not apparent in the case of the slaked lime plot, in which, as in the unmanured plot, the total amount of readily soluble material appears to be greater in December than it is after the winter rains in September. In all the other plots the amount steadily decreases towards the close of the year.

For convenience of reference a joint table is given beneath showing the averages from the upper 18 inches for all the plots in parallel columns. From the totals it appears that the manure added represents the ash of the crop fourfold, and that the total apparent loss from the soil was four times greater than the amount of chemical manure added. In other words, chemical manures do not permanently enrich, but rapidly impoverish, fine soils poor in humus, especially when applied in excess.

SUMMARY.

As regards the unmanured plot, the sodium nitrate appears to lower the percentage of dissolved matter during the eight months following its application; the slaked lime lowers the amount at first, but by the end of the year it is up to the normal level again. In all other cases, the amount of water-soluble matter is increased at first, and lowered below the unmanured level by the end of the year, except in the case of the gypsum, in which it remains high in spite of a heavy loss, and of the blood manure, in which it does not fall below the amount in the unmanured plot.

In regard to the distribution of the soluble matter in the different layers, the downward movement, as the result of continuous rain, and the less marked upward ascent during drought, were well shown by the unmanured, slaked lime, gypsum, nitrate of soda, bone dust, and superphosphate plots, while the downward movement was merely lessened in summer, and not actually reversed in the case of the quicklime, ammonium sulphate, star phosphate, and blood manure plots. The averages for the water-soluble matter in all the plots are remarkably consistent with the conclusions mentioned, the surface showing a fall and rise, 8 inches depth a slow fall, and the 16 inches an almost similar rise by the end of the year.

AVERAGE WATER-SOLUBLE MATTER FOR ALL THE PLOTS.

	May 18	Sept. 25	Dec. 20
Top	0.61	0.39	0.43
8 inches	0.49	0.48	0.45
16 inches	0.46	0.47	0.49

The amount of matter soluble in dilute acid underwent a secondary rise at the end of the year in the superficial layers in the case of the unmanured, sodium nitrate, ammonium sulphate, bone dust, and slaked lime plots, but in all other cases decreased steadily in the surface layers of soil. The quicklime plot was exceptional in showing not only a rise in the superficial layer in September, but also an increase in the average for the whole 16 inches, followed by a pronounced fall in December. As regards the averages, these decreased during the year in all the plots excepting the unmanured and slaked lime plots, but the increases in these were very slight in amount.

AVERAGE MATTER SOLUBLE IN DILUTE ACID FROM ALL THE PLOTS.

	May 18	Sept. 25	Dec. 20
Surface	4.82	4.69	4.56
8 inches	4.88	4.52	4.04
16 inches	4.69	4.41	3.76

The average acid-soluble matter decreases steadily on the surface and more rapidly in the deeper layers, especially during the summer months.

Without claiming anything more than a preliminary and suggestive value for these data, they nevertheless may be taken to apply to the fine alluvial soil occurring on so many river flats and valleys in Victoria. None of the manures as applied in the somewhat excessive quantities given would have paid for their application by the increased crop yield. It will further be noticed that the apparent loss from all the plots excepting the slaked lime and unmanured ones (where there is a slight gain) is very much greater than can be explained by the ash removed by the crop. To what extent these apparent losses are real ones, and to what extent they are due to decreases in solubility, to increases in absorptive power, or to changes in distribution, must be reserved for further investigation. As far as they go they seem to show that the fine alluvial, sandy river-flat soils widely cultivated in many parts of Victoria appear to be peculiarly liable to exhaustion under the action of all chemical manures excepting slaked lime. Even if the maximal apparent loss (85lb.) were entirely a real loss, it would take 530 years to remove the top 16 inches, assuming that all was removed by solution and none by erosion. These soils appear also to be comparatively deficient in humus, but where this is not so the manurial diagnosis in the case of virgin soil would be slaked lime at the rate of ½ to 1 ton per acre, until the soil begins to show signs of exhaustion, then farmyard manure at a probable minimum of 2 to 5 tons per acre, soluble, nitrogenous, or phosphatic manures to be used sparingly, or not at all unless the soil shows need for them.

PRACTICAL AXIOMS.

Quicklime binds a clay soil, slaked lime ameliorates it.

Quicklime in excess exercises a wasteful solvent action on composite sandy soils. Small quantities drilled in prior to seeding should, however, stimulate the early growth of seedlings, and perhaps lessen the danger of infection by fungi.

The indirect action of a manure on the soil is usually much more important than its direct chemical value as a nutrient substance. This applies not only to those manures which exert a direct chemical action on the soil, but also to those nitrogen-containing, acid or alkaline manures which affect the activity of the micro-organisms in the soil.

Chemical manures, especially soluble phosphatic ones, should not be applied in any quantity to soils poor in humus, except in company with farmyard manure or some form of humus.

The soil is a changeable matrix, whose percentage solubility in water and acid varies appreciably at different depths throughout the year, and also undergoes seasonal changes as a whole, especially under the action of chemical manures. The apparent losses from the soil after heavy manuring are many times greater than the ash contained in the crop, and also greater than the amount added to the soil by any of the chemical manures used excepting lime.

The oxidation and nitrification of humus in the soil is more favoured by air-slaked lime than by the direct application of quicklime, so long as the latter retains any alkalinity injurious to nitrifying micro-organisms.

Postscript.

Since the above was written, Mr. Hall has drawn my attention to the fact that Norman Taylor, in MacIvor's "Chemistry of Agriculture," 1879, p. 224, suggested that the superficial limestone deposits common in the Mallee may have been produced by the continued drawing up of chalk in solution by capillary action from the moister layers below. This explanation was adopted by Howchin for the desert limestones around Adelaide, and was extended by Gregory ("Geography of Victoria," 1903, p. 93) to the hard siliceous superficial cherts or quartzite beds, and also to the ironstones of superficial gold deposits. Recent research has, however, shown that iron bacteria may play a most important part in the formation of iron deposits wherever water is present, and such deposits will, in the first instance, be superficial. In any case, the data obtained by me are insufficient to do more than establish the fact that material may rise to the surface in dry weather, but say nothing as to whether wet weather may not wash it down again to an equally great extent. The alkaline ash left after bush fires would certainly tend to carry silica downwards again as soon as any rain fell.

Plot.	Manure per acre	Grams per Kilog. per 2 inches depth	Grams per Kilog. per 16 inches depth	Crop yield in lbs. per sq. pole	Max. calculated crop ash in lbs. per sq. pole	Water-soluble matter 1 Kilog. in 2 litres			Decrease or increase	Matter soluble in acid only, 1 Kilog. in 2 litres, N/10 HCl			Decrease or increase	Total apparent decrease or increase per sq. pole of 16ins. depth, in lbs.	Manure added per sq. pole
						May 18	Sept.25	Dec.20		May18	Sept.25	Dec.20			
0	No Manure - - -	—	—	120	1.6	0.42	0.40	0.46	+0.04	3.26	3.26	3.23	−0.03	+0.45	Nil.
1	Slaked Lime (2 tons) -	5.6	0.7	140	1.87	0.32	0.43	0.47	+0.15	4.9	4.31	4.72	−0.18	+1.35	28lbs.
2	Sod. Nitrate (120lbs.) -	0.148	0.016	139	1.85	0.37	0.41	0.40	+0.03	4.50	4.29	4.08	−0.42	−17.5	12oz.
3	Star Phosphate (4cwt.)	0.56	0.07	122	1.65	0.47	0.43	0.41	−0.06	4.78	4.56	4.21	−0.57	−28.3	2lb. 12.8oz.
4	Gypsum (1 ton) - -	2.8	0.35	104	1.39	0.81	0.73	0.72	−0.09	3.77	3.05	2.88	−0.89	−44.1	14lbs.
5	Bone Dust (4cwt.) -	0.56	0.07	121	1.61	0.55	0.42	0.41	−0.14	4.36	4.47	3.93	−0.43	−25.6	2lb. 12.8oz
6	Amm. Sulphate (80lb.)	0.1	0.012	132	1.76	0.5	0.435	0.38	−0.12	5.88	5.45	5.24	−0.64	−34.2	8oz.
7	Blood Manure (2cwt.) -	0.28	0.035	138	1.84	0.62	0.59	0.46	−0.16	4.87	4.1	3.34	−1.53	−76.0	1lb. 6.4oz.
8	Calcium Superphosphate (2cwt.)	0.28	0.035	141	1.88	0.55	0.46	0.43	−0.12	5.76	5.58	3.79	−1.79	−85.9	1lb. 6.4oz.
9	Quicklime (2 tons) -	5.6	0.7	149	1.99	0.57	0.51	0.42	−0.15	6.13	6.44	5.78	−0.35	−22.5	28lbs.
	Totals -	15.93	1.99	1296	17.44	5.18	4.81	4.56	−0.62	48.21	45.51	41.20	−6.83	333.3	79lb. 10.4oz.

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Art. VI.—*Fossil Fish Remains from the Tertiaries of Australia.*

Part II.

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(With Plates V.-VIII.).

[Read 13th June, 1907.]

Contents.

I.—INTRODUCTION.

The present paper is written as a continuation of the section previously published,[1] which dealt entirely with our Tertiary selachians included in the sub-order Asterospondyli. We now describe one of our remaining selachians, as well as the chimæroids and two members of the Actinopterygii, altogether represented by seven species. We have also many specimens of ver-

1 Proc. Roy. Soc. Vict., vol. xvii., n.s., pt. i., 1904, pp. 267-297.

tebræ and other fish remains from the Barwonian and Kalimnan deposits, as well as several examples from the Pleistocene of Victoria. These are not included at present, as we wish to obtain a more complete recent series for comparison. The following genera are now dealt with, all the species of which appear to be new, namely, Myliobatis, Edaphodon, Ischyodus, Labrodon, and Diodon. Of these, Myliobatis and Atopomycterus (Diodon) have been previously recorded by Professor Tate, but no species have been figured or described.

In addition to the large amount of material available to us in the National Museum collection and in the private collection of one of us, we have made use of the collections of Messrs. G. Sweet, F.G.S., J. R. Dixon, and F. P. Spry, and to these gentlemen we now express our thanks for kindly favouring us with the opportunity of dealing with their specimens. To Prof. Baldwin Spencer, C.M.G., F.R.S., we are indebted for handing to us for description the example of Ischyodus from Table Cape.

II.—DESCRIPTION OF SPECIES.

Order SELACHII.

Family *Myliobatidae.*

Genus *Myliobatis*, Cuvier.

Myliobatis moorabbinensis, sp. nov. (Plate V., Figs 1-3).

Description.—Median palatal teeth about five times as wide as long, with a rather narrow and depressed aspect, and a distinct marginal curvature. Palatal surface flat to slightly convex. Denticles of the articulating surface strong, and numbering about ten in 10 mm. of length.

Dimensions.—Width of palatal teeth, 22 to 23 mm.; length, 5 to 6 mm.; length of articulating surface, about 5 mm.

Locality and Horizon.—Beaumaris, Port Phillip, Kalimnan. (Pritchard Coll.).

Observations.—The genus Myliobatis has previously been recorded by the late Prof. R. Tate in his "Census of the Australian Tertiary Fauna."[1] Two species of the genus have also been recorded by Messrs. J. Dennant and A. E. Kitson in their "Catalogue of the Described Species of Fossils in the Cainozoic Fauna of Victoria, South Australia and Tasmania,"[2] namely, M. toliapica Agassiz (from Beaumaris), and M. plicatilis Davis (from Table Cape). Mr. Dennant,[3] with whom we have conferred respecting these fossils, is unable to give us any definite information as to the original identification of the fossils referred to, but they were presumably identified by Prof. Tate. Our specimens from Beaumaris are distinct from M. toliapica in their shorter lateral dimension, but since the latter species is in other respects fairly closely allied, it is probable that the earlier Victorian record of M. toliapica was based on an imperfect comparison of M. moorabbinensis. The Table Cape specimen is not available for comparison.

M. moorabbinensis appears to differ from our living forms by being much smaller and of a more slender character. These features seem constant, judging by their uniformity in the fragmentary remains hitherto obtained.

Order CHIMAEROIDEI.

Family *Chimaeridae.*

Genus *Edaphodon*, Buckland.

Edaphodon sweeti, sp. nov. (Plate V., Figs. 4-6.)

Description.—Mandibular teeth robust, with 5 tritors, and a prominent and rather sharp beak. In its structure, the beak tritor is laminated in front to half its length, and tubulated behind; the tubules follow the direction of the laminæ, and are obliquely arranged along the oral margin. The remaining tritors have a fine, conspicuous, tubulated structure. Median tritor very large, strongly convex, elongately triangular, and

1 Jour. Roy. Soc. N.S.W., vol. xxii., pt. 2, 1888, p. 247.

2 Records Geol. Surv., Victoria, vol. i., pt. 2, 1903, p. 94.

3 Since writing the above, we have heard with much regret of the decease of this widely known geologist, who has done so much to further the study of our Victorian Tertiary fauna

closely conjoined by a smaller and narrow tritor which extends to the oral margin. Posterior tritor elongate-subquadrate, tending posteriorly to subdivide lineally. The fifth tritor lies behind the symphysial facette, and is narrow, long-elliptical, and follows the curve of the lower border. Symphysial facette slightly longer than one-third the entire length of the lower border.

Palatine teeth (nearly always imperfect) relatively broad, and showing the presence of three tritors, the hinder and inner one being very much larger than the remaining two, and generally fully twice the length and breadth of the next largest tritor. Structure of the tritors similarly tubulate to those of the mandibular, but coarser. This may account for their usually more decomposed condition in the fossil state.

Vomerine teeth narrow; inner symphysial surface concave, and furnished with a usually large number of elongated tritors, ranging from 7 to 24. Tritors of the symphysial margin largest, elongate towards the front, whilst in the oral margin they are more numerous, and broken into an imbricated succession. Tritors with a very finely tubulated structure.

Dimensions.—Approximate, on account of worn condition of teeth.

MANDIBULAR TEETH.

	Length.	Height.	Greatest Thickness.
Spec. a. (type)	69	36	17
Spec. b.	75	30	16

PALATINE TOOTH.

	Length.	Greatest width.	Thickness.
(Figd. spec. imperfect)	47	31	16

VOMERINE TEETH.

	Length.	Height.	Greatest Thickness.
Spec. a.	71	29	12
Spec. b. (imperfect)	43	12	10
Spec. c. (imperfect)	37	20	10
Spec. d.	34	14	6

Locality and Horizon.—Grange Burn, near Hamilton, Western Victoria from the nodule bed at the base of the Kalimnan (Nat. Mus. Coll., pres. A. A. Kelley; also F. Spry Coll., G. Sweet Coll., and G. B. Pritchard Coll.), Beaumaris, Port Phillip, base of the Kalimnan (Nat. Mus. Coll., pres. by the late W. B. Jennings, and Coll. by the late W. Kershaw; also G. B. Pritchard Coll.).

Observations.—As in the case of the Diodon presently to be described, we are also fortunate in having so complete a series of these fish remains, and although we lack many completely preserved specimens, there is a large number of fragmentary specimens, and these have materially assisted in the elucidation of their characters as a whole. In all, we have examined about 35 examples of this form. Judging by the general characters shown in the previously illustrated examples of Edaphodon teeth, our forms show some slight divergences from typical specimens in the number and arrangement of the tritors, apparently making an approach towards Chimæra.[1] The recorded range of Edaphodon is Cretaceous to Oligocene. It does not appear to have been noted before as occurring in the rocks of the southern hemisphere.

Comparing our fossils with specimens of Edaphodon in our Museum from British localities, and with various descriptions and figures available for our purpose, the nearest ally appears to be Edaphodon bucklandi, Agassiz[2] from the British Eocene; but this species is a larger form, is more heavily built, and the tritors have a coarser structure.

Genus *Ischyodus*, Egerton.

Ischyodus mortoni, sp. nov. (Plate VI., Fig. 6.)

Description.—The specimen to which we append the above name is part of a left mandibular tooth having a very elongate and robust character, and with a remarkable concavity towards the upper part in the posterior region. The extreme anterior portion of the tooth is missing, but the posterior is fairly complete, showing part of the smooth superficial bony layer of the posterior margin. This marginal layer is marked by a series of slightly undulating thread-like ridges, which are most distinct on the inner third of the surface, a stronger ridge marking off this area. It is, moreover, convexly rounded off where it meets

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1 Compare diagrams in Smith Woodward Cat. Foss. Fishes (Brit. Mus.), pt. ii., 1891, p. 54.

2 Poiss. Foss., vol. iii., 1843, p. 351, pl. xl., *a*, figs. 1-4, 9-12, 19-24; also E. eurygnathus, Ag., Dixon, Foss. Sussex, 1850, p. 111, pl. x., figs. 18, 19, 22, pl. xii., f. 5.

the symphysial facette. The width of the latter is 8 mm. near the posterior margin. A narrow elevated ridge runs along the symphysial facette about 5 mm. from the margin, making an angle of about 30 deg. with the posterior layer. The tritors consist of very coarsely tubulated material, and in this specimen have been almost entirely weathered out, only a thin layer remaining, but sufficient to show the presence of three very long, narrow tritors on the posterior portion of the tooth.

Dimensions.—Height, 30.5 mm.; greatest thickness, 16 mm.

Locality and Horizon.—Table Cape, Tasmania. From the "Turritella beds," Jan Jukian. Tasmanian Museum Collection, Hobart.

Observations.—The above species shows a striking similarity in its general characters to Ischyodus egertoni, Buckland[1] from the British Jurassic, but is much narrower and more elongate, with long narrow tritors showing a more marked parallelism.

The genus Ischyodus has been previously recorded from the Tertiary rocks of Amuri Bluff, New Zealand, and identified with Agassiz's I. brevirostris by E. T. Newton.[2] The latter species belongs to the Lower and Upper Cretaceous of England. It is unfortunate that a reference to the Amuri Bluff deposits as Greensand[3] should have been made and perpetuated, considering that the fauna is so distinctly tertiary. Subsequent to Newton's description of the New Zealand specimen, three others have been recorded under the same specific name by J. W. Davis, from Amuri Bluff.[4] It is just possible, however, that since these specimens are more or less fragmentary, further material may show the New Zealand form to be a distinct species.

With regard to the name I. brevirostris, A. S. Woodward has already shown[5] that I. thurmanni, Pictet and Campiche, has priority over it.

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1 Chimaera egertonii, Buckland. Proc. Geol. Soc. Lond., vol. ii., 1835, p. 206. Chimaera (Ischyodus) egertoni, Agassiz. Poiss. Foss., vol. iii., 1843, p. 340, xl.c, figs. 1-10.

2 Quart. Jour. Geol. Soc., vol. xxxii., 1876, p. 326, pl. xxi., fig. 5.

3 Hector, Handbook of N. Zealand, 1883, p. 31 (referred to as Lower Greensand).—Newton, Q.J.G.S., vol. xxxii., 1876, p. 326 (Lower Greensand).—Davis, Trans. R. Dubl. Soc., vol. iv., ser. 2, 1888, p. 42 (Cretacco-tertiary). –Smith Woodward, Cat. Foss. Fishes, Brit. Mus., pt. ii., p. 68 (Greensand).

4 Trans. R. Dubl. Soc., vol. iv., ser. 2, 1888, p. 42, pl. vii., figs. 10-13.

5 Cat. Fossil Fishes, Brit. Mus., pt. ii., 1891, p. 67.

The Tasmanian specimen, collected from Table Cape, was presented to the Tasmanian Museum, Hobart, by Chas. Mackenzie, Esq. We owe the opportunity of dealing with this specimen to the courtesy of Prof. W. B. Spencer, C.M.G., who received it from Mr. Morton, the curator, after whom we have much pleasure in naming it.[1]

Order ACTINOPTERYGII.

Family *Labridae.*

Genus *Labrodon,* Gervais.

Labrodon confertidens, sp. nov. (Plate V., Fig. 7.)

Description.—Lower pharyngeal dentition subtriangular, with a very broad base, and apparently produced in front to a broadly rounded point, but our specimen is unfortunately imperfect in this respect. Surface strongly convex in the median area and tumid towards the front. Teeth very densely crowded, normally circular in section, excepting where so closely packed as to become compressed into polygonal form, both laterally, and from back to front along the lines of greatest convexity. Posteriorly the teeth become distinctly triangular. The largest teeth are situated in the median area, and form about 4 rows; they measure up to 3 mm. in diameter. The smallest teeth are situated anteriorly, and principally along the lateral extremities; they average about .75 mm. in diameter. By the fractured anterior of this pharyngeal, it may be noted that there are five successional series of teeth in addition to the functional layer. The unworn teeth are seen to have perfectly spherical and highly enamelled crowns.

Dimensions.—Width of completed specimen, 54 mm.; width at the base of beak-like projection, about 10 mm.; anteroposterior diameter, probably about 31 mm.

Locality and Horizon.—Grange Burn near Hamilton, Western Victoria. Base of the Kalimnan. National Museum Collection (presented by A. A. Kelley, Esq.).

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1 Since this was written we have heard with the deepest regret of the death of the distinguished curator of the Tasmanian Museum.

Observations.—The nearest ally to the above species appears to be the North American form described under the name of Pharyngodopilus carolinensis,[1] from the Tertiary Phosphate beds of South Carolina; but the characters and arrangement of the teeth are distinct, the latter form having its dentition in more regular series. We might also draw some comparison with L. haueri, Münster, sp.,[2] from the Miocene of the Vienna Basin, Italy, Sicily and Brittany, but this form does not have its teeth so crowded, being usually openly spaced.

Labrodon depressus, sp. nov. (Plate V., Figs. 8-9.)

Description.—There is another specimen of the dentition of Labrodon in our collection which, since it shows considerable divergence from the foregoing species, we have thought advisable to separate, noting some of its principal features. This pharyngeal is remarkable for its thin and depressed aspect, nearly equiangular in outline, with rather irregular and closely-packed teeth, and showing on the edges four successive layers. On the lower surface the bases of the teeth are well shown, and each possesses a conspicuous and well-developed cavity, which is central and circular. As compared with the previous species, the teeth are rather lenticular than circular.

Dimensions.—Diameter of largest teeth, 3.5 mm.; smallest teeth, 2 mm. Average height of teeth, 1.75 mm. Width of hapryngerl, about 27 mm.; antero-posterior diameter, 16 mm.; total thickness, 8 mm.

Locality and Horizon.—Beaumaris, Port Phillip. Kalimnan. (Pritchard Coll.).

Family *Diodontidae.*

Genus *Diodon*, Linnaeus.

Diodon formosus, sp. nov. (Plate VI., Figs. 1-3; Plate VII.; Plate VIII., Figs. 1-7.)

Description.—Jaws solid, and apparently heavier than in other known fossil forms. Upper jaw with a broadly-angular beak. Lower jaw rounded in front, and more depressed on the inner

1 Journ. Acad. Nat. Sci., 2nd ser., vol. viii., 1877, p. 256, pl. xxxiv., figs. 19-24 (especially fig. 20).

2 Phyllodus haueri, von Münster, Beitr., Petrefact, pt. vii., 1846, p. 6, pl. i., fig. 1.

surface than the corresponding palatal surface of the upper jaw. Denticles of the jaw margin comparatively coarse, and irregular in size, with a vermiculately crinkled surface except where worn. In the largest specimen the pile of palatal plates numbers seventeen, whilst in the smallest specimens before us there are only five, and average sized examples show eleven or twelve.

These Diodon jaws show very considerable variation in form, both as to the angle of the upper jaw margin, which ranges from 95 degrees to 110 degrees; and also in the excavated area between the palatal pile and the margin, which is often deeply concave, while the distance between the anterior margin of the plates and the denticulated border varies between 8.5 mm. and 18 mm. These measurements were made on full grown examples.

The shape of the palate is generally suboval, in which the lateral axis is the longer.

DIMENSIONS OF THE JAWS OF DIODON FORMOSUS, BASED ON THE MORE PERFECT EXAMPLES.

UPPER JAW.

Lateral Width.	Base to Front.	Width of Palate.	Depth of Palate.	No. of Plates.	Locality.
15mm.	9.5mm.*	11.5mm.	7 mm	4 imperfect	Beaumaris
31 „	19.5 „	20.5 „	11 „	(?)	Beaumaris
36 „	21 „	25 „	14 „	10	Beaumaris
39 „*	31 „	36.5 „	18 „	8	Beaumaris
52 „	49 „	34 „	28 „	8	Grange Burn
51 „	41 „	32 „	28.5 „	only 7 visible	Grange Burn
56 „	46 „	39 „	26 „	12	Beaumaris
66 „*	57 „	37 „	33 „	only 6 visible	Grange Burn
70 „	57 „	41 „	33 „	17	Beaumaris

* (Circ.)

LOWER JAW.

Lateral Width.	Base to Front.	Width of Palate.	Depth of Palate.	No. of Plates.	Locality.
26.5mm.	17 mm.	17.5mm.	12.5mm.	6	Grange Burn
29 „	15.5 „	20 „	11.5 „	6	Beaumaris
32 „	20 „	19 „	16 „	6 visible	Beaumaris
42* „	36 „	30 „	30 „	12	Beaumaris

* (Circ.)

In addition to the above, we have a large number of more or less imperfect palates from which the average number of plates in the pile was more accurately determined than might be judged from the above table, and the proportion of incomplete to complete specimens we would estimate at about three to one.

The relatively greater abundance of the upper jaw as compared with the lower may be due to the fact that the lower jaw soon falls away from the fish after death, and thus runs a greater risk of destruction before coming under the influence of sedimentation, and consequent preservation of the remains.

Locality and Horizon.—Grange Burn, Western Victoria, from the nodule bed at the base of the Kalimnan (Nat. Mus. Coll., purchased R. Lindsay; also 2 fine specimens of upper jaws presented by A. A. Kelley; also Spry Coll. and Pritchard Coll.).

Beaumaris, Port Phillip (Nat. Mus. Coll. specimens collected by the late W. Kershaw, several presented by J. A. Kershaw, an exceptionally fine upper jaw presented by C. P. Smart, a lower jaw presented by the late J. F. Bailey and 8 specimens purchased from W. B. Jennings; also Pritchard Coll., including an extensive series of small specimens; and Dixon Coll., which has yielded the largest specimen).—Base of the Kalimnan.

Observations.—The palatal aspect of the upper jaw shows the fossil form to be more angularly pointed at the beak than in the living D. hystrix, L., and more nearly approaching D. blochii, Casteln., both of which species occur in Port Phillip, the latter being the commoner. Lateral margin less curved and more widely divergent than in the living forms, the marginal denticles being generally coarser, averaging ten on each side, whilst our recent forms have twice that number. There is also a greater tendency in the full-grown fossil forms to an extension of the excavated area between the palatal plates and the denticulated oral margin.

It appears that the recent form D. hystrix occasionally attained dimensions nearly equal to that which is indicated by the size of the jaw in the fossil species, since one individual is recorded from the British Museum Collection[1] which has a length of thirty inches, but this is exceptional. Günther[2] mentions the largest form as attaining a length of two feet.

1 Cat. Fishes Brit. Mus., vol. viii., 1870, p. 306.
2 An Introduction to the Study of Fishes, 1880, p. 689.

The present species differs from other described fossils in many particulars. From D. sigma[1] it differs in having the dental plates with a subquadrate outline, instead of, as in that species, strongly rounded sides.

From D. vetus[2] it may be readily separated by the broad and angular shape of the jaws, and by their more massive build in the palatal area. It is noteworthy that of the several described fossil forms of Diodon only D. vetus appears to have been preserved as perfectly as the present species.

The only other authentic species to which we may refer is D. scillae, Agassiz[3] from the Miocene of Italy, Sicily and Malta. In this form the palatal plates are thinner and consequently more numerous than in our species, and its lateral boundaries are sinuous and incurved instead of convex.

It was in all probability the herein described species that the late Professor Ralph Tate had in mind when he recorded Atopomycterus from the Older Tertiary of Australia in his "Census" of its fauna.[4] The reason that Tate assigned this fossil to the genus Atopomycterus may probably have been due to the fact that a fish, recorded by Steindachner[5] as Atopomycterus bocagei, had been found in Port Jackson, but this has since been indicated as synonymous with Diodon novemmaculatus, Cuvier.[6]

The genus Diodon is commonest as a Miocene fossil, and is usually associated with other fish and cetacean remains characteristic of phosphatic beds in various parts of the world, but it also occurs in beds of Oligocene and Eocene age.

Diodon connewarrensis, sp. nov. (Plate VIII., Figs. 8-10).

Description.—Spine smooth, short and strong, after the type of those of D. hystrix, but not so acutely pointed, and without

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1 Martin, Samml. Geol. Reichsmus. Leiden, ser. 1, vol. iii., p. 16, pl. i., figs. 5, 5*a*, 5*b*.

2 Leidy, Proc. Acad. Nat. Sci. Philad., vol. vii., 1855, p. 397; also Journ. of same Society, ser. 2, vol. viii., 1877, p. 255, pl. xxxiv., figs. 15-18.

3 Poiss. Foss., vol. ii., pt. ii., p. 274. See also Smith Woodward, Cat. Foss. Fishes Brit. Mus., pt. iv., 1901, p. 572; text-figure 20 (p. 573).

4 Journ. Roy. Soc. N. S. Wales, vol. xxii., pt. ii., 1888, p. 247.

5 Sitzungsb. and K. Ak. Wiss. Wien, vol. liii., 1866, p. 477, pl. vi., f. 3.

6 A. Günther, Cat. Fishes Brit. Mus., vol. viii., 1870, p. 308; also W. Macleay, Descr. Cat. Australian Fishes, vol. ii., 1881, p. 280.

the basal grooves. On the other hand, there is evidence of the presence of an anterior ridge such as is seen on the spines of D. blochii. Both the above-mentioned species are living in Port Phillip, D. hystrix being readily distinguished by its short spine with a broad base, whilst D. blochii has fewer and more slender spines with a comparatively narrow base.

The section of the fossil spine is subtrigonal, with the inner surface concave at the base, the roots or basal prongs making an angle of about 120 degrees with the main shaft.

Dimensions.—Length, 6 mm.; width from point to point of the roots, 5 mm.; thickness at the base of the spine, 2 mm.

Locality and Horizon.—Point Campbell clays, Lake Connewarre, near Geelong.—Balcombian (Pritchard Coll.).

Observations.—No separate spines of Diodon appear to have been recorded in the fossil state except those of the type specimen of D. erinaceus Agassiz, from the Upper Eocene of Monte Bolca, near Verona.[1] It therefore seems desirable to record the above fossil with a distinctive name, especially since the example was found in beds of older date than those from which the palates have hitherto been procured.

1 Poiss. Foss., vol. ii., pt. ii., p. 274. See also Smith Woodward, Cat. Foss. Fishes, Brit. Mus., pt. iv., 1901, p. 572.

III.—The Range-in-Time, as hitherto known, of the Genera herein referred to, is shown in the following Table:

Genus	Jurassic.	Cretaceous	Eocene.	Oligocene.	Miocene.	Pliocene.	Recent.
Myliobatis - - -			—	—	—	—	—
Edaphodon - - -		—	—	—			
Ischyodus - - -	—	—	—				
Labrodon - - -			—	—	—	—	
Diodon - - -			—	—	—	—	—

IV.—Table of Distribution of the Species now described.

Species.	Localities.	Relative Abundance.	Stratigraphical Horizon.
Myliobatis moorabbinensis	Beaumaris	Not rare	Kalimnan (base)
Edaphodon sweeti	Grange Burn and Beaumaris	Common	„ „
Ischyodus mortoni	Table Cape	Very rare	Jan Jukian
Labrodon confertidens	Grange Burn	„ „	Kalimnan (base)
Labrodon depressus	Beaumaris	„ „	„ „
Diodon formosus	Beaumaris and Grange Burn	Common	„ „
Diodon connewarrensis	Lake Connewarre	Very rare	Balcombian

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VI.—CORRIGENDA FOR PART I.

P. 280.—12th line from top, for "pl." I. read "pl. XI."

P. 285.—14th line from top, for "Creep" read "Creek."

P. 297.—In Explanation to Plates.

14th line from top, delete "[5434]."

After Fig. 14 read "*Oxyrhina hastalis*, Agassiz. Inner surface of posterior tooth; from Beaumaris. Natural size. [5424]."

Before *Acanthias geelongensis* insert "fig. 15" instead of "14."

Delete last two lines on p. 297, "fig. 4 *Oxyrhina hastalis*," etc.

EXPLANATION OF PLATES V.-VIII.

V.

Fig. 1. *Myliobatis moorabbinensis*, sp. nov. Tooth showing articulating and outer surfaces. Beaumaris.

Fig. 2. *M. moorabbinensis*, sp. nov. Lower surface of same tooth.

Fig. 3. *M. moorabbinensis*, sp. nov. A tooth of less curvatnre, showing lower surface. Beaumaris.

Fig. 4. *Edaphodon sweeti*, sp. nov. Right mandibular tooth, inner side. Grange Burn, near Hamilton.

Fig. 5. *E. sweeti*, sp. nov. Right vomerine tooth. Grange Burn.

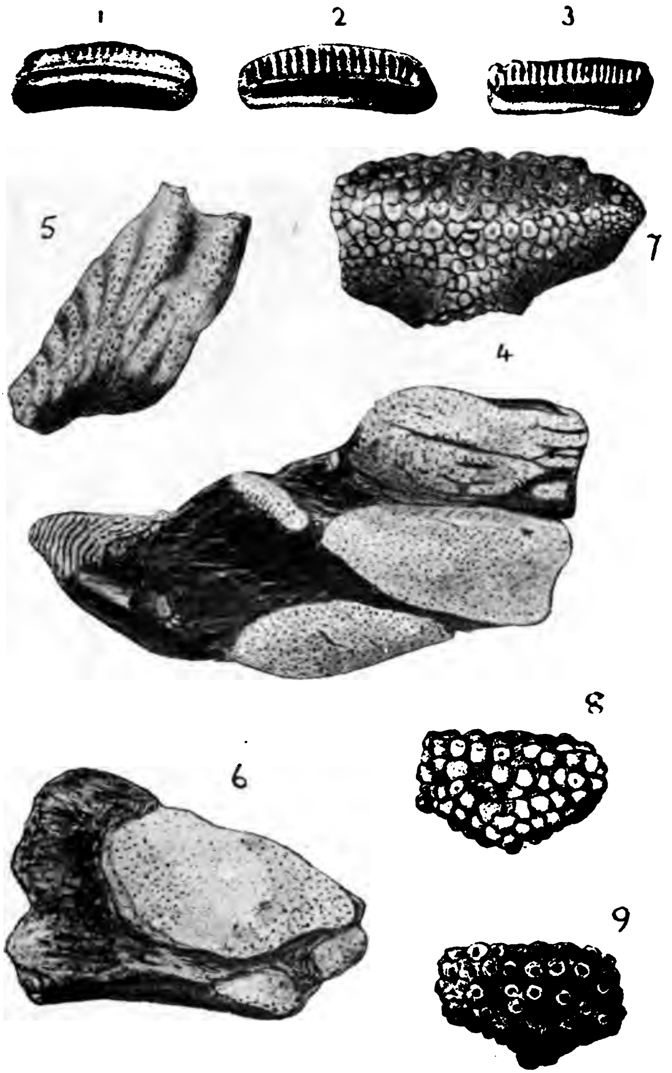
Fig. 6. *E. sweeti*, sp. nov. Left palatine tooth. Beaumaris.

Fig. 7. *Labrodon confertidens*, sp. nov. Lower pharyngeal. Grange Burn. Natural size.

Fig. 8. *Labrodon depressus*, sp. nov. Pharyngeal; upper surface. Beaumaris.

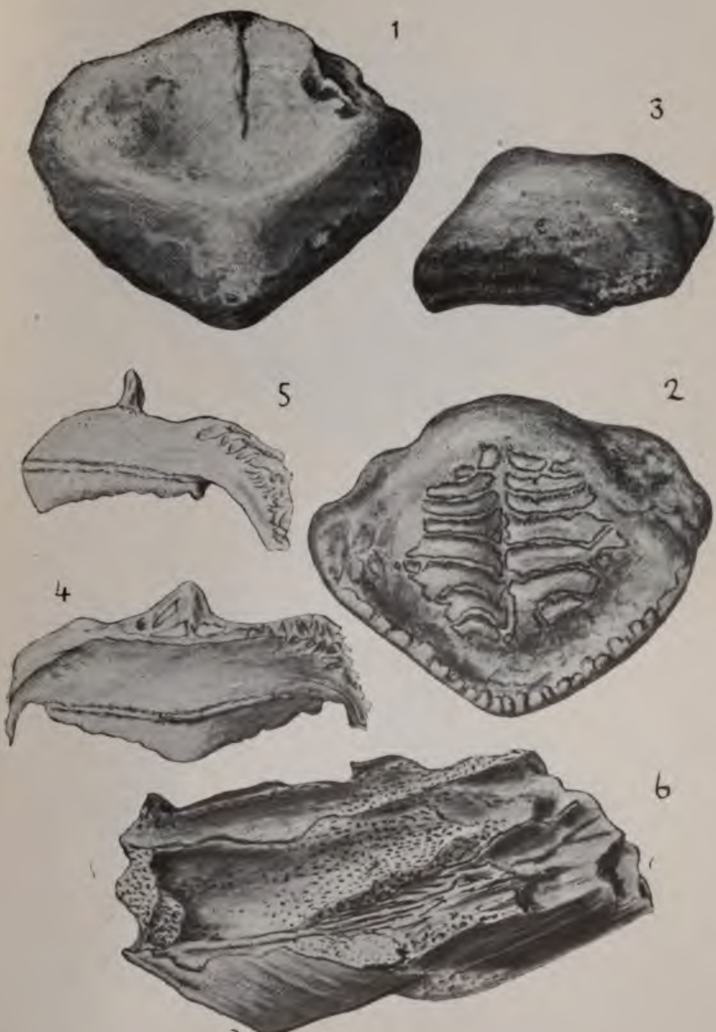
Fig. 9. *L. depressus*, sp. nov. Lower surface of same specimen.

All figures of the natural size.



F. Chapman, ad nat. del.

Teeth of Australian Tertiary Fishes.



F. Chapman, ad nat. del.

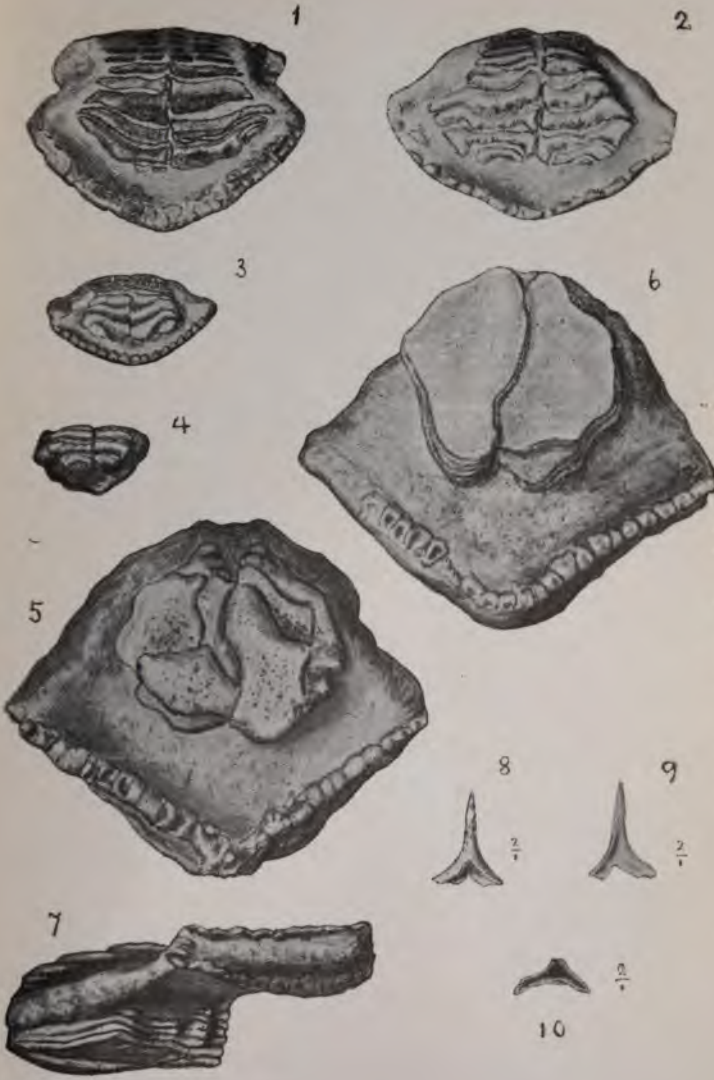
Teeth of Australian Tertiary Fishes.

1

2

F. Chapman, ad nat. del.

Jaw of Diodon formosus, sp. nov.



F. Chapman, ad nat. del.

Australian Tertiary Fish Remains.

VI.

Fig. 1. *Diodon formosus*, sp. nov. Outer surface of upper jaw. Grange Burn, near Hamilton.

Fig. 2. *D. formosus*, sp. nov. Inner surface of same specimen.

Eig. 3. *D. formosus*, sp. nov. Profile of same.

Fig. 4. *Diodon blochii*, Castelnau. Anterior view of upper jaw of one of the species now living in Port Phillip.

Fig. 5. *D. blochii*, Castel. Profile of same.

Fig. 6. *Ischyodus mortoni*, sp. nov. Left mandibular tooth. Table Cape, Tasmania.

All figures of the natural size.

VII.

Fig. 1. *Diodon formosus*, sp. nov. Outer surface of upper jaw of a full grown example (Dixon Coll.). Beaumaris.

Fig. 2. *D. formosus*, sp. nov. Inner surface of same specimen.

Both figures of natural size.

VIII.

Fig. 1. *Diodon formosus*, sp. nov. Inner surface of upper jaw. Beaumaris.

Fig. 2. *D. formosus*, sp. nov. Inner surface of lower jaw. Beaumaris.

Fig. 3. *D. formosus*, sp. nov. Inner surface of lower jaw of a young example. Beaumaris.

Fig. 4. *D. formosus*, sp. nov. Inner surface of upper jaw of a young example. Grange Burn.

Fig. 5. *D. formosus*, sp. nov. Inner surface of upper jaw of a full-grown example. Showing the pile of strong palatal plates and the marginal alveolar ridges. Beaumaris.

Fig. 6. The same; outer surface.

Fig. 7. The same; edge view.

Fig. 8. *Diodon connewarrensis*, sp. nov. Outer surface of spine.

Fig. 9. The same; inner surface.

Fig. 10. The same; basal view.

Figs. 1-7 of the natural size; 8-10 magnified twice.

[PROC. ROY. SOC. VICTORIA, 20 (N.S.), PT. I., 1907.]

ART. VII.—*Contributions to the Flora of Australia, No. 6.*[1]

BY ALFRED J. EWART, PH.D., D.SC., F.L.S., &c.,

Government Botanist and Professor of Botany
at the Melbourne University.

(With Plates IX.-XIII.).

[Read 11th July, 1907].

ANGIANTHUS HUMIFUSUS, Benth., var. GRANDIFLORUS, new var. (Compositae), M. Koch. Woorooloo, W. Australia, 1906.

Attention is drawn to this plant on account of its remarkable external resemblance to large specimens of Myriocephalus rhizocephalus, Benth., forming a striking case of plant mimicry. The two plants are readily distinguished by the pappus, which in M. rhizocephalus consists of a single bristle, and in A. humifusus of five or six fringed ragged scales. [Specimens exhibited].

BAECKEA CRISPIFLORA, F. v. M. Fragm. IV., p. 72, var. TENUIOR (Myrtaceae).

Elder exploring expedition No. 2. Kangaroo Hill, R. Helms. 1891. Cowcowing, W.A., M. Koch, 1904. The variety is more slender than the type forms and has a shorter pedicel, so that the usually slightly smaller bracts are close under the ovary, which is less urceolate than in the type form. A specimen from Jibberding, W.A., M. Koch, 1905, is in some respects intermediate between the variety and type form.

CALLITRIS MORRISONI, R. T. Baker (Coniferae). Linn. Soc. of N.S.W., vol. xxxi., 1906, p. 717.

Under this head Baker includes one of Oldfield's specimens from W. Australia, which was placed by Mueller as a variety of

1 No. 5 in Vict. Nat., vol. xxiv., 1907, p. 56

C. verrucosa, R. Br. This latter species is a synonym for C. robusta, R. Br., to which Baker admits his species closely approaches. The internodes to which Baker attaches special importance are not any shorter than in other specimens of C. robusta, and the scales which he gives as obtuse are acute as in C. robusta. There can be no doubt that this species is a variable one, but variations are shown often on one and the same specimen, and hence it is necessary to retain for it the scope given by Bentham, and include under it such varieties as microcarpa, verrucosa, intratropica, and possibly also the columellaris of F. M., and the Morrisoni of R. T. Baker. The last-named especially seems to come within the range of the C. robusta type, and a similar specimen was referred to that species by Bentham in the Flora Australiensis, p. 237.

CASSINIA LAEVIS, R. Br. (Compositae).

This plant was recorded by Mueller as new to Victoria (Vict. Nat., vol. x., 1893 and 1894, pp. 132 and 160), on the strength of three specimens, one from Werribee Gorge, A. J. Campbell, 1892, one from J. F. Mulder, C. Otway, 1893, and the other from C. French, Goulburn R. Mr. Tovey drew my attention to the fact that these specimens were peculiar in several respects, and on examination the Werribee specimen proves to be C. longifolia, R. Br., and the Otway specimen C. aculeata. These three species are fairly closely related, but the specimens in question are identical with the types of their respective species. [Specimens and types exhibited]. Hence C. laevis has been wrongly recorded as Victorian.

CASSINIA THEODORI, F. v. M.

The Victorian specimens in the Herbarium all prove to be Cassinia arcuata, R. Br. Hence the former has been wrongly recorded as Victorian owing to incorrect identification. See Vict. Nat., vol. x., p. 160, 1894.

CHAMAELAUCIUM HALLI, n. sp. (Myrtaceae), (after the Secretary of the Royal Society). Cowcowing, W.A., M. Koch, Sept., 1904.

A small shrub with stiff erect rough greyish branches, the leaves alternate and closely set at their ends in clusters of nearly 1 to 3 cm. length. The leaves are terete, mostly half a cm. long, slightly narrowed at the base, the apex curved to a small, usually straight, white point, and sparsely covered with glandular spots.

The flowers are practically sessile in terminal clusters of usually three or more. Calyx tube wrinkled but not prominently ridged (when dry), dark red, glandular, the five broad obtuse ciliate lobes with a light red border, and with pellucid spots. Corolla twice the length of the calyx, the lobes broad obtuse, pale brownish-yellow, and minutely fringed. Stamens ten, the anthers adherent to an enlarged glandular connective, alternating with ten staminodes, the whole uniting to form a single distinct tube within the corolla. Ovary of one loculus, with several ovules arising from an erect wavy basal placenta. Style distended below the middle, stigma globular with a basal fringe of hairs.

The plant is allied to C. ciliatum, but its pointed leaves, flowers in terminal clusters, larger and broader unribbed calyces, petals distinctly fringed, at once distinguish it. The latter features show a slight approach to Verticordia, from which genus, however, it differs widely.

CONOSPERMUM CRONINIAE, DIELS. Fragm. Phytog. Austr. Occid., p. 143)=C. amoenum, Meisn.

This "species" is merely a depauperated form of C. amoenum, Meisn. With reduced inflorescences, somewhat smaller flowers and bracts, perianth with the external hairs well developed, so that the blue colour is partly hidden and the leaves usually, though not always, horizontally spreading. None of these features is constant, and a specimen seen by Bentham and referred to C. amoenum diverges still more widely in the same direction. In the Flora Australiensis, Bentham apparently described an extreme type in the direction of luxuriance, and hence for instance exaggerates the size of the bracts. All grades of transition exist between the luxuriant and depauperate forms, and Diels' figure of the stamens in the opened corolla is not quite correct, these and the peculiar style being precisely similiar in both the luxuriant and depauperate forms. Diels collected no new material, and apparently saw only two of the extreme types at the Melbourne

Herbarium, being unaware of the intermediate forms referred by Bentham and Mueller to this species or of those since obtained. Neither Bentham nor Mueller considered these forms to be separable as a distinct and fairly constant variety, in which opinion I must emphatically concur, and desire to point out the danger of establishing a new species on a couple of odd forms taken from another Herbarium.

ERIOSTEMON (PHEBALIUM) GIBBOSUS, Luehm. (Rutaceae). Norseman, W.A., J. D. Batt, 1897.

This plant was exhibited before the Field Naturalists in 1897 (vol. xiv., p. 18), but no description of it has been published. The specimens are very fragmentary, but the leaves are like those of E. difformis, and the flowers like those of C. obovalis. The filaments are, however, not ciliate, and the anthers not apiculate, and there is no reason to suppose that the specimens form a hybrid between these two species.

The younger branches are minutely pubescent, and the leaves have very prominent glands. The calyx lobes are very short, obtuse, and very slightly ciliate. The petals are glabrous and imbricate. Of the ten stamens those opposite the petals are somewhat longer than the others. The pale glabrous filaments bear reddish spots, and the gynaeceum is glabrous.

GEOCOCCUS PUSILLUS, J. Drumm. et Harv. (Cruciferae).

This curious plant was suggested by Bentham as being possibly a form of Blennodia with dimorphic flowers and geophilous fruits. This suggestion was revived by Mueller (Vict. Nat., 1892, p. 137), who pointed out that the foliage resembled that of Sisymbrium cardaminoides, F. v. M., and that a Brazilian Cardamine sometimes exhibits a similar peculiarity. Geococcus pusillus might possibly be a geophilous form of Sisymbrim cardaminoides, produced as the result of continued grazing or cropping. Some specimens of Geococcus in the Herbarium have the normal flowers of Sisymbrium, and show great variation in the shape and length of the fruit. The shortened, and sometimes almost sagittate, fruit of Geococcus is obviously developed in order to penetrate the ground readily. It may even be shorter and broader than in the figures given, and may be three or more times longer, and half as broad, thus bringing the fruit near to some of the rather variable shapes assumed by the aerial fruits of Sisymbrium cardaminoides.

Mr. Reader (Vict. Nat., 1905, p. 177), has, however, watched the growth of the plant, and concludes that it is not a form of S. cardaminoides, but is a good species (and genus) usually forming hypogeal fruits, but when luxuriant also producing them above ground. The variation in the shape of the fruit would, however, bring it near to S. cardaminoides. The differences in the flowers might be easily the result of their autogamous habit, as in species of Viola or Lamium. Numerous attempts to germinate and grow the plant from seed failed. The seed apparently rapidly loses its vitality, presumably in accordance with the fact that normally it is immediately planted. The appended figures show that Geococcus differs in many respects besides its general habit from Sisymbrium, but until the former plant has been proved to remain true for several generations, the possibility of a relationship between the two remains. Geococcus was omitted from the census by Mueller, but on the present evidence as to its structure must be restored, at least until cultural experiments succeed in showing that it is a form of another plant.

GUNNIOPSIS INTERMEDIA, Diels. (Diels and Pritzel, Fragm. Phyt. Aust., etc., p. 197) = Aizoon intermedium, Diels. (Aizoaceae).

This new species appears to be the same as the "Aizoon glabrum" recorded by Mr. Luehmann, but of which no description was published.

In Engler's Pflanzenfamilien, Pax founds the genus Gunniopsis for the Australian species of Aizoon upon the following characters :—

AIZOON, calyx 5 partite, imbricate ; capsule loculicidal.

GUNNIOPSIS, calyx 4 partite, valvate ; capsule septicidal.

In Gunniopsis, G. quadrifaria (F. v. M.), Pax is included, which is presumably a misprint for G. quadrifida (A. quadrifidum, F. v. M.). The capsule is, however, both septicidal and partly loculicidal in both the Australian species, the valvate and imbricate characters do not appear to be constant, and further, the calyx is sometimes five partite, as was first noted by Mueller, Fragm., vol. vii., p. 129. There seems therefore to be no solid reason for founding a new genus for the Australian Aizoons, but preferably to give to that genus the somewhat broader latitude admitted by Bentham to include the Australian species, in spite of their additional development of septicidal dehiscence, and usually of four partite calyces.

HELIPTERUM JESSENI, F. v. M. M. Koch, W. Australia, 1904.

The plant is mentioned on account of its highly misleading external resemblance to Myriocephalus gracilis, Benth. [Specimens exhibited.]

HELICHRYSUM SUBULIFOLIUM, F. v. M. (Compositae). (Syn. H. filifolium, F. v. M.).

Various forms of this plant from W. Australia (Cowcowing, M. Koch, 1904) bridge the gap to the very closely allied "species" H. filifolium, F. v. M., which appears to be merely a form of H. subulifolium, and can probably be classed as a variety of that species. The plant is often confused with Helipterum tenellum on account of its almost plumose pappus and filiform leaves but differs widely in its involucre.

HELICHRYSUM TEPPERI, F. v. M. (Compositae). Cowcowing Lakes, W. Australia, M. Koch, 1904; L. Boga, Victoria, H. B. Williamson, 1898.

This pretty little Composite described by Mueller in the S. Science Record 1882, p. 1, from S. Australia, was represented in Herbarium by the type specimens only. The plant from L. Boga was named Podolepis Lessoni by Mr. Luehmann, to a dwarf form of which it bears a fairly close resemblance, as noted by Mueller. The two are, however, quite distinct, and H. Tepperi, though apparently rare has a wide range through Victoria, S. Australia and W. Australia. It has been recorded from W. Australia by Spencer le Moore in Journ. Linn. Soc. of London, vol. xxxiv., 1899, p. 198.

HELIPTERUM GUILFOYLEI, n. sp. (Compositae) (named after the Director of the Melbourne Botanical Gardens).

An annual prostate or ascending, rarely exceeding 4 to 5 cm. in height, covered with long loosely woolly hairs, and with one or more stems branching to form clusters of small ovoid heads. Leaves sessile, narrow, linear, mostly obtusely pointed, and 4 to 5 mm. long, channelled on the upper surface, alternate or opposite. Heads partly within the upper leaves, mostly 5 mm. long by 3 broad, the outer bracts 2 mm., the inner 4 or 5, and with small yellow or brown laminas, the innermost smaller again without any lamina and very thin. All with various entire margins, and twenty or more in number. Flowers all tubular and hermaphrodite, usually ten, the corolla, with five blunt points, the style swollen at the base, the pappus about the length of the corolla, of usually 8 plumose scales flattened at their bases and united to form a sessile ring easily separated entire. Achenes 1.5 to 2 mm. long, and quite twice as long as broad, reddish-brown, glabrous, the outer layers becoming mucilaginous in water, but with a reticulate surface before swelling. Style bifurcate with papillose ends; it and the stamens barely projecting beyond the throat of the corolla.

The plant has a close external resemblance to H. exiguum, F. v. M., but appears to be allied to H. pygmaeum, Benth., and of recently described species. H. verecundum (S. Moore, Journ. Linn. Soc., vol. xxxiv., 1899, p. 200) is distinguished by its minute size, and H. Zacchaeus (S. Moore, Journ. of Bot., 1897, p. 166), by its pappus, achenes nearly as broad as long, and green tips to the involucral scales. The latter species also has presumably not the mucilaginous seed coat or peculiar style of H. Guilfoylei. Owing to the former fact the whole cluster of ripe achenes adheres and comes out in one mass, usually with the florets and pappus attached, two or three of the florets being usually sterile.

KOCHIA MASSONI, n. sp. (Chenopodiaceae) (named after Prof. Masson). Cowcowing, W.A., M. Koch, 1904.

A small annual slightly prostate, up to 15 cm. in height, soft, and sparsely covered with a white or brownish wool, less developed on the leaves and absent from the fruits. Leaves linear, mostly 1½ cm. long, narrow without obtuse ends, alternate, closely set, the upper ones with sessile axillary flowers. Fruit sessile, dark greyish-brown, table-like, with ridged sides, 2 mm. high, and 4 mm. broad at the top, 2 mm. at base. The fruit thus has a flat top and broadened rim, but no wing. The latter fact at once distinguishes it from K. humillima, to which it is otherwise fairly closely allied in habit and general appearance. The plant is much smaller than the Kochia polypterygia of Diels, has smaller fruits with the discoid wing much less developed, and a flattened top to the fruit with the ridges barely showing.

PATERSONIA DRUMMONDI, F. v. M. (Irideae). Cowcowing, W.A., M. Koch, 1904.

The plant appears to be very rare, only three sheets of imperfect specimens being in the National Herbarium, collected by Drummond. Koch's specimens have the marginal hairs less prominently developed than the type, but some of Drummond's specimens show the same peculiarity, the larger hairs apparently rubbing off readily. A part of Drummond's specimens had evidently been burnt back by a bush fire some time previously to their collection.

PODOLEPIS KENDALLI, F. v. M., var. NANUS, new var. (Compositae).

Height four to six inches. Flowers all terminal and smaller than the terminal ones of the type. Waterloo, W.A., Max Koch, 1906. Champion Bay, W.A., L. Gould, 1890.

PODOLEPIS SPENCERI, n. sp. (Compositae), (named after Prof. W. Baldwin Spencer). Woorooloo, W.A., M. Koch, 1906.

Annual, 20-40 cm. height, one or more flowering stems from the same root, forming a loose panicle of heads, the final forks almost dichotomous. Stems glabrous, leaves hairy, and almost woolly on the under sides. Basal leaves lanceolate, spathulate about 5 cm. long by 1 cm. broad, the upper leaves all alternate, becoming narrower and smaller, and all sessile, with broad slightly-decurrent bases.

Heads on stalks of usually 5 or more cm., 1 to ½ cm. long, and nearly as broad as long. Basal and outer bracts small, sessile and obtuse, the inner larger, developing pronounced claws with glands on the outer surface, and becoming more pointed; all with shining transparent unwrinkled and unfringed laminas. Outer rows of florets, female, ligulate, pale to brownish-yellow, with usually three blunt points, projecting beyond the bracts. Inner disc florets tubular and hermaphrodite, with five short, blunt, equal teeth. These in both florets are usually tipped with red. Pappus of about eight or ten fine bristles, minutely fringed but not plumose, present on all the florets.

The plant appears to come between P. Lessoni, and P. rugata. It is easily distinguished from the recently described P. Georgei of Diels, by the facts that the outer florets are ligulate, the leaves are never opposite, and the inner scales have curved glandular stalks. The smooth scales distinguish it from P. rugata, and its size and the colour of the florets from P. Lessoni.

PTEROSTYLIS REFLEXA, R. Br., var. INTERMEDIA, n. var. (Orchidaceae).

This plant has been referred at different times to various species and was finally classed by Baron von Mueller as a variety of P. obtusa. Although closely related to P. obtusa it differs from that species in various features. The leaves on the evanescent basal rosette are three-veined instead of five-veined, and the two lateral veins are often very faint. The leaves are also smaller and more orbicular. The flowering stem is covered with fine closely-set short papillae, especially short and dense on the stalk and ridges of the ovary, and on the under surfaces of the leaves. The upper leaves on the flowering stem are often more than an inch long and nearly quarter of an inch broad, the edges finely denticulate, and contracted to a subulate brownish, often curved tip usually one-eighth of an inch or more in length, but less developed on the basal leaves. The labellum is lanceolate, strongly contracted in its upper third to a reddish-brown entire tip. The basal appendage is curved and irregularly fringed with cilia along its distal third, the terminal cilium being larger than the rest. In other respects the plant bears a close resemblance to P. obtusa, from which however its labellum at once distinguishes it. The labellum and flower are like those of P. praecox, the leaves, stem, and papillose surface are more like the characters of P. reflexa.

Since a perfect series of gradations exist as regard size of flower, length of point of labellum, size and acuminate character of leaves, and scabrous or glabrous character of stem and leaves between P. reflexa and P. praecox, Lindl., the latter species must be reduced to a variety of P. reflexa. P. obtusa, R. Br., seems to be distinct, especially as regards the obtusely oblong shape of its labellum.

Mentone, J. R. Tovey and C. French, Jun., 1907; Cheltenham, J. McKibbin, 1893; Brighton, C. French, Jun.; Wedderburn, F. Colvin, 1880; near Beaumaris, C. French, Jun., 1882.

TYSONIA PHYLLOSTEGIA, F. v. M. (Compositae) = SWINBURNIA PHYLLOSTEGIA, F. v. M.

This plant was described in the Chemist and Druggist of Australia, Oct. 1, 1896, at the time of Mueller's death. A description but no specimens are in the Herbarium. The latter were apparently claimed and retained by Mueller's Executors. Mueller was evidently unaware of the existence of a prior generic name of Tysonia Bolus, Boraginaceae, represented by one African species. Mueller's name therefore may be replaced Swinburnia phyllostegia, the generic name commemorating the services of the present Minister of Agriculture to Botanical research.

VERTICORDIA PRITZELLI, Diels. Fragm. Phytog. Austr. Occid., p. 404.

Under this name Diels and Pritzel include the plant recorded as V. humilis, Benth., of the Elder exploring expedition (Trans. Roy. Soc. S. Aust. XVI, p. 353). The latter identification was certainly incorrectly, since the specimens have bearded and not glabrous styles, but the style is not capitate as shown in Diel's figure but with an obtusely linear point. In other respects the specimens tally closely with Diels' description so that their figure of the style may have been incorrectly drawn.

Unrecorded Naturalised Aliens.

ALKANNA LUTEA, D. C. (Boragineae).

Derwent, Tasmania, ex. Herb., Spicer.

ALKANNA LUTEA, D. C., var. PARVIFLORA. (Boragineae).

Geelong, Victoria, H. B. Williamson, 1905.

BETA VULGARIS, L., var. MARITIMA. (Chenopodiaceae).

Probably an escape from cultivation. Geelong, Victoria, H. B. Williamson, 1907.

CONIUM MACULATUM, L. "Hemlock." (Umbelliferae).

Portland, 1907, and various other districts in Victoria.

ECBALLIUM ELATERIUM, A. Rich. (Cucurbitaceae).

Squirting cucumber. Probably a garden escape. Geelong, H. B. Williamson, 1907.

GLADIOLUS CUSPIDATUS, Jacq. (Irideae).

Geelong, H. B. Williamson, 1905. Near Melbourne, F. M. Reader, 1883. Ovens River, A. W. Euston, 1891. The first appearance of this plant was recorded by Mr. Reader in the Austr. Jour. of Pharmacy, 1887.

LOLIUM ITALICUM, A. Br. Italian Rye grass (Gramineae).

Various districts in Victoria.

MATRICARIA DISCOIDEA, D. C., "Wild Chamomile." (Compositae).

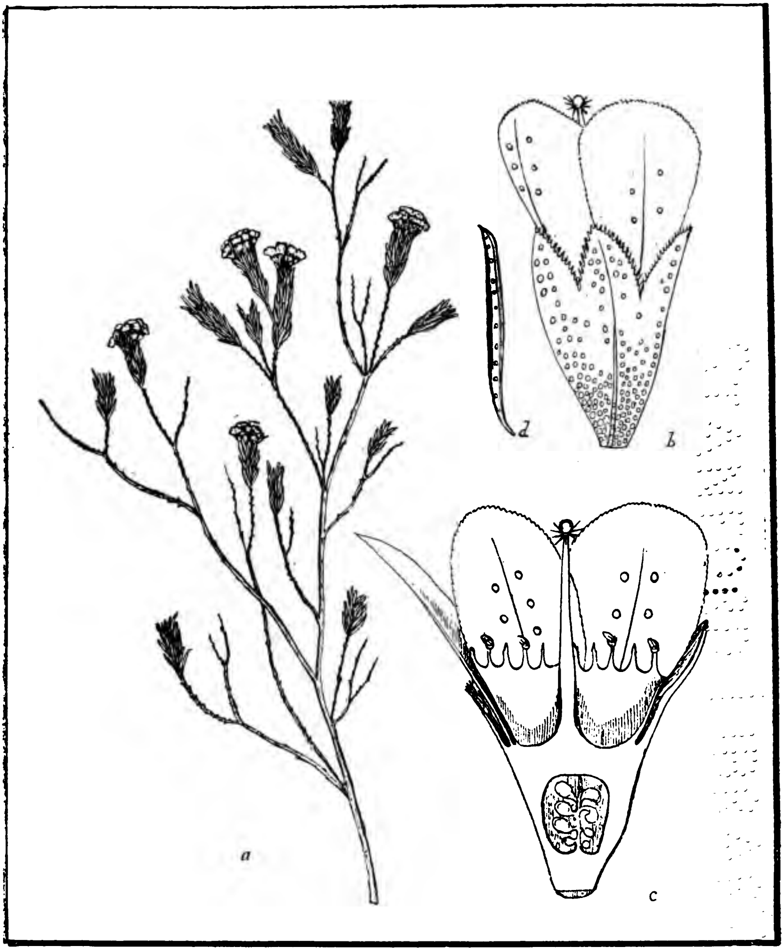
Widely spread in Victoria.

RANUNCULUS SCELERATUS, L. (Ranunculaceae).

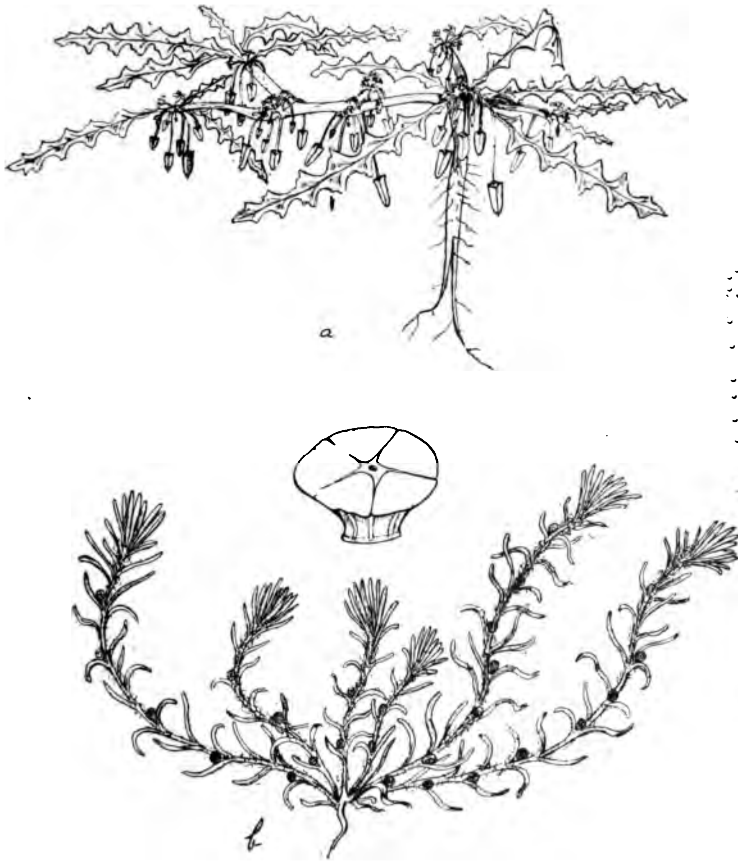
Orbost, Snowy R., C. H. Grove, 1905.

RESEDA LUTEOLA, L. "Dyer's Rocket." (Resedaceae).

Various localities in Victoria.

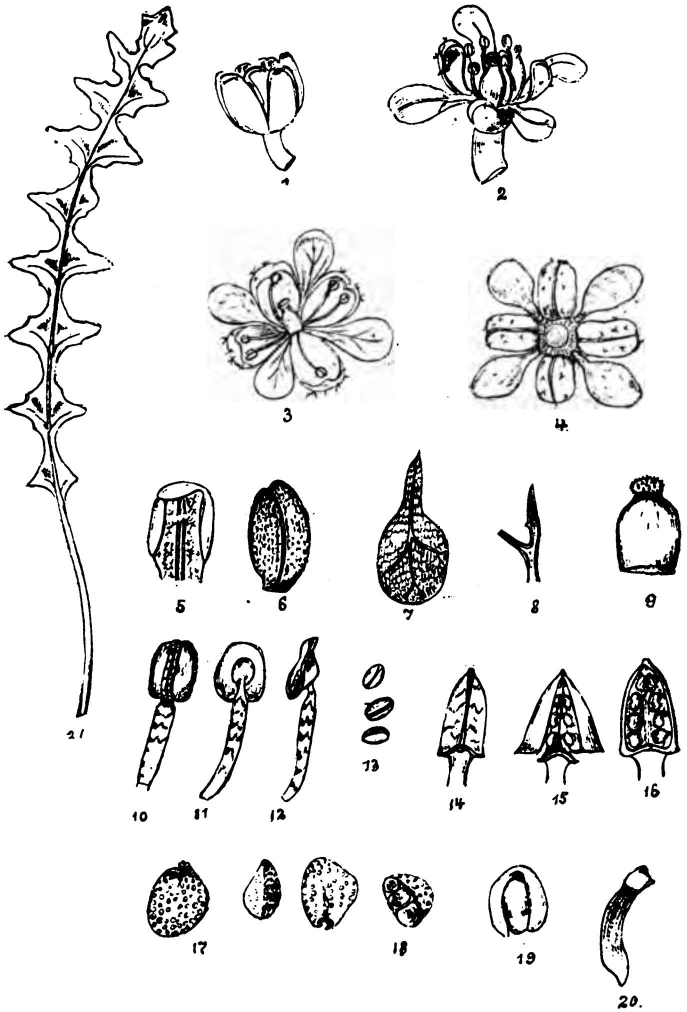


Chamaelaucium Halli, n. sp.

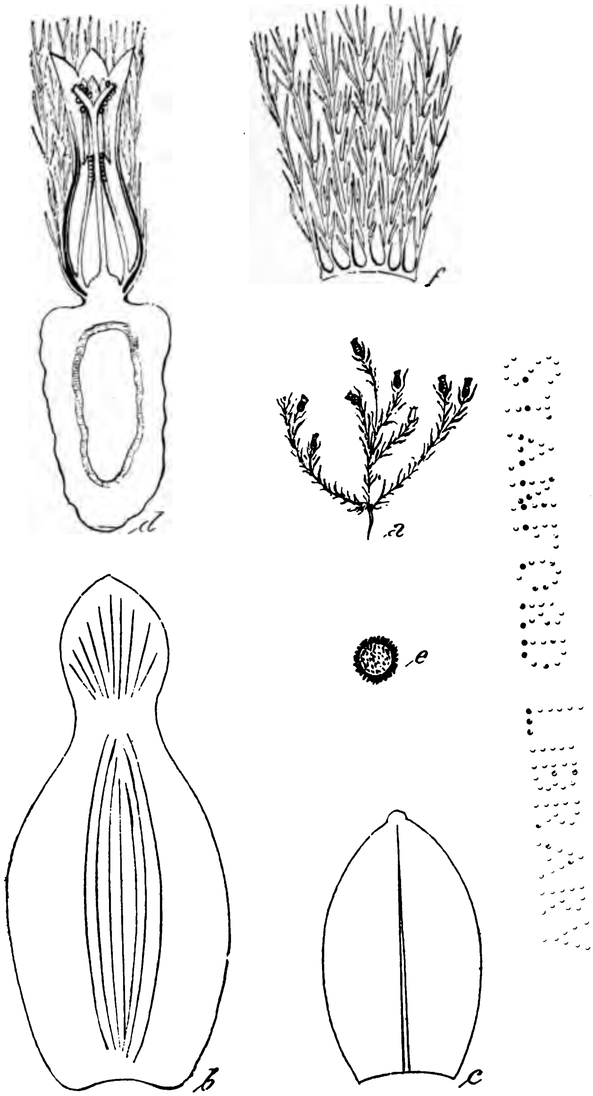


(*a*) **Geococcus pusillus,** Drumm. et Harv.

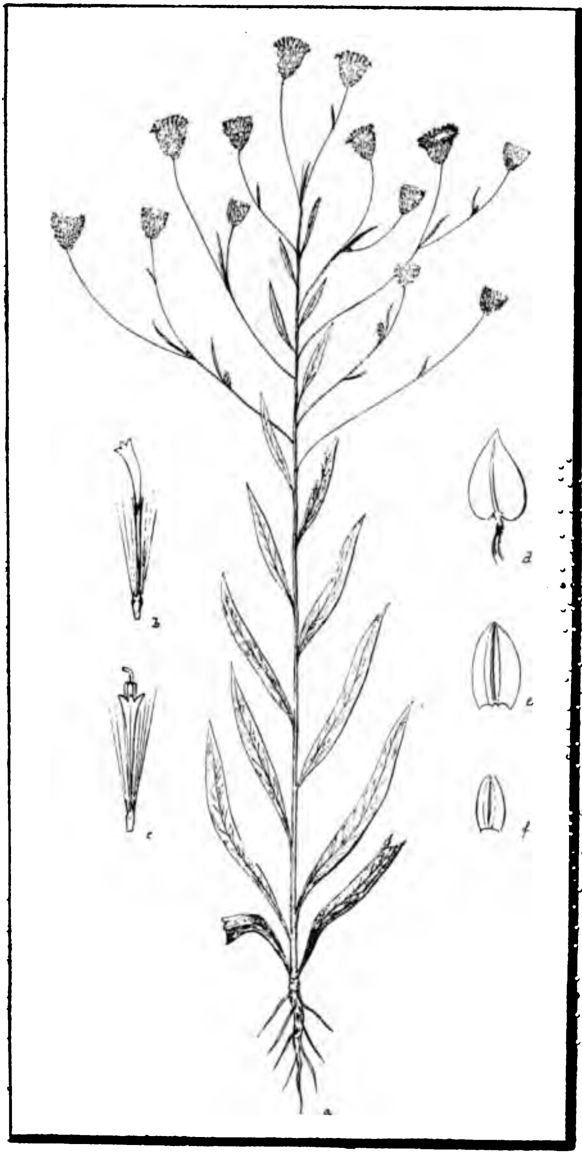
(*b*) **Kochia Massoni,** n. sp.



Geococcus pusillus, Drumm. et Harv.



Helipterum Guilfoylei, n. sp.



Podolepis Spenceri, n. sp.

SCOLYMUS HISPANICUS, L. (Compositae).

Widely spread in Victoria, but not very plentiful.

TRIGONELLA ORNITHOPODOIDES, D. C. "Fenugreek." (Leguminosae).

Penshurst, H. B. Williamson, January, 1907.

DESCRIPTION OF PLATES.

PLATE IX.

Chamaelaucium Halli, n. sp.—*(a)* Plant somewhat reduced, *(b)* flower, *(c)* the same in vertical section, *(d)* leaf.

PLATE X.

(a) Geococcus pusillus, Drumm. and Harv. Plant reduced. *(b) Kochia Massoni*, n. sp. Plant reduced.

PLATE XI.

Geococcus pusillus.—1 and 2, flower bud and flower; 3 and 4, superior and inferior views of flower; 5 and 6, face and back views of sepal; 7, petal; 8, hair; 9, ovary; 10, 11, 12, 13, stamen and pollen grains; 14, 15, 16, fruit; 17, seed; 18 section of seed; 19, embryo; 20, radicle; 21, leaf.

PLATE XII.

Helipterum Guilfoylei, n. sp.—*(a)* Plant somewhat reduced, *(b)* a median bract with lamina, *(c)* an innermost bract with a blunt point but no lamina, *(d)* flower, *(e)* pollen grain, *(f)* pappus.

PLATE XIII.

Podolepsis Spenceri, n. sp.—*(a)* plant reduced, *(b)* ray floret, *(c)* disc floret, *(d)* inner stalked bract, *(e)* and *(f)* outer sessile bracts.

END OF VOLUME XX., PART I.

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CONTENTS OF VOLUME XX., PT. II.

[PROC. ROY. SOC. VICTORIA, 20 (N.S.), PT. II., 1907.]

ART. VIII.—*Notes on the Geology of Mooroodúc in the Mornington Peninsula.*

BY ERNEST W. SKEATS, D.Sc., A.R.C.S., F.G.S.

Professor of Geology, University of Melbourne.

(With Plates XIV.-XVI.).

[Read 10th October, 1907].

INTRODUCTION.

My first visit to the neighbourhood of Mooroodúc was made in 1905, in the company of my assistants, Messrs. H. J. Grayson and H. Summers, and the members of the Geological Field Class of the University. On this visit we were concerned mainly with three problems:—

1. The age of the Palæozoic sediments which rise above the mantle of Tertiary rocks.

2. The characters of the granitic mass of Mt. Eliza and of the acid veins proceeding from it.

3. The nature of the metamorphism effected by the intrusion to the granitic rocks into the Palæozoic sediments.

This first visit enabled us to obtain evidence bearing on the two latter questions, but we shared the fate of previous observers in failing to find any fossils, so that the age of the rocks remained in doubt. A second visit made under similar auspices in 1906 was more successful, as recognisable fossils were obtained.

The present communication is based partly on field-work during these visits and a later examination, and partly on a petrological determination of the granitic and metamorphic rocks.

Previous Literature.

The first published account of the geology of the district is included in a report made by Selwyn, entitled:—"Report on the Geology, Palæontology and Mineralogy of the country situated between Melbourne, Western Port Bay, Cape Schank and Point Nepean, accompanied by a geological map and sections." This was published in the Votes and Proceedings of the Legislative Council of Victoria, 1854-5, vol. I.

Two years later Selwyn published a fuller report on the district, which was accompanied by a more detailed map.

Two statements in the earlier paper have reference to the rocks of the Moorooduc district. On page 7 he describes the oldest rocks of the area, and in the absence of fossils ascribes them on lithological grounds to the Older Palæozoic series. He recognised four lithological types among these rocks. One type, "seen only on the flanks of Mt. Eliza, Mt. Martha and Arthur's Seat," he described as "very hard crystalline felspathic grey-brown and red micaceous sandstones, and beds of hard, dark-blue indurated slates and shales . . . and their crystalline character is probably due to alteration caused by the intrusion of the granite forming these hills."

The granites of the district he referred to on page 8 as "presenting no peculiar features, being composed of quartz, reddish-coloured felspar and black mica; the two latter, however, occasionally vary in colour, the mica being yellow and the felspar white." On his second map, printed in 1856, Selwyn records the cast of an encrinite stem from Sandstone Island in Western Port, and the rocks are referred to the Silurian period.

The next paper bearing on the area was by Mr. A. E. Kitson, F.G.S., entitled, "Report on the coast line and adjacent country between Frankston, Mornington, and Dromana," and was published in March, 1900, in Monthly Progress Report No. 12 of the Department of Mines, Victoria. Mr. Kitson gives an interesting and somewhat detailed account of the geology of the district, and the report is accompanied by sections and a geological sketch map of the area described. Mr. Kitson does not describe the plutonic mass of Mt. Eliza, but refers to the acid dykes which penetrate the sedimentary rocks in a quarry north of Mooroodue Railway Station. He notes that they have indurated the contiguous strata for distances ranging from less than an inch to several feet. He describes most of the dykes as aplites, and makes the interesting observation that the muscovite and biotite in the dykes line the walls, while the centres consist of the more acid quartz and felspar. He gives a lithological description of the sediments, and refers to the spotted character of the thin bedded micaceous shales. The rocks are described under the heading "Silurian" by Mr. Kitson, and the same view is expressed in the large Geological Map of Victoria of 1902. Mr. Kitson, however, remarks that the rocks resemble in some respects the graptolite-bearing shales of the Lancefield district, and "they may eventually prove to be of Ordovician age, though the Silurian belt may be the extension of the Upper Silurian of the Melbourne district."

In the year 1900, Mr. Evelyn Hogg published a paper entitled, "The Petrology of certain Victorian granites." [1]. Mr. Hogg does not discuss the granitic rock at Mt. Eliza, but describes one from an adjoining locality, Frankston, as a medium-grained granitite, a rock with pink felspar, orthoclase and plagioclase being about equally represented, quartz and biotite. The rock of Watson's Quarry, Mt. Martha, lying south of Mt. Eliza, is described as a medium-grained syenite. As these are the nearest granitic masses to Mt. Eliza, their composition is of some interest in this connection. It is to be noted, however, that Mr. Hogg defines a granitite as including all holocrystalline quartz-biotite, rocks in which a monoclinic felspar is not the dominant one, while he defines a syenite as a normal granite with hornblende. Most petrologists would now, I think, describe such a rock as a hornblende granite.

In 1901, Messrs. T. S. Hall and G. B. Pritchard published a paper in the Proceedings of the Royal Society of Victoria, Vol. XIV., N.S,. Pt. 1, entitled "Some Sections Illustrating the Geological Structure of the Country about Mornington." They go fully into the previous literature of the area, and the greater part of the paper is devoted to the detailed discussion of the Tertiary rocks and fossils of the district. The rocks of the Mooroodue quarry

1 Proc. Roy. Soc. Vict., n.s., vol. xiii., 1900, p. 218.

are described as Silurian or Ordovician. In this paper we have the first indication that the palæozoic rocks are fossiliferous They describe a coarse conglomerate which underlies the older basalt in many places as being "derived in the main from the older palæozoic sedimentary rocks of the district, and from the granitic series. In two places—namely, in the first cutting on the coast road south of Frankston, and near the first outcrop of granite rock south again from this place on the shore, we have found a few graptolites in slate pebbles. They are very indistinct, and beyond saying that they are species of Diplograptus, we do not at present care to venture. Their evidence, then, leaves the age of the rocks still open."

In the year 1904 the first definite record of fossils found "in situ" in the older Palæozoic rocks of the Mornington Peninsula was given by Mr. T. S. Hall, M.A.[1] The record does not mention the finder of the fossils, but I understand that it was Mr. W. H. Ferguson, of the Geological Survey of Victoria. The first record is that of the occurrence of Climacograptus and Diplograptus in boulders from Grice's Creek, Mornington, a locality nearer to Moorooduc than the earlier finds of Messrs. Hall and Pritchard. The evidence of these fossils, however, still leaves the age of the beds doubtful. A second suite of fossils found "in situ" at Balnarring, and identified by Mr. Hall, shows clearly that Lower Ordovician rocks occur in that part of the Mornington Peninsula. Mr. Hall records

Didymograptus, c.f. pritchardi.
Tetragraptus approximatus.
Tetragraptus quadribrachiatus.
Tetragraptus fruticosus (?).
Ostracoda.

Mr. Hall states that if the identification of T. fruticosus (?) is correct, the age of the rocks is Bendigonian, and in any case cannot be higher than the horizon of Castlemaine. Another series of fossils from Bulldog Creek, near Dromana, yielded to Mr. Hall the same forms as those from Balnarring, and in addition undoubted specimens of Tetragraptus fruticosus, thus fixing their Bendigonian horizon.

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1 Reports on Graptolites, Records of Geological Survey of Victoria, vol. i., pt. iii., 1904, pp. 220, 221.

Didymograptus, sp. indet.
Temnograptus, sp.
Dendrograptus (?).
Rhinopterocaris maccoyi.
Brachiopod cast,

and indeterminate Hexactinellid sponge spicules were also recognised from among the collection made by Mr. Ferguson at this locality. The credit, then, for first finding fossils "in situ" in the Palaeozoic rocks of the Mornington Peninsula belongs to Mr. Ferguson, and for determining their Lower Ordovician (Bendigonian) age to Mr. Hall.

THE AGE OF THE OLDER SEDIMENTARY ROCKS OF MOOROODUC.

The foregoing account of the geological literature dealing with the district shows the progress already made towards determining the age of the Palæozoic rocks of the Mornington Peninsula. The records from Balnarring and Bulldog Creek definitely established the Lower Ordovician age of the rocks of the southern part of the Mornington Peninsula, but the age of the series near Moorooduc remained still in doubt, as it lies about ten miles to the north of the localities mentioned above, and, moreover, the graptolites found in the boulders of the conglomerates of Grice's Creek and near Frankston showed only that the rocks might be Ordovician or Lower Silurian.

The area near Moorooduc does not look promising, as apart from the highly altered rocks in the quarry north of Moorooduc station, rock exposures are very few, and several observers had already searched the locality with negative results. This also was our experience in 1905, but on the second visit in 1906 we were more fortunate. We were searching the hillside about a third of a mile north-east of the large quarry at about an elevation of 350 feet above sea level, and almost due west of a slight bend in the road which runs north towards Frankston. Here the uprooting of a tree had exposed a very limited area of the slates, and from this and another small exposure close at hand we found a number of graptolites. They were clearly of Lower Ordovician age, as forms belonging to Didymograptus and Tetragraptus were recognised. On returning to Melbourne I submitted the collection to Mr. Hall for more detailed examination, and he has kindly identified the followings forms:—

Didymograptus caduceus, Salter.
Tetragraptus serra (sensu stricto) Brongn.
Diplograptus, sp.
Trigonograptus, sp.
Lasiograptus, sp.
Glossograptus, sp.

Also specimens of Rhinopterocaris maccoyi, Eth. fils., and sponge spicules.

Mr. Hall adds the following notes:—"The horizon is that of the Upper Castlemaine series, although the presence of Glossograptus is suggestive of the horizon of the Darriwill series. The species of Diplograptus is similar to one which occurs as low down as the Victorian Gully beds at Castlemaine, but is indistinct. Trigonograptus is known from higher beds, but possibly occurs at Castlemaine. The presence of graptolies in the Eocene (?) conglomerate on the beach near Frankston has been recorded by Mr. Pritchard and myself.[1] We announced the presence of Diplograptus, but ventured no further. At the same time I found a specimen which I thought might be Didymograptus caduceus, but it was so indistinct that I thought it wiser not to mention it, especially as the record of even the genus would have upset the generally-received opinion as to the age of the slates of the district." The discovery of these graptolites provides the evidence previously wanting for determining the age of the Mooroodue rocks, clearly shows their Lower Ordovician character, and Mr. Hall's determinations show that the rocks belong to the Upper Castlemaine, or possibly the Darriwill series, a higher horizon than that of the graptolite bearing rocks previously described from the southern part of the Peninsula. It is now probable that all the slates and sandstones of the Mornington Peninsula belong to the Ordovician series. The graptolites were found on a steeply sloping part of the hillside, where no observations of the dip or strike of the beds could be obtained. At a lower level the Ordovician rocks pass below the Tertiary series, the general direction of the eastern boundary of

1 Proc. Roy. Soc. Vict., xiv., 1901, p. 41.

the hill being N. 60 deg. E. On walking south-westwards towards the large quarry, further search gave negative results. The rocks of the quarry are in places much disturbed. On the south-western face of the quarry a steep anticlinal fold is seen, and towards the N. end an abrupt change of strike to E. and W., and a dip to N. at 70 deg. is noticed, while at the south end, where the beds are less disturbed, the strike is nearly N.E. and S.W., and the dip N.W. at 80 deg. At the opposite or North-east face of the quarry the strike was observed to be N. 20 deg. E., and dip E. 20 deg. S. at 70 deg. Possibly the rocks of the quarry belong to the same series as those in which the graptolites were found, as a continuance of the N. 20 deg. E. strike would pass close to the graptolite localities.

The Metamorphic Rocks of the Mooroodue Quarry.

The rocks consist of sandstones and slates. The sandstones, some of which occur in fairly thick beds, show little visible alteration except that in places they are changed to quartzite. The slates are, however, highly altered. Among the slates are some with alternate dark and light laminae. On splitting a specimen of laminated slate along a bedding plane, elongated colourless prismatic crystals up to an inch in length were seen. A fragment of one of these crystals examined under the microscope shows the refractive index, polarization colours, and pink to colourless pleochroism characteristic of andalusite.

Thin sections of the slates show the occurrence of two types, the one more, the other less altered. The less altered type is a spotted slate (Sections 505A and 506B). Under the microscope crypto-crystalline to micro-crystalline aggregates of a white micaceous mineral are seen to form abundant lighter areas with subrectangular boundaries, while the fine-grained groundmass consists of biotite, quartz, uniaxial white mica, hematite, limonite, and some dark red-brown rutile crystals.

The white uniaxial mica is possibly bleached biotite, since some of the larger crystals have apparently unaltered brown areas parallel to the cleavage traces, while hematite and limonite surround the white mica in such a way as to suggest that the iron has been leached from biotite and deposited as oxide round the bleached cystals. Several sections of another mineral are present. It occurs as colourless prismatic sections, showing minute fluid and other inclusions, with high refractive index and low polarization colours which are grey to yellow, of the first order. Two cleavages are noticed, a well-defined one parallel to the longer axis of the crystal, and a less well developed one at right angles to this. A few sections showed straight extinction, but the majority extinguished in an oblique position. The maximum extinction angle observed was 43 deg. from the longer axis. It is invariably associated with a marginal colourless mineral of lower refractive index and higher polarization colours. This mineral extends inwards from the margins of the crystals, and appears to be an alteration product consisting of a white uniaxial micaceous mineral. Most of the sections of the mineral show the emergence of an optic axis in a somewhat oblique position. The mineral is andalusite. The sections are too thin to exhibit the characteristic pleochroism, and the high angle of extinction noticed in some sections is to be connected with the large optical axial angle exhibited by this mineral.[1]

The more altered type of slate (Section 507) shows complete recrystallization of the clastic materials. The rock consists mainly of a number of interlocking quartz granules and micaceous minerals. The latter include biotite, muscovite and bleached biotite (?). No trace of a spotted structure is seen, but the original bedding planes are defined by lines along which there is a greater concentration of biotite and hematite, and larger crystals of the micas occur along these laminæ. Among the minor constituents minute rutiles occur, and a few pleochroic granules of tourmaline, which have been included in the bleached micas. Andalusite is not represented in this rock.

These altered rocks, containing an abundance of micas, are evidently rich in alkalies. It is therefore probable that in the formation of the shale the alkali contents were not leached out as sometimes happens. It must be remembered, however, that the alkali contents of the shales may have been reinforced by thermal solutions passing out from the margin of the granitic intrusion.

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1 The numbers of the rock sections refer to the University collection of rock slices.

THE GRANO-DIORITE AND APOPHYSES OF MOUNT ELIZA.

The Apophyses.—These have only been noticed in the metamorphosed slates and sandstones of the large Moorooduc quarry, about three-quarters of a mile north of Moorooduc railway station. They consist of acid extrusions from the plutonic mass, and vary from fine-grained aplitic rocks to fairly coarse pegmatites. The largest vein seen measured about three feet in width. They are all somewhat decomposed, and on that account no rock sections have been made from them. In places quartz and felspar alone are present, in others biotite and muscovite also occur, usually in large flakes up to three-quarters of an inch in length, and in one or two cases black tourmaline was noticed.

Mr. Kitson has drawn attention[1] to the most interesting feature in connection with them—viz., the general concentration of the mica along the walls of the veins, the central parts being relatively free from that mineral. The small sizes of the veins makes it improbable that convection currents have played any part in the marginal grouping of the micas. This arrangement may be referred to as an illustration of a process first investigated by Soret[2] in the case of crystallization from aqueous solutions. He showed that if a constant difference of temperature is maintained between two parts of a vessel containing a saturated solution, crystallization will proceed at first only in that part of the vessel which is at the lower temperature. Mr. Teall[3] has sought to explain the concentration of the earlier formed basic minerals on the walls of some ingenous intrusions in terms of Soret's principle.

The disposition of the mica flakes in the acid veins of the Moorooduc quarry may probably be referred to the same cause.

The Grano-diorite.—The plutonic mass of Mt. Eliza extends as a somewhat elliptical shaped mass just over two miles long from N.E. to S.W., and about a mile across in the widest part in a N.W. S.E. direction. Most of this area is covered with a mantle of granite detritus, and only two or three limited outcrops are seen of the rock "in situ." The best exposure occurs

1 Op. cit.
2 Ann. Chim. Phy., Paris, 1881, (5) 22, p. 293.
3 British Petrography, p. 402.

in a shallow quarry near the summit of the hill. The rock is grey, fairly even grained, and felspar, quartz, black biotite and a little hornblende are visible in the hand specimen. Its specific gravity is 2.69. Under the microscope (Section 504) it is noticed that both plagioclase and orthoclase are present, that some of the biotite has been altered to chlorite, abundant needles of apatite are included in the generally ragged crystals of biotite, and a little rutile is probably present. The symmetrical extinction angles of the plagioclase lamellæ range from about 11 deg. to 17 deg. The crystals are frequently zoned, the margins being invariably more acid, and are sometimes untwinned. The central parts of the crystals correspond to andesine of composition Ab_5An_8, the margins to oligoclase of composition Ab_4An_1. The average composition of the plagioclase as a whole is probably near Ab_9An_5. The plagioclase is generally somewhat kaolinised, and is usually idiomorphic. The orthoclase, containing some minute irregular intergrowths with albite is, however, fresh and moulded on the plagioclase. The structure of the rock, as a whole, is hypidiomorphic, and the average grain-size is 1 mm.

Petrographically, it should be classed with a number of other Victorian granitic rocks as a grano-diorite, on account of the large amount of quartz present, the considerable quantity of an alkali felspar, and the relatively acid character of the plagioclases present in this group of rocks. Professor Gregory,[1] following American usage, has suggested the application of this term in preference to Quartz-mica-diorite, to which group Dr. Howitt has referred some of them.

No chemical analysis of this rock is available, but an attempt has been made to determine, quantitatively, its mineral volume composition. From this the bulk mineral composition is found by multiplying the percentage volume of each mineral by its specific gravity. Finally, by accepting analyses of minerals having similar optical properties, an attempt has been made to determine approximately the chemical composition of the rock.

The method followed in determining the volume percentage of each mineral in the rock is due to Rosiwal.[2] He has used a

1 The Geology of Mount Macedon, Victoria, Proc. Roy. Soc. Victoria, 14 (1902), p. 192.

2 Verhandl d.k.k. Geol Reichsanst. 1898, pp. 143, et seq. The Quantitative Classification of Igneous Rocks, 1903, p. 204. J. P. Iddings, Journal of Geology, vol. xii. (1904), p. 252.

travelling stage or eye-piece micrometer to obtain a number of traverses across a microsection, and has shown that the volumes of the different minerals are proportional to the sums of their intercepts or any line or lines drawn across the rock, if the number of minerals traversed be sufficient. Applying this method, it was found that, out of a total length of 1035 units, the sums of the intercepts of the different minerals were as follows:—

The percentage volumes are shown in the second column:—

Plagioclase - - -	414 -	40
Quartz - - - -	305 -	29.47
Orthoclase - - -	198 -	19.13
Biotite - - - -	113 -	10.91
Hornblende - - -	5 -	0.48
Apatite (estimated) - -	2.5 -	0.24
		100.23

The specific gravities of the minerals is taken to be as follow:—

Plagioclase $(Ab_9\ An_5)$ -	= 2.65
Orthoclase - - - -	= 2.55
Quartz - - - - -	= 2.65
Biotite[1] - - - -	= 2.99
Hornblende - - - -	= 3.28
Apatite - - - -	= 3.20

Multiplying the percentage volumes of the minerals by their densities we obtain the proportions by weight which are then recalculated as percentages.

	Gravimetric proportions.	Percentage Mineral Composition.
Plagioclase - - -	106.00 -	39.87
Quartz - - - -	78.09 -	29.37
Orthoclase - - -	46.78 -	17.59
Biotite - - - -	32.62 -	12.23
Hornblende - - -	1.57 -	.59
Apatite - - - -	.80 -	.30
	265.86	99.95

1 The specific gravity of the Biotite was determined from flakes by immersing them in Sonstadt's heavy liquid, and determining by the Westphal balance the specific gravity of the liquid in which they floated in any position. The composition of the Biotite is assumed to be similar to that of Chebarkul of similar specific gravity (see Dana's System of Mineralogy, p. 630), while the Hornblende is assumed to be similar to that from a Vesuvian locality.

The plagioclase is assumed to have the composition $Ab_9\ An_5$. Distributing the 39.87 per cent. among these two molecules we obtain Albite 25.63 per cent., Anorthite 14.24 per cent.

Knowing the chemical composition of all the minerals and the percentage of each mineral present we arrive at the ultimate chemical composition of the rock.

Percentage Mineral Composition.	Orthoclase.	Anorthite.	Albite.	Quartz.	Biotite.	Hornblende.	Apatite.	Percentage Chemical Composition.
—	17.59	14.24	25.63	29.37	12.23	.59	.30	—
SiO_2	11.38	6.15	17.62	29.37	4.70	.24	—	69.46
Al_2O_3	3.24	5.24	5.00	—	1.76	.09	—	15.33
Fe_2O_3	—	—	—	—	.66	.01	—	.67
FeO	—	—	—	—	1.80	—	—	1.80
MgO	—	—	—	—	2.00	.07	—	2.07
CaO	—	2.86	—	—	—	.08	.20	3.14
K_2O	2.96	—	—	—	1.00	—	—	3.96
Na_2O	—	—	3.00	—	.07	—	—	3.07
P_2O_5	—	—	—	—	—	—	·10	.10
H_2O	—	—	—	—	.13	—	—	.12
						Total	-	99.72

In this mineralogical analysis, apart from the small experimental error in the traverses and estimation of the volume composition of the minerals of the rock, there are two sources of ambiguity. The Biotite analysis from Chebarkul, chosen for comparison on account of similar specific gravity, is that of a variety in which ferrous and magnesia oxides are present in almost equal amounts. The biotite in this grano-diorite may not have these oxides present in similar proportions. The other ambiguity rises from the fact that no allowance has been made for the small quantity of albite irregularly intergrown with the orthoclase. If this could be allowed for, potash would be slightly diminished and soda correspondingly increased in amount. Apart from these possible sources of error, it is believed that the figures fairly represent the chemical composition of the rock. Although the indicated silica percentage is higher than in some of the Victorian grano-diorites, the high total of the alkaline earths and the lack of preponderance of the potash in the alkalies, shows that it should be grouped with the grano-diorites rather than the granites or granitites. An analysis of the granodiorite from two miles N. or Dandenong township is appended for comparison.[1]

	Grano-diorite Mount Eliza.	Grano-diorite N. of Dandenong.
SiO_2	69.46	63.38
Al_2O_3	15.33	17.36
Fe_2O_3	.67	1.61
FeO	1.80	1.98
MgO	2.07	1.80
CaO	3.14	4.18
K_2O	3.96	.31
Na_2O	3.07	4.07
P_2O_5	.10	.54
H_2O	.42	CO_2 1.13
		Fes 3.38
	99.72	99.74

Summary and Conclusion.

1. This paper discusses the sedimentary, igneous and metamorphic rocks of Mooroodue, in the Mornington Peninsula, Victoria.

2. The previous literature on the area is discussed. Chronologically arranged, the salient features so far as they bear on this communication are as follow:—

- 1856. Selwyn finds a cast of an encrinite stem on Sandstone Island, Western Port, and indicates the age of the older sedimentary rocks of the district as Silurian on his geological map.
- 1900. A. E. Kitson suggests a lithological resemblance between the older sedimentary rocks of Mooroodue and the L. Ordovician rocks of Lancefield. He also notes the localization of the micas in the acid veins from the granite to the walls of the intrusion.
- 1900. Evelyn G. Hogg describes petrologically the granite rocks of areas adjoining Mt. Eliza. Some are described as "granitite," others as "syenite."

1 Geology of Mount Macedon, Proc. Roy. Soc. Vict., 14 (1902), p. 201.

1901. T. S. Hall and G. B. Pritchard discover Diplograptus in pebbles of Eocene (?) conglomerates near Frankston.

1904. T. S. Hall identifies graptolites found by W. H. Ferguson "in situ" at Balnarring, 10 or 12 miles south of Moorooduc. Tetragraptus fruticosus and other L. Ordovician forms are noted, and the horizon is described as Bendigonian.

3. *The Age of the Sedimentary Rocks of Moorooduc.*

The following L. Ordovician graptolites were found by me "in situ" in 1906, in slates three-quarters of a mile north of Moorooduc railway station, and identified by Mr. T. S. Hall:—

Didymograptus caduceus, Salter.
Tetragraptus serra (sensu stricto), Brongn.
Diplograptus, sp.
Trigonograptus, sp.
Lasiograptus, sp.
Glossograptus, sp.

Mr. Hall fixed their horizon as Upper Castlemaine, or possibly Darriwill. The discovery at Balnarring, and this later one at Moorooduc makes it probable that all the slates and sandstones of the Mornington Peninsula are of Ordovician age.

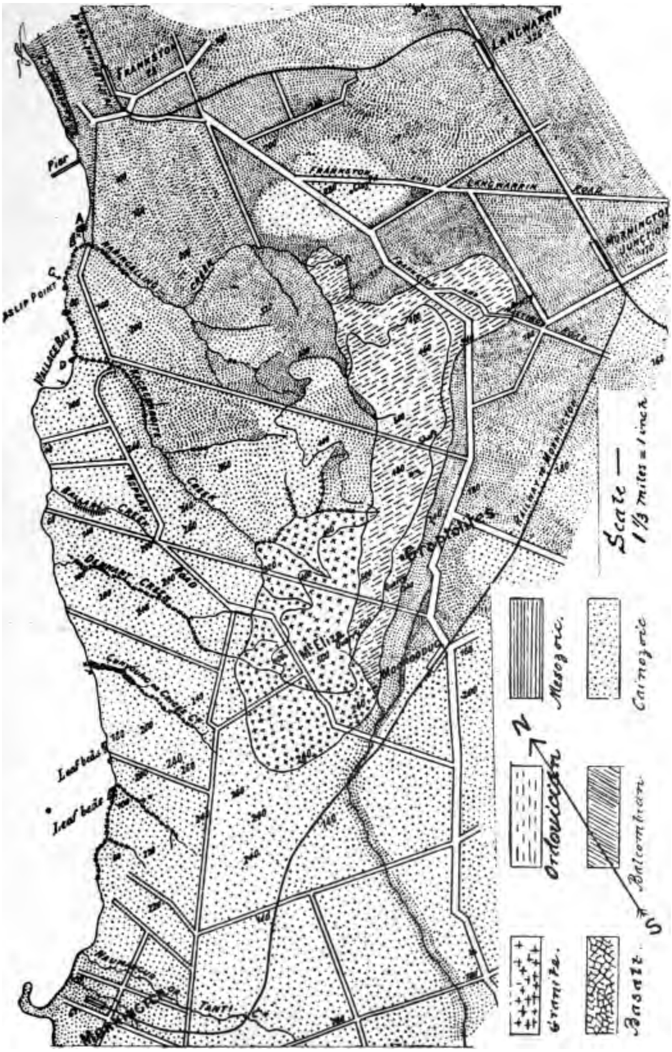
4. *The Metamorphic Rocks.*

Near the intrusive granite highly altered micaceous slates occur. One type is spotted, and contains andalusite showing high extinction angles. In the other type the recrystallization is more complete, although the bedding planes are still traceable. Rutile and tourmaline occur as accessory constituents, while bleached biotite (?) muscovite and biotite are abundant.

5. *The Grano-diorite and Apophyses.*

The Apophyses.—These are aplites and pegmatites. It is suggested that the concentration of the micas near the walls of the veins provides an illustration of the application of Soret's principle to igneous intrusions.

The Grano-diorite.—The rock is a hypidiomorphic, even-grained grano-diorite of Specific Gravity 2.69. In order of decreasing abundance the minerals present are:—Plagioclase,


Frankston
Langwarrin
Pier
Frankston Road
Mornington Junction
Graptolites
Mt Eliza
Mornington
Leaf beds
Leaf beds
Scale — 1 1/3 miles = 1 inch
Mesozoic
Cainozoic
Ordovician
Balcombian
Granite
Basalt
N
S


Bi.
Q.
Bi
Ab.
And.
Bi.
Quartz.
Q.
Ab.
Andesine
And.
And.
And.


M.A.
M.
M.A
Andalusite
M.A.
Hem.

Quartz, Orthoclase, Biotite, Hornblende, Apatite. By Rosiwal's method the volume proportions of the minerals are determined, their proportions by weight calculated, and from a knowledge of the chemical composition of each mineral the composition of the rock is estimated. The analysis supports the identification as grano-diorite. Possible errors in the estimation of relative proportions of the oxides of iron and magnesia, and in the relative proportions of potash and soda are noted. Finally, a comparison is instituted between the analysis so estimated and that of the Grano-diorite from two miles north of Dandenong township.

DESCRIPTION OF PLATES XIV.–XVI.

Plate XIV.

Geological sketch map of the Mooroodue district, reduced from the Geological sketch map of the Mornington district, by A. E. Kitson, F.G.S.

Plate XV.

Upper figure. Grano-diorite, Mt. Eliza (No. 504) + Nicols × 17 diameters.

Lower figure. Metamorphic spotted Ordovician Slate, N. of Mooroodue Railway Station (No. 506B), + Nicols. × 48 diameters.. H. L. Grayson, Photo-micro.

Plate XVI.

Key to plate XV.

Upper figure. Q = Quartz, Bi = Biotite, H = Hornblende, And = Andesine, Ab = Albite and Albite-Oligoclase.

Lower fignre. M = Micaceous alteration product, Q = Quartz, Bi = Biotite, M.A. = Mica aggregates, Hem = Hematite.

[PROC. ROY. SOC. VICTORIA, 20 (N.S.), PT. II., 1907.]

ART IX.—*On the Validity of Callitris Morrisoni.*

BY R. T. BAKER, F.L.S.

Curator Technological Museum, Sydney

Communicated by Professor Alfred J. Ewart, Ph.D., D.Sc., F.L.S.

[Read 14th November, 1907.]

In Vol. 20 (N.S.), part I., 1907, p. 76, of these Proceedings, Professor Ewart under "Contributions to the Flora of Australia, No. 6," expresses an opinion as to the specific rank of this species.

Inter alia he states, "There can be no doubt that this species (C. robusta) is a variable one, but variations are often shown on one and the same specimen, and hence it is necessary to retain for it the scope given by Bentham, and include under it such varieties as microcarpa, verrucosa, intratropica, and possibly also the columellaris of F. v. M. and the Morrisoni of R. T. Baker."[1]

Unfortunately no facts are educed to support the statement that there "can be no doubt that C. robusta is a variable species," or that it is necessary to retain for it the scope given by Bentham and include microcarpa, verrucosa, intratropica, and possibly columellaris and C. Morrisoni. That a variation of fruits can be found on the same twig is common in most species, but the point is, can fruits similar to C. verrucosa, C. intratropica, C. Drummondii and C. calcarata be found on one and the same specimen, for my species is allied to these two last and not C. robusta, which was a misprint in my paper? I maintain, No.

The establishment of C. Morrisoni was made only after

1. A thorough examination of all Callitris material in the principal herbaria of Europe and Australia.
2. A thorough morphological examination of *living material* of nearly every known Callitris species of Australia and Tasmania.
3. A macro- and microscopical examination of their timbers, barks, leaves and fruits.

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1 Proc. Linn. Soc. N.S.W., vol. xxxi., 1906.

4. A chemical investigation of their oils, sandarachs, camphors &c.
5. And lastly the aid of the physicist (which supports this differentiation) has been laid under tribute.

The result of all this has been the accumulation of specific data that leave no alternative but to differentiate all these species enumerated (supra). That is, if differences constitute a species, as I believe they do.

It would be asking the Royal Society too much to publish here all the results obtained in this connection, in order to prove the case, but it is hoped they will be in print next year.

I might, however, state en passant that, concerning two of the proposed varietal forms, i.e. verrucosa and columellaris, these two morphologically, cortically, ligneously, chemically, and physiologically are quite different, and again any one who has compared only the timbers of intratropica and microcarpa would hardly be prepared to say they also are one and the same species.

Unfortunately Professor Ewart does not say to which C. robusta his remarks refer. It was to clear the identity of this species more especially that the European herbaria were visited by me, for in my opinion it was hopeless to do it in Australia, and this was especially impressed on me after reading De Candolle's list of doubtful and excluded species of Callitris, [Prodromus, vol. 16. pp. 451-3].

To place all those Callitris enumerated by Professor Ewart under one species would be a parallel case to that of Baron von Mueller, who when dealing with Eucalyptus amygdalina, Labill, synonymised at least half a dozen good species under this name, which can all be shown to possess distinctive morphological, cortical, chemical, and other physiological differences from La Billardière's species.

These two cases are only another illustration of the failure of *morphology alone* in the determination of species in Eucalypts and Callitris.

In this connection no better example can be quoted than that of Eucalyptus maculata and E. citriodora. Both species were established by Hooker, and later were synonymised by Baron von Mueller because morphologically the leaves and fruits were identical.

Recent research has shown (1) that the two trees differ in facies, being easily distinguished in the field; (2) that they differ in the quality and texture of their timber and bark; (3) most decidedly in the chemical constituents of the leaf content.

In all probability E. citriodora will be a source of considerable commercial enterprise in the future when it will be known as such, and not as E. maculata, var. citriodora, of recent botanists, and the same remarks will also apply to the several Pines it is now proposed to classify as Callitris robusta.

[PROC. ROY. SOC. VICTORIA, 20 (N.S.), PT. II., 1907.]

ART. X.—*The Formation of Red Wood in Conifers.*

BY JEAN WHITE, M.Sc.

[Read 14th November, 1907].

A series of experiments was carried out by Professor Ewart and Mr. Mason-Jones, on Pinus contorta, and P. cembra, and on Cupressus nutkaensis and C. Lawsoniana, in which certain of the lateral branches were curved round and tied securely for some time, until new wood could be formed. The results of their experiments, published in the "Annals of Botany," April, 1906, led them to conclude that in all probability the formation of red wood was a "morphogenic response to a gravitational stimulus."

Professor Ewart suggested that I should carry the investigations further by noting the effects of diffusing the action of gravity, by causing a plant to rotate on a klinostat.

The plants experimented on were growing in flower pots, and included Araucaria excelsa, Callitris Gunnii, Cedrus deodara, Cryptomeria elegans, Cupressus sempervirens, Juniperus phœnicea, Pinus strobus, Podocarpus elata, Sequoia sempervirens, Taxus baccata, Thuja orientalis.

On 20th September, 1906, the Cupressus was put on to the klinostat, which was set rotating at the rate of one turn in four hours. The remaining plants were laid down horizontally on their sides, in a glass-house, the upper side of each pot being marked. The plants had been previously tied to long stakes, so as to relieve the pressure on the under side.

The plants were all examined on 28th November, 1906, and the following results were noted:—In Araucaria excelsa, Cryptomeria elegans, Juniperus phœnicea, Pinus strobus, Podocarpus elata, Sequoia sempervirens, and Taxus baccata, there was an extremely well-marked layer of red wood developed on the under side of the stem, as it lay horizontally. Also the red wood was very conspicuous on the under surface of all the lateral branches which were examined.

In Callitris gunni, Cedrus deodara and Thuja orientalis, there was a less conspicuous layer of red tracheides produced on the under surface of the main stem and its branches.

The Cupressus sempervirens was also removed from the klinostat on 28th November, 1906.

During the two months' rotation, there were two stoppages of the klinostat for a possible duration of 16 hours and 3 hours respectively. Examination showed a uniform exceedingly faint layer of red wood round the main stem and lateral branches. The Cupressus plant had two similar main stems, one of which was examined when it was first removed from the klinostat, and the other one after it was removed for the second time.

The Cupressus plant was replaced on the klinostat on 29th November, 1906, the speed of rotation being changed to one revolution in two minutes. It was kept on the klinostat till 28th December, during which time there was a stoppage of the machine possibly for 30 hours. On examination of the stem, after removal of the plant from the klinostat on 28th December, no red wood was visible. Evidently, therefore, to produce any permanent impression upon the developing cambial segments, the gravitational stimulus must last at least 1 to 2 hours. One minute's stimulation is either not perceived, or leaves the segment cell in a labile condition, continually reversed by the completion of each rotation without producing any permanent and definite morphogenic response.

The pot containing the Cupressus plant was laid on its side in the glass-house on 25th January, 1907, the upper side of the flower pot being marked. It was left in this position till 18th October, 1907. On stripping off the bark, a thick layer of red wood, about 20 tracheides deep, was observed on the under surface of the main steam and lateral branches.

The above results serve to strengthen Professor Ewart's and Mr. Mason-Jones' conclusions as to the primary stimulus responsible for the production of the red wood, being a gravitational one.

Diameter of the Xylem Vessels, and Thickness of Their Walls.

The diameters of the cavities of the vessels, and also the thickness of the vessel walls were measured by means of the screw micrometer eyepiece, in both the red and white wood. Sections were cut of the main stems of several of the plants, which had been growing in the pots placed on their sides from 20th September to 28th November, 1906.

Taking the averages of the thickness of the walls in the red and white wood, the two sets of readings being taken from the same section as nearly diametrically opposite as possible, in practically every case, the walls of the white tracheides were found to be thicker than those of the red, whilst the cavities of the tracheides of the white wood were smaller in diameter than those of the red tracheides.

These results are not in accordance with those previously recorded by Sonntag,[1] who found that the walls of the tracheides in the red wood were thicker than those of the white.

Experimental Results.

A number of readings were taken of the internal diameters and the thickness of the walls of the tracheides, and the results are given in the form of averages of sets of five readings, followed by averages of these again.

Taxus baccata.

In the thickest part of the red wood in the sections examined, the tracheides were 20 deep.

SECTION I.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.008 mm.	.004 mm.	.008 mm.	.008 mm.
.009 ,,	.004 ,,	.008 ,,	.008 ,,
.011 ,,	.004 ,,	.008 ,,	.007 ,,
.012 ,,	.005 ,,	.009 ,,	.007 ,,
Average	Average	Average	Average
.010 mm.	.004 mm.	.008 mm.	.008 mm.

1 Jahrb. für wiss, Bot., Bd. xxxix., p. 71.

SECTION II.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.011 mm.	.006 mm.	.007 mm.	.005 mm.
.008 ,,	.006 ,,	.008 ,,	.006 ,,
.010 ,,	.006 ,,	.008 ,,	.007 ,,
.010 ,,	.006 ,,	.007 ,,	.005 ,,
.009 ,,	.006 ,,	.008 ,,	.008 ,,
.011 ,,	.007 ,,	.011 ,,	.007 ,,
Average	Average	Average	Average
.009 mm.	.006 mm.	.008 mm.	.006 mm.

SECTION III.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thicknes of Wall
.008 mm.	.006 mm.	.006 mm.	.008 mm.
.008 ,,	.007 ,,	.009 ,,	.008 ,,
.011 ,,	.008 ,,	.007 ,,	.006 ,,
.008 ,,	.005 ,,	.008 ,,	.007 ,,
.007 ,,	.005 ,,	.009 ,,	.007 ,,
.010 ,,	.004 ,,	.008 ,,	.006 ,,
Average	Average	Average	Average
.008 mm.	.006 mm.	.008 mm.	.007 mm.

Pinus strobus.

SECTION I.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.016 mm.	.005 mm.	.014 mm.	.005 mm.
.011 ,,	.003 ,,	.012 ,,	.005 ,,
.012 ,,	.004 ,,	.014 ,,	.003 ,,
Average	Average	Average	Average
013 mm.	.004 mm.	.013 mm.	.004 mm.

SECTION II.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.015 mm.	.004 mm.	.014 mm.	.005 mm.
.014 ,,	.004 ,,	.015 ,,	.005 ,,
.012 ,,	.005 ,,	.012 ,,	.005 ,,
Average	Average	Average	Average
.014 mm.	.004 mm.	.014 mm.	.005 mm.

Araucaria excelsa.

SECTION I.

Red Wood Internal Diameter	Red Wood Thickness of Wall	White Wood Internal Diameter	White Wood Thickness of Wall
.017 mm.	.007 mm.	.017 mm.	.009 mm.
.017 ,,	.007 ,,	.018 ,,	.009 ,,
.020 ,,	.007 ,,	.016 ,,	.009 ,,
Average	Average	Average	Average
.018 mm.	.007 mm.	.017 mm.	.009 mm.

SECTION II.

Red Wood Internal Diameter	Red Wood Thickness of Wall	White Wood Internal Diameter	White Wood Thickness of Wall
.016 mm.	.006 mm.	.020 mm.	.009 mm.
.018 ,,	.008 ,,	.017 ,,	.009 ,,
.017 ,,	.007 ,,	.016 ,,	.008 ,,
Average	Average	Average	Average
.017 mm.	.007 mm.	.018 mm.	.009 mm.

Podocarpus elata

SECTION I.

Red Wood Internal Diameter	Red Wood Thickness of Wall	White Wood Internal Diameter	White Wood Thickness of Wall
.014 mm.	.007 mm.	.008 mm.	.007 mm.
.011 ,,	.005 ,,	.011 ,,	.007 ,,
Average	Average	Average	Average
.012 mm.	.006 mm.	.009 mm.	.007 mm.

SECTION II.

Red Wood. Internal Diameter	Red Wood. Thickness of Wall	White Wood. Internal Diameter	White Wood. Thickness of Wall
.012 mm.	.009 mm.	.008 mm.	.007 mm.
.012 ,,	.005 ,,	.011 ,,	.007 ,,
Average	Averege	Average	Average
.012 mm.	.007 mm.	.009 mm.	.007 mm.

Summary of Preceding Results.

The plants were placed horizontally, the upper side being the more strongly illuminated.

Thickness of Walls		Internal Diameter	
Red Wood	White Wood	Red Wood	White Wood
Taxus baccata.			
.004 mm.	.008 mm.	.010 mm.	.008 mm.
.006 ,,	.006 ,,	.009 ,,	.008 ,,
.006 ,,	.007 ,,	.008 ,,	.008 ,,
Average	Average	Average	Average
.0053 mm.	.0070 mm.	.0090 mm.	.0080 mm.
Pinus strobus.			
.004 ,,	.004 ,,	.013 ,,	.013 ,,
.004 ,,	.005 ,,	.014 ,,	.014 ,,
Average	Average	Average	Average
.0040 mm.	.0045 mm.	.0135 mm.	.0135 mm.
Araucaria excelsa.			
.007 ,,	.009 ,,	.018 ,,	.017 ,,
.007 ,,	.009 ,,	.017 ,,	.018 ,,
Average	Average	Average	Average
.0070 mm.	.0090 mm.	.0175 mm.	.0175 mm.
Podocarpus elata.			
.006 ,,	.007 ,,	.012 ,,	.009 ,,
.007 ,,	.007 ,,	.012 ,,	.009 ,,
Average	Average	Average	Average
.0065 mm.	.0070 mm.	.0120 mm.	.0090 mm.

The above results appeared to indicate that the thickness of the tracheide walls might be influenced by either pressure or illumination, or both.

In order to investigate this matter further, some of the lateral branches of Cedrus deodara, Thuja orientalis, Callitris Gunnii, Cryptomeria elegans, and Pinus strobus, were curved round and tied in the same manner as were those described by Professor Ewart and Mr. Mason-Jones.[1] The plants were set upright in the glass-house on 21st May, 1907. Parts of the lateral branches of Taxus baccata, Podocarpus elata, and Araucaria excelsa were bound round with tinfoil, and the pots were laid horizontally in the glass-house, and the uppermost part of the pot marked, also on 21st May, 1907.

1 Annals of Botany, vol. xx., p. 202.

On 10th August, 1907, some of these plants were examined. Very conspicuous layers of red wood were developed on the under surface of both parts of the curve, just as described in the "Annals of Botany." Sections were cut from the parts of the curve where the development of red wood was greatest, and the internal diameters of the red and white tracheides, and also the thickness of their walls, were measured.

Experimental Results.

Pinus strobus.

SECTION I.—(From upper portion of curve).

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.008 mm.	.003 mm.	.012 mm.	.006 mm.
.010 ,,	.002 ,,	.012 ,,	.006 ,,
.009 ,,	.003 ,,	.010 ,,	.006 ,,
.010 ,,	.002 ,,	.010 ,,	.007 ,,
Average	Average	Average	Average
.009 mm.	.003 mm.	.011 mm.	.006 mm.

SECTION II.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.009 mm.	.003 mm.	.008 mm.	.005 mm.
.012 ,,	.003 ,,	.010 ,,	.006 ,,
.012 ,,	.002 ,,	.009 ,,	.006 ,,
.009 ,,	.002 ,,	.010 ,,	.007 ,,
Average	Average	Average	Average
010 mm.	.003 mm.	.009 mm.	.006 mm.

SECTION III.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.009 mm.	.002 mm.	.008 mm.	.006 mm.
.013 ,,	.003 ,,	.010 ,,	.006 ,,
.008 ,,	.002 ,,	.009 ,,	.006 ,,
Average	Average	Average	Average
.009 mm.	.002 mm.	.009 mm.	.006 mm.

Callitris gunni.

Section I.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.012 mm.	.002 mm.	.009 mm.	.004 mm.
.006 ,,	.002 ,,	.008 ,,	.003 ,,
.009 ,,	.003 ..	.008 ,,	.005 ,,
.009 ,,	.002 ,,	.008 ,,	.003 ,,
Average	Average	Average	Average
.008 mm.	.002 mm.	.008 mm.	.002 mm.

Section II.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.009 mm.	.004 mm.	.009 mm.	.005 mm.
.006 ,,	.002 ,,	.006 ,,	.004 ,,
.008 ,,	.001 ,,	.006 ,,	.003 ,,
.008 ,,	.002 ,,	.008 ,,	.003 ,,
Average	Average	Average	Average
.008 mm.	.002 mm.	.007 mm.	.003 mm.

Cryptomeria elegans.

Section I.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.006 mm.	.002 mm.	.006 mm.	.005 mm.
.007 ,,	.001 ,,	.006 ,,	.004 ,,
.008 ,,	.001 ,,	.008 ,,	.006 ,,
.008 ,,	.002 .,	.009 ,,	.005 ,,
Average	Average	Average	Average
.007 mm.	.002 mm.	.007 mm.	.005 mm.

Section II.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.007 mm.	.002 mm.	.006 mm.	.005 mm.
.009 ,,	.002 ,,	.006 ,,	.006 ,,
.008 ,,	.001 ,,	.008 ,,	.005 ,,
.010 ,,	.002 ,,	.009 ,,	.003 ,,
Average	Average	Average	Average
.009 mm.	.002 mm.	.008 mm.	.005 mm.

Summary of Preceding Results.

The stems were bent in curves. The white wood side was under tension, and was the more strongly illuminated side.

PINUS STROBUS.

Thickness of Walls		Internal Diameter	
Red Wood	White Wood	Red Wood	White Wood
.003 mm.	.006 mm.	.009 mm.	.011 mm.
.003 ,,	.006 ,,	.010 ,,	.009 ,,
.002 ,,	.006 ,,	.009 ,,	.009 ,,
Average	Average	Average	Average
.0028 mm.	.0060 mm.	.0091 mm.	.0093 mm.
CALLITRIS GUNNI.			
.002 ,,	.003 ,,	.008 ,,	.008 ,,
.002 ,,	.003 ,,	.008 ,,	.008 ,,
Average	Average	Average	Average
.0020 mm.	.0030 mm.	.0080 mm.	.0080 mm.
CRYPTOMERIA ELEGANS.			
.002 ,,	.005 ,,	.007 ,,	.007 ,,
.002 ,,	.005 ,,	.009 ,,	.008 ,,
Average	Average	Average	Average
.0020 mm.	.0050 mm.	.0080 mm.	.0075 mm.

On August 16th 1907, the lateral branches which had been covered with tinfoil were examined. A layer of red wood was observed on the under side of the branches which had been covered with tinfoil, as before. Hence Sonntag is incorrect in supposing that heliotropic or pressure stimuli are responsible for the formation of redwood. Sections of the lateral branches which were covered were cut, and the thickness of the tracheide walls and their internal diameters were measured.

Experimental Results.

Taxus baccata.

SECTION I.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.010 mm.	.001 mm.	.008 mm.	.005 mm.
.008 ,,	.002 ,,	.005 ,,	.002 ,,
.009 ,,	004 ,,	.007 ,,	.002 ,,
.009 ,,	.004 ,,	.006 ,,	.003 ,,
Average	Average	Average	Average
.009 mm.	.003 mm.	.006 mm.	.003 mm.

Section II.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.009 mm.	.004 mm.	.008 mm.	.005 mm.
.007 ,,	.004 ,,	.005 ,,	.005 ,,
.008 ,,	.004 ,,	.006 ,,	.005 ,,
.008 ,,	.005 ,,	.006 ,,	.004 ,,
Average	Average	Average	Average
.008 mm.	.004 mm.	.006 mm.	.004 mm.

Podocarpus elata.

Section I.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.010 mm.	.002 mm.	.009 mm.	.001 mm.
.016 ,,	.004 ,,	.009 ,,	.004 ,,
.012 ,,	.006 ,,	.012 ,,	.005 ,,
.009 ,,	.005 ,,	.010 ,,	.005 ,,
Average	Average	Average	Average
.011 mm.	.004 mm.	.010 mm.	.004 mm.

Section II.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.010 mm.	.003 mm.	.012 mm.	.003 mm.
.009 ,,	.007 ,,	.013 ,,	.005 ,,
.008 ,,	.006 ,,	.012 ,,	.005 ,,
.009 ..	.005 ,,	.012 ,,	.008 ,,
Average	Average	Average	Average
.009 mm.	.005 mm.	.012 mm.	.005 mm.

Section III.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.013 mm.	.003 mm.	.013 mm.	.003 mm.
.015 ,,	.005 ,,	.015 ,,	.005 ,,
.010 ,,	.006 ,,	.010 ,,	.006 ,,
.008 ,,	.003 ,,	.008 ,,	.003 ,,
Average	Average	Average	Average
.011 mm.	.004 mm.	.011 mm.	.004 mm.

Araucaria excelsa.

Section I.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.013 mm.	.003 mm.	.022 mm.	.003 mm.
.010 ,,	.001 ,,	.016 ,,	.004 ,,
.010 ,,	.002 ,,	.015 ,,	.003 ,,
.010 ,,	.003 ,,	.013 ,,	.003 ,,
Average	Average	Average	Average
.011 mm.	.002 mm.	.014 mm.	.003 mm.

Section II.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.016 mm.	.005 mm.	.020 mm.	.005 mm.
.021 ,,	.004 ,,	.016 ,,	.003 ,,
.017 ,,	.005 ,,	.016 ,,	.006 ,,
.018 ,,	.006 ,,		
Average	Average	Average	Average
.018 mm.	.005 mm.	.017 mm.	.005 mm.

Section III.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.013 mm.	.005 mm.	.013 mm.	.004 mm.
.018 ,,	.008 ,,	.023 ,,	.006 ,,
.006 ,,	.005 ,,	.013 ,,	.003 ,,
.016 ,,	.006 ,,	.020 ,,	.005 ,,
Average	Average	Average	Average
.013 mm.	.006 mm.	.017 mm.	.005 mm.

Summary of Preceding Results.

Both sides were equally darkened. The red wood side was under compression, and the white wood side was under tension.

Taxus baccata.

Thickness of Walls		Internal Diameter	
Red Wood	White Wood	Red Wood	White Wood
.003 mm.	.003 mm.	.009 mm.	.006 mm.
.004	.004 ,,	.008 ,,	.006 ,,
Average	Average	Average	Average
.0035 mm.	.0035 mm.	.0085 mm.	.0060 mm.

PODOCARPUS ELATA.

.004 ,,	.004 ,,	.011 ,,	.010 ..
.005 ,,	.005 ,,	.009 ,.	.012 ..
.004 ,,	.004 ,,	.011 ,,	.011 ,,
Average	Average	Average	Average
.0043 mm.	.0043 mm.	.0101 mm.	.0110 mm.

ARAUCARIA EXCELSA.

.002 ,,	.003 ,,	.011 ..	.014 ,,
.005 ,,	.005 ,,	.018 ,,	.017 ,,
.006 ,,	.005 ,,	.013 ,,	.017 ,,
Average	Average	Average	Average
.0043 mm.	.0043 mm.	.0140 mm.	.0490 mm.

These sections, taken from the curved lateral branches, were all cut from the upper portion of the curve, so that the red wood vessels were subjected to compression, and the white wood vessels were subject to tension.

Concerning the thickness of the walls, the ratio of the thickness of the white to the red tracheides is not very different from their ratio when they were not subjected to any special pressure, and so, presumably, the thickness of the walls does not to any appreciable extent depend on pressure effects of the intensity produced by forcibly bending a stem into circular form or laying a vertical stem in a horizontal position. Also in those sections, cut from the parts of the branches covered with tinfoil, in practically every case, it was found that the thickness of the walls of red wood vessels and white wood vessels was the same, which indicates that photomorphic stimuli take an important part in the regulation of the thickness of the walls. In this respect my experiments appear to agree with those of Knight,[1] who found, for instance, that roots freed from soil and exposed to light formed firmer wood.

The Cryptomeria, Callitris and Pinus had some of their lateral branches curved and tied round in the manner described previously, the upper part of the curve being covered over with tinfoil. They were placed upright in the glass-house on 16th August, 1907.

Measurements of the diameters of the red and white wood vessels, and of their walls, were taken on 4th November, 1907.

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1 Pfeffer's Physiology of Plants, English Translation. Vol. ii., page 88.

Experimental Results.

Callitris Gunnii.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.009 mm.	.005 mm.	.008 mm.	.005 mm.
.008 ,,	.005 ,,	.009 ,,	.008 ,,
.008 ,,	.006 ,,	.008 ,,	.005 ,,
.009 ,,	.005 ,,	.006 ,,	.005 ,,
Average	Average	Average	Average
.008 mm.	.005 mm.	.008 mm.	.006 mm.

Cryptomeria elegans.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.005 mm.	.006 mm.	.006 mm.	.005 mm.
.008 ,,	.006 ,,	.005 ,,	.005 ,,
.005 ,,	.004 ,,	.005 ,,	.004 ,,
.006 ,,	.004 ,,	.005 ,,	.004 ,,
Average	Average	Average	Average
.006 mm.	.005 mm.	.005 mm.	.005 mm.

Pinus strobus.

Red Wood		White Wood	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.010 mm.	.006 mm.	.009 mm.	.008 mm.
.010 ,,	.008 ,,	.008 ,,	.008 ,,
.012 ,,	.005 ,,	.013 ,,	.005 ,,
.009 ,,	.006 ,,	.010 ,,	.005 ,,
Average	Average	Average	Average
.010 mm.	.006 mm.	.010 mm.	.006 mm.

Summary of Preceding Experiments.

Internal Diameter		Thickness of Walls	
Red Wood	White Wood	Red Wood	White Wood
Callitris gunni.			
.008 mm.	.008 mm.	.005 mm.	.006 mm.
Cryptomeria elegans.			
.006 ,,	.005 ,,	.005 ,,	.005 ,,

PINUS STROBUS.			
.010 mm.	.006 mm.	.010 mm.	.006 mm.

A large branch of Cupressus sempervirens with sufficient bark and phloem to cut off nearly all light from the cambium was removed from the tree on which it was growing normally. An extremely thick layer of red wood was visible on the under side of the branch as it grew.

Sections of the red and white wood were examined, and the diameters of the cavities, and the thickness of the walls of the xylem vessels in each kind were measured, with the following results :—

RED WOOD		WHITE WOOD	
Internal Diameter	Thickness of Wall	Internal Diameter	Thickness of Wall
.012 mm.	.004 mm.	.016 mm.	.006 mm.
.016 ,,	.004 ,,	.016 ,,	.005 ,,
.012 ,,	.005 ,,	.013 ,,	.005 ,,
015 ,,	.005 ,,	.018 ,,	.005 ,,
Average	Average	Average	Average
.0143 mm.	.0045 mm.	.0156 mm.	.0052 mm.

In this case the difference between the intensity of the illumination on the upper (white wood) and the lower (red wood) surface must be extremely small, and the average thickness of the white wood walls is little or not at all greater than in the red wood.

Summary of Preceding Experiments.

THICKNESS OF WALLS		INTERNAL DIAMETER	
Red Wood	White Wood	Red Wood	White Wood
.0160 mm.	.0052 mm.	.0140 mm.	.0045 mm.

Pinus strobus.

Plant grown horizontally.
White wood on illuminated side.

THICKNESS OF WALLS		INTERNAL DIAMETER	
Red Wood	White Wood	Red Wood	White Wood
Average	Average	Average	Average
.0040 mm.	.0045 mm.	.0135 mm.	.0135 mm.

Plant grown vertically.

Curved stem. Red wood compressed. White wood stretched and illuminated.

Thickness of Walls		Internal Diameter	
Red Wood Average	White Wood Average	Red Wood Average	White Wood Average
.0033 mm.	.0060 mm.	.0093 mm.	.0096 mm.

Curved stem. Both sides equally darkened.

Thickness of Walls		Internal Diameter	
Red Wood Average	White Wood Average	Red Wood Average	White Wood Average
.0060 mm.	.0060 mm.	.0100 mm.	.0100 mm.

Araucaria excelsa.

Plant grown horizontally.

White wood on the illuminated side.

Thickness of Walls		Internal Diameter	
Red Wood Average	White Wood Average	Red Wood Average	White Wood Average
.0070 mm.	.0090 mm.	.0175 mm.	.0175 mm.

Plant grown upright.

Both sides equally darkened.

Thickness of Walls		Internal Diameter	
Red Wood Average	White Wood Average	Red Wood Average	White Wood Average
.0043 mm.	.0043 mm.	.0140 mm.	.0160 mm.

Podocarpus elata.

Plant grown horizontally.

Whited wood on the illuminated side.

Thickness of Walls		Internal Diameter	
Red Wood Average	White Wood Average	Red Wood Average	White Wood Average
.0065 mm.	.0070 mm.	.0120 mm.	.0090 mm.

Plant grown upright.
Both sides equally darkened.

Thickness of Walls		Internal Diameter	
Red Wood	White Wood	Red Wood	White Wood
Average	Average	Average	Average
.0043 mm.	.0043 mm.	.0103 mm.	.0110 mm.

Taxus baccata.

Plant grown horizontally.
White wood on the illuminated side.

Thickness of Walls		Internal Diameter	
Red Wood	White Wood	Red Wood	White Wood
Average	Average	Average	Average
.0053 mm.	.0070 mm.	.0090 mm.	.0080 mm.

Plant grown vertically.
Both sides equally darkened.

Thickness of Walls		Internal Diameter	
Red Wood	White Wood	Red Wood	White Wood
Average	Average	Average	Average
.0035 mm.	.0035 mm.	.0085 mm.	.0060 mm.

Cryptomeria elegans.

Plant grown vertically.
Lateral branches curved. White wood on illuminated side.

Thickness of Walls		Internal Diameter	
Red Wood	White Wood	Red Wood	White Wood
Average	Average	Average	Average
.0020 mm.	.0050 mm.	.0080 mm.	.0075 mm.

Lateral branches curved. Both sides equally darkened.

Thickness of Walls		Internal Diameter	
Red Wood	White Wood	Red Wood	White Wood
Average	Average	Average	Average
.0050 mm.	.0050 mm.	.0060 mm.	.0050 mm.

Callitris Gunnii.

Plant grown vertically (lateral branches curved).
White wood on the illuminated side.

Thickness of Walls		Internal Diameter	
Red Wood	White Wood	Red Wood	White Wood
		.008 mm.	008 mm.
		.008 ,,	.008 ,,
Average	Average	Average	Average
.0020 mm.	.0030 mm.	.0080 mm.	.0080 mm.

Lateral branches curved. Both sides equally darkened.

Thickness of Walls		Internal Diameter	
Red Wood	White Wood	Red Wood	White Wood
.0080 mm.	.0060 mm.	.0080 mm.	.0050 mm.

Conclusion.

So far as my results dealing with this matter go, they point to the conclusion that the formation of red wood is primarily due to a gravitational stimulus, while the lesser thickness shown by the wall of the red wood tracheides, as compared with that of the white wood tracheides, appears to be largely the result of a photomorphic stimulus, the response being somewhat akin to etiolation in character.

The preceding averages all agree in showing that the thickness of the tracheide walls on the more strongly illuminated side exceeded that of the tracheide walls where the illumination was less intense. The same uniformity, under similar conditions, does not apparently prevail in the size of the internal cavities of the tracheides; thus as a general rule along a single radial row of tracheides, isolated cases occurred in which the internal cavities were of abnormal size in either direction, while such abrupt variations did not appear to occur to any marked extent in the thickness of the tracheide walls of either kind of wood.

Considering the cases in which both sides of the branches were equally darkened, the assumption is strengthened by the fact that in every case tested except one, the thickness of the tracheide walls in both red and white wood tallied exactly.

As in some of the above cases, the parts of the stem which were equally darkened were subjected to unequal pressure or tension, due to the curving round of the branches experimented upon, the thickness of the tracheide walls in red and white wood was the same, it seems to be improbable that pressure and tension of the intensity produced by forcibly curving the branch, exert any pronounced influence on either the thickness of the walls, diameter of the tracheides, or formation of red wood. The latter is purely a response to gravity, and is only accompanied by an increase in the thickness of the walls when the red wood side is the more strongly illuminated one, which is unusual. The minimal period for perception and response, as tested by the method of summation, is two hours. Exposures to gravity of less than two minutes' duration produce no permanently lasting effect.

In conclusion, I wish to record my sincere thanks to Prof. Ewart for his assistance, and also for allowing me the use of the Botanical laboratory at the Melbourne University.

[Proc. Roy. Soc. Victoria, 20 (N.S.), Pt. II., 1907.]

Art. XI.—*Contributions to the Flora of Australia, No. 7.*[1]

By ALFRED J. EWART, D.Sc., Ph.D., F.L.S.,

Government Botanist and Professor of Botany
at the Melbourne University.

[Read 14th November, 1907.]

Latin in Systematic Botany.

At the last Botanical Congress, held at Vienna in 1905, on the whole a salutary check was administered to the objectionable tendencies of modern systematists in certain quarters, especially as regards frivolous changes of name, and it is, in fact, a matter of regret that the list of protected names was not greatly increased. On the other hand, it is impossible to follow Mr. Maiden[2] when he states that botanists are as bound by these laws as by those of their own country, and must follow these laws whether they approve of them or not. For this to be requisite the Congress would need to be a really representative one, to which all botanists sent elected representatives. At present it is a fortuitous concourse almost solely of systematists, among whom the local interests of the country in which the Congress is held are always unduly strongly represented. So far as I am aware, botanists from the south of the Equator were entirely unrepresented, and plant physiologists and anatomists were conspicuous by their absence. Yet the man who has intimately investigated the structure and properties of a plant has a greater claim to decide that its name shall not be altered than the systematist whose interest in the plant largely ceases as soon as it is labelled, and is often only revived when a chance of relabelling it occurs.

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1 No. 6 in Proc. Roy. Soc. Vict, 1907, vol. 20, p. 76.
2 Jour. Roy. Soc. N.S. Wales, vol. xl., 1906, p. 74.

Until the Congress is a thoroughly representative one, it must remain a purely voluntary matter with each botanist as to whether he follows its rules or not, and the power of the Congress to enforce its rules will depend solely upon the number of botanists who elect to follow them. Under these circumstances I must take strong exception to Art. 36, and, by disobeying it, adopt the best plan to have it rescinded or altered.

Art. 36 reads: "On and after January 1st, 1908, the publication of names of new groups will be valid only when they are accompanied by a Latin diagnosis." In Art. 13 a group is defined as including a species. Any practice which tends to render a science unnecessarily inaccessible to the general public is bad in principle, and ultimately reacts injuriously upon the science in question, and upon the eclectic few connected with it. Latin is thoroughly discredited as a scientific language, and in re-adopting it systematists are taking a step back to the middle ages. If the rule had been to the effect that diagnoses not written in English, French, or German, or unaccompanied by diagnostic figures must be written in Latin, less exception could have been taken to it, although it would have been more satisfactory to state that diagnoses not accompanied by analytic figures, must be written in English, French or German. A good diagnostic figure is worth a dozen pages of the average systematist's dog Latin, which at its best would hardly satisfy even Tacitus, and at its worst is sufficient to make Cicero turn in his grave.

To describe plants both in the author's language and in Latin would be to unnecessarily increase the already enormous bulk of systematic literature, and to swell its pouring torrent to a permanent flood level. To avoid this, and as a protest against the rule, the plants, in the present and subsequent papers, will be given, as hitherto, with diagnoses in English, and if necessary with explanatory figures. Any Latinist who would like to see his initials after a plant name is at liberty to acquire this right by publishing a translation in Latin of the plant diagnosis here given, and thus following the rule laid down by the last Congress. I shall make no complaint, and am willing to take this risk in order to get an absurd law altered.

It is a pity the rules were not submitted to some well-known authority on jurisprudence before publication. Thus the omission of the word Latin in Art. 37 renders Arts. 36 and 39 invalid, or at least renders their interpretation doubtful in many cases. By means of Art. 37, it would be possible in a roundabout way to force the acceptance of a new species according to Congress rules without a Latin diagnosis. Further, to change the name or authority for a new species because it had not been published with a Latin diagnosis would be to act in flat defiance of Art. 50, and other instances of rules whose effects are difficult to harmonise might be given.

Nomina Conservanda.—It is greatly to be regretted that the time limit for change of name was put so far back as 1753, and that the list of nomina conservanda was not greatly extended. To give an instance. Anthistiria L. (Graminae), 1779, is changed to Themeda, Forst, 1775, by Haeckel in De Candolle's Monograph and in Engler's Pflanzenfamilien. It is impossible to accept any such change of a Linnean name on such slender grounds as a four years' priority, when a name has been universally accepted for over 120 years. Questions of general convenience override any such claim in a case of this kind.

Acacia accola, Maiden and Betche. Proc. Linn. Soc. N.S. Wales, 1906, p. 734. (Leguminosae).

This appears to be a narrow-leaved and broad-fruited form of A. neriifolia. A specimen from Bailey resembles Maiden's form more closely as regards the fruit and the funicle of the seed, but has the broader phyllodes of A. neriifolia. Probably the future discovery of other intervening forms will render advisable the reduction of this species to a variety.

Adenanthos cygnorum, Diels. Fragm. Phyt. Aust. Occid., p. 138. (Proteaceae).

This "species" is made to include the A. apiculata of Meissner, and the Drummond specimens of A. sericea. The species is, however, undoubtedly the same as A. sericea, Benth., and if Dr. Diels had seen No. 788 as well as No. 787, he would probably not have made this error. There can be no doubt that many accepted species of this genus will be ultimately reduced to varieties as the result of cultural observations, and hence great care should be exercised to avoid creating useless synonyms by conclusions made without such observations in the case of highly plastic genera of this character. It is also doubtful whether the A. Drummondii, Meisn., revived by Diels, represents more than a variety of A. apiculata, R.Br.

AIZOON INTERMEDIUM, Diels, and AIZOON GLABRUM, n. sp. (Aizoaceae).

The former species is distinguished by Diels from A. zygophylloides (F. v. M.), by the shape of the leaves, longer pedicels and narrow calyx lobes. It comes very close to some nearly smooth stemmed specimens included by F. v. Mueller in A. zygophylloides, and may ultimately prove to have not more than a varietal significance. It is, however, quite distinct from Luehmann's undescribed Aizoon glabrum. This is a rather small plant, spreading more or less from a single root, the slender wiry glabrous stems, 2 to 6 inches high, simple or branching one or more times, bearing terminal flowers in loose cymes on short pedicels, one or two pairs of linear leaves being close under the flower, which is sometimes an inch across when fully open, but usually less. Calyx 4 partite, usually divided nearly to the base, enlarging during flowering to nearly ½ inch in length, in large, fully-opened flowers, the lobes more or less acuminate, usually lanceolate, but not always of equal breadth in the same flower. Stamens numerous. Styles 4. Capsule dehiscing into 8 valves. Seeds numerous, almost black, shaped like the head of a mace and covered with small tuberculate spines.

Murchison R., I. Tyson, 1898; Mt. Caroline, 1891, Miss Sewel; Salt Lakes, Martha Heal.

AIZOON RODWAYI, n. sp.

Plant 3 to over 8 inches high, stems more or less decumbent at base, and spreading. Leaves in opposite pairs, soft, fleshy, with scattered warty, transparent tubercles, ovate or linear, mostly ½ inch long, but beneath each flower usually a larger pair more pointed and with broader bases. Plant glabrous throughout, the stems more slender than A. quadrifidum, but stouter than A. glabrum. Flowers large terminal, 1 to 1½ inches diameter when fully expanded. Calyx divided to about the middle, the five segments with broad bases and more or less bluntly acuminate tips. Other features much as in A. quadrifidum. Seeds apparently reddish-brown, but otherwise as in A. glabrum.

The absence of any scurfy tomentum at once distinguishes these two species from A. quadrifidum. In addition, A. Rodwayi has broader ovate or lanceolate leaves, the calyx is less deeply divided, the flower larger and more bulky at its base. This, with the less deeply divided calyx and the shape of the leaves distinguishes the plant from A. zygophylloides. A. glabrum is told by its glabrous wiry stems, smaller flowers and calyx deeply divided to the base.

I. Tyson, Salt Marsh, W. Australia, 1893; F. A. Rodway, M.B., dried up salt lake, Desdemona, W. Australia, 1907.

ANGIANTHUS HUMIFUSUS, Benth., var. GRANDIFLORUS. (Compositae).

In the last contribution to the Flora of Australia, No. 6, this was erroneously given as a new variety by the accidental omission of a proof correction.

CASSINIA LAEVIS, R. Br. (Compositae).

The record from C. French, Goulburn R., under the above heading, in Contributions to the Flora of Australia, No. 6, should apply to Cassinia arcuata, R.Br., wrongly recorded as C. Theodori, F. v. M.

CONOSPERMUM POLYCEPHALUM, Meisn., var. LEIANTHUM, Benth. (Proteaceae).

Diels and Pritzel[1] raise this variety to specific rank as C. leianthum, Benth. The material at the National Herbarium, a part only of which appears to have been examined by Diels and Pritzel, shows conclusively that there is no reason for this change. It is impossible to lay down any clear line of demarca-

1 Fragm. Phyt. Austr. Occid., p. 141.

tion based on a group of constant characters, for Diels' distinctions do not apply to all the specimens between this variety and the type species. The typical form of the closely allied C. Toddii of F. Mueller[1] shows a trifling difference in the size and acuminate character of the bracts, while the perianth tube is rather more slender, is longer in proportion to the lobes, and somewhat more slender, and is more pubescent outside. Even these characters do not appear to be quite constant, so that C. Toddii may also ultimately prove to be a variety of C. polycephalum when more intermediate material is available.

DAVIESIA CORYMBOSA, var. ST. JOHNII = D. CORYMBOSA, var. VIRGATA. (Papilionaceae).

This plant was recorded in the Victorian Naturalist, Nov., 1906, p. 133, and specimens have since been received from Mr. C. French, Jr., collected at Ringwood. They are identical with the D. virgata of Cunningham, which Bentham refers to D. corymbosa, var. mimosoides. The condensed clusters of small flowers and the very narrow leaves would, as suggested by Mr. W. R. Guilfoyle, justify the recognition of a second variety differing more widely from the type than var. mimosoides, even though transition forms occur, but the name should be variety virgata, in recognition of the old specific name for the variety.

DIPLOTAXIS MURALIS, D.C., the wall or sand mustard. (Cruciferae).

This introduced alien has been variously referred to as D. muralis and D. tenuifolia, D.C. It has, however, the small flowers and less divided leaves of the former. The Australian specimens have the leaves less exclusively radical and more on the stem, and are often double the normal height, frequently reaching 12 to 16 inches. The plants also show a greater tendency to be perennial, but these changes are probably climatic ones, not necessarily of varietal significance, although they are approaches towards D. tenuifolia, D.C.

1 Fragm., vol. x., p. 20.

ERIOSTEMON GRACILE, R. Grah. (Proteaceae). In Edinb. N. Phil. Journ., xvi., 1834, p. 175 = ERIOSTEMON DIFFORMIS, A. Cunn.

The former name is given as that of a valid species in the Kew Index, and the Nat. Herbarium possesses specimens from the Grampians, which are indentical with forms of E. difformis, the glabrous petals and slightly longer flower stalks of the specimens being variable features in E. difformis. The specimens do not exactly tally with the description given in Mueller's Plants Indigenous to Victoria, I., 1860, p. 125, but our specimens appear to be authentic. E. gracile is the older name, but to change the current one would be a frivolous interference with established nomenclature. Bentham seems to have entirely overlooked E. gracile, and makes no mention of it in the Flora Australiensis.

ERIOSTEMON INTERMEDIUS. (Proc. Roy. Soc. Vict., 19, 1907, p. 40 = E. DESERTI, Pritzel (Fragm. Phytog. Austr. Occ., 1905. p. 320).

The plant was described before Diels' and Pritzel's work was available. Their description is exceedingly condensed, and imperfect in several respects, but specimens of their plant since received show that the two species are identical, the older name standing. Pritzel seems to have overlooked the fact that the plant is an interesting connecting link, especially as regards the stamens between the Leionema section of "Phebalium" and Eriostemon proper. The close resemblance to E. Brucei, which misled Mueller, and to which Pritzel attaches undue importance, is mainly external.

EUPHRASIA COLLINA, R. Br. (Syn. E. BROWNII, F. v. M., Fragm., v. 88. (Scrophulariaceae).

There can be no doubt that Mueller was correct in placing four of R. Brown's species in one, but as was pointed out by Bentham, the proper course was to extend one of them to include the others, and so avoid a new name. Even considered as varieties, the line of demarcation is not distinct in all cases, and the type forms show a regular gradation from dwarf, small-flowered forms to taller, more luxuriant and larger-leaved and flowered forms, in the following sequence:—

E. collina, R.Br., var. striata. (E. striata, R.Br.; E. alpina, var. humilis, Benth.).

E. collina, R.Br., var. alpina. (E. alpina, R.Br.; E. diemenica, Spreng.).

(Type form) var. typica. (E. collina, R.Br.; E. tetragona, R.Br.; E. multicaulis, Benth.).

E. collina, R.Br., var. paludosa.

" " var. speciosa. (E. speciosa, R.Br.).

Further, the size of the flowers tends to increase in cultivated specimens, and the colour is highly variable.

KOCHIA VILLOSA, Lindl., 1848. (Salsolaceae).

Among some stored specimens at the Herbarium, probably derived from the Sonder collection, one was found from A. de Jussieu, dated 1832, E. Nova Hollandia, and named Rhogodia, Billardierii, R.Br., which proves to be the above. Hence this Kochia reached Europe long before it was described by Lindley, and the present is possibly the oldest Herbarium specimen of the plant. The label and specimen are pasted on the sheet, and hence there is no possibility of accidental transference having occurred.

LYONSIA STRAMINEA, R. Br. = L. STRAMINEA (R. Br.). Benth. and Mueller. (Apocynaceae).

In pursuing some interesting archæological but hardly botanical, studies, Britten[1] concludes that the L. reticulata of F. v. Mueller, is the true L. straminea of R.Br., and proposes a new name (L. Brownii) for the plant, supposed to be Brown's L. straminea by Bentham and Mueller. A more confusing and unnecessary addition to synonymy could hardly be proposed, and it is interesting to note on p. 240, that Britten sharply criticises Druce for a similar addition to synonymy based on no more certain grounds. Britten admits that "Brown published no detailed description of the species," but considers that de Candolle's description of L. straminea referred, "at any rate in

1 Journ. of Botany, vol. xlv., 1907, p. 235.

part," to Mueller's reticulata, and that Bauer's figure was named, "doubtless on Brown's authority," L. straminea. Vague assumptions of this kind afford no grounds for troublesome changes of long-standing names. Indeed, a work of this character tends to bring systematic botany into bad odour with workers in other branches, who suffer from such changes, and if there is any difficulty in regard to the specimens at the National Museum, London, surely the proper course is to add explanatory labels to them, as in the above heading. Archæology and botany are separate subjects, and should be kept apart.

Article 50 of the International Rules of Botanical Nomenclature, 1905, says:—"No one is authorised to reject, change or modify a name (or combination of names) because of the existence of an earlier homonym which is universally regarded as non-valid, or for any other motive either contestable or of little import." Hence the names should remain as before, L. Brownii Britten being a synonym for L. straminea (R.Br.), Bentham and Mueller.

MEDICAGO HISPIDA, Gaertn., var. INERMIS, Urb. (Papilionaceae). (Syn. MEDICAGO RETICULATA, Benth.). Determined at Kew Herbarium, England.

Dimboola Shire, F. M. Reader, October 16th, 1898. Geelong and Penshurst (1906), H. B. Williamson.

This Medick was recorded by Mr. Reader in the Victorian Naturalist, vol. 19 (1903), p. 159, as Medicago turbinata, Willd., but M. turbinata is quite a distinct plant from Reader's specimens. It was also known here under the names of M. striata and M. nummularia (M. cretica), but differs from both of these. As no specimens of the above variety were in the National Herbarium, the plants were sent to the Kew Herbarium for verification, and determined as above. It is a naturalized alien from Southern Europe.

OLEARIA HOMOLEPIS, F. v. M., var. PILOSA, new var. (Compositae).

Cowcowing, West Australia. Max Koch, No. 1087 (1904).

The variety differs from the type in having slightly longer peduncles, the flowers sometimes more than three together, the bracts usually somewhat shorter and more pointed. The leaves shorter (about 1cm. long), and the whole plant covered with a more or less well-developed pubescence, the scabrous hairs less developed.

From O. strigosa, Benth., it differs in its twenty or more ray florets, equal pappus and short nonseptata scabrous hairs. It bears some resemblance to O. adenolasia (F. v. M.), but is distinguished by its more numerous ray florets, larger heads, more pointed and usually coloured bracts.

Phymatocarpus. (Myrtaceae).

The leaves of this plant are given as opposite in Bentham's Flora, as in Beaufortia and Regelia. Examination shows that they are all alternate in Phymatocarpus, though closely set in P. porphyrocephalus, the bases are all at different levels, and in P. Maxwellii the internodes between the separate leaves are of some length. This gives an easy mode of distinguishing roughly Phymatocarpus from Beaufortia and Regelia. The only exception to the rule of opposite leaves in the last two genera is in Beaufortia squarrosa. This has mostly opposite leaves, but in some of the shoots the leaves, though closely set, are alternate, the bases being all at different levels. This is probably an instance of partial reversion to the more primitive type.

Podolepis Spenceri, A. J. E. (Compositae).

This plant bears a close external resemblance to P. aristata, Benth., Fl. Aust., III., 605, from which, however, the blunt outer bracts, the less deeply lobed ray florets, and the flowers white or pale instead of yellow distinguish it. Mr. Max Koch, its discoverer, also informs me that P. spenceri is only found in damp places near river flats, whereas P. aristata grows in drier situations.

Pterostylis concinna X P. reflexa, var. intermedia.

A hybrid Orchid.

In all large genera (Salix, Eucalyptus, Acacia, Rubus, Hieracium) the imperfect segregation of certain species may result in the production of hybrids, some of which in time obtain the to the production of hybrids, some of which in time obtain the fixity of species. The same applies to many genera of less extended scope. The present case of the occurrence of a natural hybrid in the genus Pterostylis (Orchidaceae) is, so far as I am aware, only the second instance recorded for that genus in Australia. The plants were found by Mr. J. R. Tovey at Mentone, Victoria, 1907, growing among patches of Pterostylis concinna and of P. reflexa, var. intermedia. Externally they resemble the latter plant, except that the basal rosette of leaves persists in some cases until flowering. The labellum, however, instead of having an entire obtusely-pointed tip, is broader and faintly but distinctly bifid at its extremity, in this respect, being exactly intermediate between the two forms. Some specimens show signs of reversion to one or the other parent. Bentham gives the scape of P. concinna as rarely above 1 inch. It is usually 3 to 5 inches long, and may bear 1, 2, or even 3 bracts, the lower ones always empty. The wings of the column are marked in white, green and purple, but the intensity, especially of the latter coloration, varies. The possibility of hybridisation must be borne in mind in future studies of this genus, and this explanation may apply to some of the species already described. In Fitzgerald's Australian Orchids mention is made of a supposed hybrid between P. curta, R.Br., and P. pedunculata, R.Br.

PULTENAEA STRICTA, Sims. In Bot. Mag., 1588 (1813). (Leguminosae).

Synonyms: P. MAIDENI, F. M. Reader, in Vict. Nat., xxii., 158 (1905); P. LARGIFLORENS, F. v. M., in Benth., Fl. Austr., ii., 134 (1864); P. GUNNII, Benth., in Ann. der Wien. Mus., ii., 82 (1839).

As the result of a close investigation of the numerous forms of these highly variable and closely related "species," it can only be concluded that we are dealing with forms of one large, extremely pleomorphic species. The original description of Pultenaea stricta in the Botanical Magazine, 1813, page 1588, was made from a plant flowering in England, and naturally refers to that specimen only, Sims being unaware of the varied forms assumed by the species in its native habitat.

The following description tallies in all essentials with the original one, but includes the other species mentioned. P. stricta, Sims. An erect spreading or somewhat decumbent shrub of 1 to 3 feet; the slender young branches minutely hoary or more or less silky-pubescent, sometimes somewhat angular and becoming glabrous when old. Leaves varying greatly in shape and size, sometimes on the same plant, from about 3 to 12 mm long, ovate, oblong, cuneate or linear, obtuse or with a small straight or recurved point, nearly flat, but with the margin usually slightly recurved, shining and glabrous above, paler and hairy or silky pubescent beneath, especially when young. Mid-rib prominent, stipules small, narrow or lanceolate, and appressed, the narrower stipules often spreading. Flowers very shortly stalked, usually in small terminal heads of 2 to 8, but sometimes laterally arranged, and then usually axillary. Bracts imbricate, the outer ones small, the inner ones, when present, larger, 3 or 4 mm. long and either entire, bilobed, or with a hairy point between the two apical lobes, varying in these respects in the same head. Bracteoles lanceolate or nearly linear, usually about 3 mm. long, and more or less hairy on the back, inserted on the calyx tube, usually near its base. Calyx about 4 mm., pubescent or silky villous the three lower lobes pointed —lanceolate, about as long as the tube, the two upper lobes broader, usually more or less falcate and united to about the middle. Standard twice as long as the calyx, the wings and keel a little shorter than the standard, the keel deeply coloured, the ovary villous, the style filiform, but slightly thickened towards the base, where a few scattered hairs may be seen. Pod obliquely or almost triangular, ovate, more or less flattened and hairy, or silky, pubescent, usually 4 to 5 mm., long and projecting beyond the calyx.

Variety MAIDENI (PULTENAEA MAIDENI, Reader).

The stipules more lanceolate, the inner bracts usually hairy on the back, as well as the edges and tip, and slightly shorter. The "trifid" or bilobed apex of some of the inner bracts is evidence of their stipular character, and is not peculiar to this variety, which is very close to the type form.

Variety GUNNII (P. GUNNII, Benth.). In Ann. der Wien. Mus., ii., 82 (1839).

This has narrower, usually spreading stipules, the inner large bracts are usually absent, but in all the forms, including the type, the bracts usually fall as flowering advances, and some forms of our Gunnii, have much larger bracts than others. In the typical forms the leaves are usually broader at the base and taper more or less towards a usually pointed apex. In the typical A. stricta the leaves are usually broader near the apex· then suddenly contracting to a distinct point. The difference is more constant on the larger stem leaves.

Variety LARGIFLORENS (P. LARGIFLORENS), F. v. M. In Benth. Fl. Austr., ii., 134 (1864).

The flowers may be either axillary or lateral, or in terminal clusters, the bracteoles are usually inserted higher up on the calyx tube, and the two upper calyx teeth are less or not at all falcate, and the fruits usually smaller.

Variety INCURVATA, new var. Locality, Frankston, Coll. J. W. Audas, 1907.

This has the leaves with hard, minutely-pointed, recurved tips, giving the plant a peculiar harsh feel when drawn through the fingers. In some respects it is intermediate between the variety Maideni and the type form.

Pultenaea retusa, Sm., comes near to some forms of P. stricta, but the calyx teeth are of more equal shape and length, and the calyx is hardly bilabiate. The usually straight upper calyx teeth of variety largiflorens show an approach to this species.

It may seem a bold course to reduce these three well-known species, but the numerous connecting links leave no other course possible, and there is no evidence as to the existence of hybridization between these four species. Variety largiflorens, shows the largest, variety Gunnii a lesser, and variety Maideni the least divergence from the type, but the same reasons that could be urged for their maintenance as distinct species could be used to found at least 12 species out of the numerous connecting forms. It may be taken as a general rule that in all large genera the term "species" should be given as broad a scope as possible, not merely for reasons of practical utility, though these are of value, but because it is precisely in such genera that groups of varieties as yet imperfectly segregated into species are most likely to occur, and by recognising such varieties as species too hastily we render it more difficult for the workers of subsequent centuries to obtain evidence of evolution in such cases. In addition, the synonymy is less likely to become so extensive as at present. Thus it is doubtful whether the genus Pultenæa contains many more than 60 valid species, although over 150 have been recorded, and the same proportion holds for most large genera.

A specimen of P. Williamsoni, Maiden[1] was referred at Kew to a variety of P. stricta. The National Herbarium contains both under P. stricta and P. paleacea specimens examined by Bentham or by Mueller, which come very close to, or practically match specimens of P. Williamsoni. Altogether there can be no doubt that the genus will not be on a satisfactory basis until cultural experiments under varying conditions have been performed with all its supposed species, and the result of such experiments will probably be to give the selected species in the genus a much wider range than they have hitherto enjoyed.

SPOROBOLUS BENTHAMI, Bailey = S. VIRGINICUS, Kunth, var. PALLIDA. (Gramineae). Queensland Flora, p. 1880, Bull. Dept. Agric., Queensland, xiii., p. 16.

The 22 sheets of this variety in the National Herbarium show a far greater range of variation than Bailey's specimen from the type, and yet have no constant character of more than varietal significance. Although the outer glumes are usually about equal, the lower one is occasionally slightly longer than the upper, and sometimes, especially on the basal spikelets, not more than half its length. In this respect, in the more hyaline outer glumes, and in the longer spike the variety shows an approach to S. indicus, R.Br., from which, however, the vegetative habit differs. It is, in fact, possible that cultural experiments might show S. virginicus to be a marsh and maritime form of variety of S. indicus, developed in brackish situations.

1 Vict. Nat., vol. xxii,, p. 6, 1905.

Bailey admits that his S. Benthami, and his var. minor of S. virginicus probably form the var. pallida of S. virginicus, recognised by Bentham, and even a cursory examination of the material at the National Herbarium would have shown that the new species was untenable.

Given as new to New South Wales (L. Cudgellico) by Maiden and Betche, Proc. Linn. Soc. N.S.Wales, 1906, Vol. XXXI., p. 739.

TUNICA PROLIFERA (L.) Scop., var. VELUTINA (T. VELUTINA, Fisch. and Meyer). (Caryophyllaceae).

This naturalized alien was recorded by Mueller as T. velutina in Vict. Nat. X., p. 145, 1893, and by Reader as T. polifera, in Vict. Nat., XX., p. 88, 1903. Both species are given as valid in the Kew Index, and in Boissier's Flora Orientalis. T. velutina differs from T. prolifera mainly in having leaves with smooth edges (instead of minutely toothed), hairy internodes (instead of glabrous), longer leaf-sheaths and smaller seeds. None of these features are constant; hairy specimens may have rough-edged leaves, and some specimens of T. velutina have the lower leaves minutely toothed entirely or in part. The length of the leaf-sheath may vary on one and the same specimen, as may also the size of the seeds. Hence the species must be reduced to a variety of T. prolifera, joined to that species by intervening forms. Most of the Victorian specimens belong to the variety velutina, but some of Mueller's are intermediate in character.

Mount Ararat, Nov., 1883, D. Sullivan; Upper Murray River, C. French, 1886; Clyde Mts., N.S.W., Oct., 1888, W. Bauerlen; Delatite, 1890 and 1891, Rev. R. Thom, Goulbourn River, 1892, W. F. Gates; near Lake Urana, N.S.W., 1894, G. Luehmann, Jnr.; near Seymour, 1902, Mrs. F. M. Reader.

[PROC. ROY. SOC. VICTORIA, 20 (N.S.), PT. II., 1907.]

ART XII.—*On the occurrence of a Marsupium in an Echinoid belonging to the Genus Scutellina.*

BY T. S. HALL, M.A.,

Melbourne University.

[Read 14th November, 1907.]

On a visit to the mouth of the Glenelg River, in the west of Victoria, I collected about twenty-five specimens of Scutellina. They were found in the soft white polyzoal limestone which occupies such a large area of the south-east of South Australia and the south-western borderland of Victoria. The age of this formation is Barwonian, and may be Eocene.

On cleaning them with a dental engine a deep depression was displayed in some examples on the actinal surface, between the peristome and the anterior margin. The size and shape of the pit varies somewhat in different individuals. It is generally so deep that its upper surface is almost, if not quite, in contact with the abactinal surface of the test. The pit is very shallow near the peristone, but deepens as it runs forward. Its front and lateral walls are vertical. A rounded, but distinct median ridge slightly divides the pit into two halves.

Scutellina sp., actinal and abactinal views, profile, and section through marsupium and mouth x 1½.

The only suggestion that I can make as to the function of the pit is that it is a marsupium for the protection of the young.

The only group of Echinoids in which a definite marsupium has been recorded, as far as I am aware, is that of the Spatangoids. In them those forms with sunken petals, such as Hemiaster and Schizaster, the pits in some cases, and perhaps in all, function as brood pouches. In Hemiaster cavernosus, the pits are present in the female, absent in the male, so that they furnish an external sexual character.

Eleven of my specimens have a marsupium, while the remainder are without it. Its presence, then, if we may argue on the analogy of Hemiaster, indicates the female.

In some of the Cidaroids a temporary protection is afforded to the young by the tent-like arrangement of the spines, but there is no pitting in the test, as in the case of Spatangoids, or as in the present specimens. It is consequently of interest to find the permanent marsupium present in a second order of Echinoids, the Clypeasteroida.

The question as to the name of the species is not easy to settle. The amount of specific variation amongst echinoids is considerable, and there is a growing tendency to limit the number of specific forms. F. Jeffrey Bell is one of the most eminent of those who hold this view.[1]

We have already two species of Scutellina described from our Australian older tertiary—namely, S. patella, Tate[2] and S. morgani, Cotteau.[3] Although there are certain details of Cotteau's species that I cannot decipher in specimens from Mount Gambier, the locality of the type, yet I have no doubt that Tate's and Cotteau's species are identical. Tate in his description gives Mount Gambier as one of the localities from which his species was obtained. The species is widely spread, being found in almost all our tertiary limestones.

The question of priority is not easy to settle, for both papers are dated 1891. Professor Tate, many years ago, when acting as editor of the publications of the South Australian Society, told me that the publications for the year always appeared in that year, so that though his present paper was read only in October, it almost certainly appeared in 1891. Cotteau's paper

1 Marine Investigations in South Africa, vol. iii.
2 Trans. Roy. Soc. S. Australia, 1891, p. 279.
3 Mem. Soc. Zool. de France, pt. iv. (1891), pp. 629, 630, pl. 19, figs. 10-14.

appeared in part 4, the final part, of the volume for 1891. Both species are recorded on the same page of the Zoological Record. The fact that S. patella has been familiar to Australian geologists as a manuscript name of Tate's is no argument for its use, but till the question of priority is settled I shall use Tate's name.

The present specimens, with the marsupium, are not, I think, separable, though in most of them the pentagonal outline is decided, and I think they may be regarded as S. patella. I have found one or two specimens from Mount Gambier also showing the marsupium.

[PROC. ROY. SOC. VICTORIA, 20 (N.S.), PT. II., 1907.]

ART. XIII.—*The Coleoptera of King Island, Bass Strait.*

BY ARTHUR M. LEA.

(Communicated by J. A. Kershaw, F.E.S.)

[Read 12th December, 1907.]

In December, 1906, in company with Mr. A. Conlon, of the Tasmanian Department of Agriculture, I spent a few days on King Island, where we stopped in the vicinity of Currie Harbour. Mr. Jas. A. Kershaw, of the National Museum, Melbourne, crossed over to the island with us, but had to proceed some distance away on a search for bones of an extinct emu and of various mammals. Part of Mr. Conlon's, and almost the whole of my time was devoted to collecting; Mr. Kershaw has sent for examination the whole of the Coleoptera obtained by him, and I have seen a few taken by Mr. H. J. Colbourn, by the late Mr. Alexander Morton and by Mr. W. Hickmott, of the island.

Most of the species were taken on low-growing plants, close to the seaside, on tea-tree and melaleuca scrubs and dwarf eucalypti, never more than a mile from the seaside, on the beaches or in sand dunes close thereto. Bark and flower frequenting beetles are consequently sparsely represented, and very few were obtained under logs and stones. The collecting, in fact, was much the same as could be done on the N.W. coast of Tasmania or on the S.E. coast of Victoria.

For the names of 32 species I am indebted to the Rev. T. Blackburn; I am also indebted to him for suggestions as to the generic positions of a few species. To Mr. T. G. Sloane I am indebted for four names, in addition to two others, the descriptions of which are included here.

The "Victorian Naturalist" for January, 1888, contains an account of an outing of the Field Naturalists' Club of Victoria to the island, with an account of the island itself and lists of the plants, birds, beetles, etc. Of the beetles 39 species are recorded, of which, however, 16 are named by the genus only (probably a number of these, and at least Staphylinus and Amycterus, wrongly named). Of the others Chileone deyrollei is almost certainly wrongly recorded from the island; for Creophilus lachrymosus was probably meant Ptomaphila lachrymosa; Clivina clivinoides, Heteronychus interpunctus, Entilus apochilus, Cossonus ephippiger and Graptodera australis appear to be manuscript names only.

The following species recorded from their outing were not seen by me, and should probably be added:—

Histeridae	Saprimus laetus[1]
Scarabaeidae	Trox australasiae.
	Scitala pruinosa.
	Heteronyx dimidiata.
	Bolboceras proboscideus.
Buprestidae	Melobasis superba.
Elateridae	Crepidomenus taeniatus.
Tenebrionidae	Adelium calosomoides.
	Meneristes servulus.
Cerambycidae	Phoracantha recurva.

In addition to the species here recorded, 25 others were examined, most of which, however, were represented by unique or damaged specimens. The total here given can only be regarded as a comparatively small fraction of the whole, as no specimens were obtained from the hilly or forest country. It is probable that the island contains almost as many species as an area of equal size in Tasmania, and probably at least 1000 species are to be obtained on it.

Where I have had specimens of the new species from Australia or Tasmania the additional localities have been given; but for previously described species this was not considered necessary.

Eleven of the names given are manuscript only. Of these there are six[2] by Mr. Blackburn, which will be described shortly in the Transactions of the South Australian Royal Society, and five by myself. Of these two[3] are included in a revision of the Australian and Tasmanian Malacodermidae, which was "read"

1 Given as latus.

2 Cercyon kingensis, Cryptophagus tasmaniensis, Cis leanus, Paropsis acclivis, P. subfasciata, Chp., var. planior, and Arsipoda variegata, Wath., var. kingensis. Since this was written, these names have been published.

3 Metriorrhynchus obscuripennis and Hypattalus exilis.

at the Science Congress in Adelaide (January, 1907); and three[1] are included in a paper entitled "Notes on the Genus 'Lemidia' with Descriptions of new Species"; sent for publication to the Belgian Entomological Society.

CARABIDAE.

1. *Calosoma schrayeri*, Er.

2. *Trigonothops vittipennis*, Sloane, n. sp.

Mr. Sloane's description is as follows:—

"Undersurface, legs, antennae, head, sides of prothorax (widely) and elytra (narrowly), and a median vitta on each elytron yellowish; vertex subinfuscate; apical ventral segments infuscate; femora paler than tibiae and tarsi; disc of prothorax piceous black; elytra black.

"*Head* elongate, narrow (1.65 mm. across eyes), laevigate; neck wide; eyes prominent; orbits small behind eyes; front narrowly convex on each side above base of antenna; these supra-antennal ridges defined on inner side by a slightly oblique preocular impression.

"*Prothorax* lightly transverse (1.7 x 2.15 mm.), widest before middle; disc convex; apex (1.4 mm.) lightly and widely emarginate; anterior angles widely rounded; sides rounded on anterior four-fifths, sinuate posteriorly and meeting base at right angles; base wider than apex (1.8 mm.), a little oblique on each side, lightly rounded in middle; basal angles sharply rectangular; lateral margins wide, widest towards base, hardly narrower near anterior marginal seta, lightly narrowed to apex. *Elytra* much wider than prothorax (5.5 x 3.3 mm.), fully striate; striae narrowly linear, finely subcrenulate; first interstice with a striole at base; ninth decidedly narrower than eighth, seriate punctate, the punctures wide apart in middle. Length, 9.5; breadth, 3.3 mm.

"Allied to T. lineata, Dej., but I have thought it best not to regard it as conspecific with that sp. owing to the following differences from Chaudoir's description of T. lineata (Bull. Mosc. III., 1877, p. 222):—Size larger; prothorax with disc black; prothorax

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1 Lemidia cicatricosa, nigrovaria and simsoni.

not as in T. pacifica, Er., the sides being more widely margined anteriorly and more strongly sinuate posteriorly. The elytral vittae seem the same as in T. lineata, Dej., beginning at the base on the fifth and sixth interstices, but at once leaving the sixth and extending on to the fourth, then over the third at the anterior discal puncture, then continuing towards the apex along the fourth interstice and turning inwards towards the suture rather indistinctly to unite with the marginal border. T. vittipennis differs decidedly from T. plagiata, Germ., by pattern; head longer, narrower, more convex, far less strongly narrowed to neck behind eyes; prothorax more emarginate at apex with anterior angles not absolutely rounded off as in T. plagiata. The close resemblance of T. vittipennis to T. lineata, Dej., and its evident difference from T. plagiata, Germ., has convinced me that the Rev. T. Blackburn was mistaken in his opinion that these two species were in all probability synonymous (c.f. Trans. Roy. Soc., S.A., 1890, p. 82)."

3. *Homethes sericeus*, Er.

Three specimens from the island agree with the description of sericeus, given as a synonym of elegans in Master's catalogue; but I think it should be regarded as a variety, as it differs from typical specimens of elegans in being smaller, with narrower elytra and the fine waved lines on the prothorax less conspicuous.

4. *Sarothrocrepis callida*, Newm.
5. *S. civica*, Newm.
6. *Ectroma benefica*, Newm.
7. *Agonochila binotata*, White.
8. *A. curtula*, Er.
9. *Scopodes boops*, Er.

10. *Scopodes lineatus*, n. sp.

Coppery; in places, especially front of head, shading off to coppery green; elytra with numerous fine coppery brown lines; under surface black with a greenish gloss, legs flavous, the tarsi becoming infuscated towards apex.

Head finely corrugated; with a setose puncture near middle of each eye, and another on each side of clypeus. *Prothorax* angularly dilated near apex; with a long seta at widest part of each side, apex itself widely rounded, each side near base with another seta on a small projection, sides behind rather strongly notched; densely and finely corrugated, and with a distinct median line. *Elytra* suboval, each side near apex slightly incurved; surface shagreened; with three large but shallow foveae on each side near suture, and a few less distinct ones near the sides. Length, 4½-5 mm.

The male differs from the female in being slightly smaller and narrower, more brightly coloured, with larger eyes and basal joints of front tarsi wider.

In size resembling flavipes, but with coppery elytra, on which the foveae are also more distinct; griffithi having metallic elytra has black legs, and is considerably larger; sigillatus is much smaller with less metallic elytra and darker antennae. In Sloane's table[1] it would be placed beside aterrimus and sydneyensis, from both of which its colour will readily distinguish it. The antennae are sometimes slightly infuscated towards the apex. The lines on the elytra (about eight on each) are not always clearly defined, especially towards the sides and apex, they are somewhat similar to those on sigillatus, but are decidely brighter.

11. *Adelotopus politus*, Cast.
12. *Scaraphites insulanus*, Sloane.
13. *Chlaenius australis*, Dej.
14. *Promecoderus bassii*, Cast.

15. *P. cordicollis*, Sloane, n. sp.

Mr. Sloane's description is as follows:—

♂ Robust; head with post-ocular tubercles small; prothorax cordate; elytra oval, faintly striate; ventral segments 3—6 with a deep round foveae on each side; anterior tarsi with four basal joints dilatate and densely spongiose beneath; intermediate tarsi with three basal joints spongiose beneath (first joint more decidedly so than usual, third joint very slightly so); posterior tarsi long, slender; fifth joint elongate, not flattened

1 Proc. Linn. Soc. N. S. Wales, 1903, p. 638.

on upper surface. Nitid, upper surface dark olive green; under surface bronzed black, submetallic; antennae palpi and tarsi reddish.

"*Head* moderate (3.25 mm. across eyes), convex; front with a well-marked, wide foveiform impression on each side just behind clypeal seta. *Prothorax* laevigate, convex (subdepressed along median line), cordate (3.8 x 4.3 mm.); base (2.8 mm.) narrower than apex (3.4mm.); basal angles marked, a little obtuse; border subsinuate just before basal angles, obsolete on middle of base; median line strongly impressed, a wide, shallow, transverse impression at posterior extremity of median line. *Elytra* oval (8.5 x 5.3 mm.), widest behind middle, lightly narrowed to base, widely rounded at apex; humeral angles marked, a little distant from peduncle; striae very faint on disc, obsolete on sides. Legs light; posterior femora narrow.

Length 15, breadth 5.3 mm.

"This fine species is at once differentiated from P. gibbosus Gray, by the round foveiform lateral impressions of the ventral segments. The form of these foveae associates it with Castelnau's species, P. nigricornis, P. striato-punctatus, and P. maritimis, from Victoria, and all unknown to me in nature. From P. maritimis it is evidently distinct, if only by the spongiose tissue of the anterior joints of the tarsi extending on to the outer side of the joints, and of the intermediate tarsi unusually well developed; from P. nigricornis and P. striato-punctatus it seems to differ by its less convex elytra (less convex than in P. gibbosus, not more so, as said by Putzeys of P. nigricornis), antennae reddish, etc."

16. *Hypharpax inornatus*, Germ.
17. *Lecanomerus mastersi*, Macl.
18. *Euthenarus promtus*, Er.
19. *Mecyclothorax ambiguus*, Er.
20. *Amblytetus brevis*, Blackb.

21. *Dystrichothorax placidus*, n. sp.

Piceous-brown; scutellum, margins of prothorax and of elytra, mouth parts and appendages paler.

ad smooth; shallowly foveate at sides, between and in of eyes. Antennae extending to middle coxae. *Prothorax* ; once and one-third as wide as long, apex feebly emarginate, sinuous towards the sides, each hind angle with a long sides rather strongly reflexed, greatest width about middle; finely wrinkled; with a feeble median line; transversely ›ssed near base; each side of base shallowly foveate. *Elytra* , margins narrower than on prothorax and near apex d to a narrow carina that extends backwards for a short ıce; very feebly striate, the striae almost impunctate and pearing before apex. Front *tarsi* with fourth joint somedilated, deeply bilobed and almost white below. Length, · mm.

ıo from Tasmania (Hobart and Mount Wellington).

Blackburn's table this species would be placed beside ıctatus, from which it differs in the elytra being darker the head, and with the third interstice impunctate. In size general appearance it strongly resembles Epelyx lindensis, apart from the front tarsi and unisetose sides of prothorax, it adily distinguished therefrom, by the almost impunctate a. The elytra are always darker than both prothorax and , but in one specimen they are almost black (except for on of the suture and the sides); at a glance they appear to ıite impunctate, and it is only from certain directions that small and shallow punctures can be seen in the striae. On ıpecimen the prothoracic sculpture is very feeble. The Tasan specimens have been described as the unique one from Island appears to be immature.

22. *Notonomus accedens*, Chd.
23. *N. chalybeus*, Dej.
24. *Prosopogmus chalybeipennis*, Chd.
25. *Chlaenioidius prolixus*, Er.
26. *Leptopodus solicitus*, Er.
27. *Simodontus aeneipennis*, Dej.

28. *Tachys semistriatus*, Blackb.

ro specimens appear to belong to this species, but have ›ody darker than in South Australian specimens, the subapical maculae are also scarcely traceable. Tasmanian (and King Island) specimens, however, are frequently so much darker than those from the mainland that no importance can be attached to this.

Dytiscidae.

29. *Bidessus gemellus*, Clark.
30. *Rhantus pulverosus*, Steph.
31. *Hyderodes shuckhardi*, Hope.
32. *Cybister tripunctatus*, Fab.

Hydrophyllidae.

33. *Paracymus pygmaeus*, Macl.
34. *Cercyon flavipes*, Fabr.
35. *C. fossum*, Blackb.
36. *C. kingensis*, Blackb.

Staphylinidae.

37. *Falagria jauveli*, Sol.

38. *Aleochara kershawi*, n. sp.

Black; elytra in part, parts of palpi and of legs of a more or less reddish brown. Sparsely pubescent, the sides with a few longish hairs.

Head coarsely punctate, with a sparsely punctate impression in middle, the impression terminating in a subtrangular impunctate space. Antennae fairly stout, first joint as long as second and third combined, these subequal in length, fourth—tenth strongly transverse. *Prothorax* about once and one-half as wide as long, sides and base strongly rounded; with coarse, irregularly distributed punctures, but forming an irregular line on each side of middle. *Elytra* with rather coarse punctures, becoming smaller posteriorly, and absent from a shining narrow space on each side, and from a small space near the suture and scutellum. *Abdomen* with small and fairly dense punctures, interspersed with larger ones on the apical half of each segment; under surface with sparser punctures of medium size. Length, 5½, to apex of elytra 3; variation in length, 4½-6 mm.

Belongs to section of genus having "Prothorax with two impressed rows of punctures." In appearance fairly close to speculifera, but smaller and narrower, colour of elytra and legs different, impunctate space on each elytron much smaller (on some specimens it might almost be regarded as absent) and the punctures on the abdomen and elytra larger and less numerous. From the description of pelagi it differs in its very different punctures of prothorax and abdomen.

In some specimens the elytra are entirely blackish except at their tips, whilst in others the brownish colour extends over most of their surface; the entire legs are sometimes brown, but the femora are sometimes black, and the tarsi are always pale. The tips of the abdominal segments on the under side are reddish. The antennae are occasionally diluted with red.

39. *A. actae*, Oll.

40. *Quedius pectinatus*, n. sp.

♂ Black; head, prothorax and elytra with a coppery gloss; first and eleventh joints of antennae, palpi, femora (wholly or in part), tarsi, and tips of abdominal segments, more or less reddish or flavous. Head and prothorax glabrous, except for a very few long hairs at the sides; elsewhere densely pubescent; sides and apex of abdomen with long hairs.

Head distinctly longer than wide, or without the neck about as long as wide; upper surface with two setiferous punctures close to each eye, one on each side close to the neck, and another between this and each eye. Antennae extending to base of prothorax, first joint as long as the second and third combined, second slightly shorter than third, the others to the tenth gradually decreasing in length, but none transverse. *Prothorax* strongly rounded at sides and apex; margins with a few setiferous punctures, usually one on each side, about four on base, and about six on apex, disc with two simple punctures.[1] *Elytra* moderately transverse, slightly dilated posteriorly, apex rather strongly incurved to middle; with dense and fine punctures. *Abdomen* with dense and fine punctures, except at the base of

1 On one of the four specimens before me a seta arises from one of these punctures.

each segment. Basal joint of middle *tarsi* stout, blackish, and with a distinct comb of about 20 black teeth. Length, 8½, to apex of elytra 4 mm.

♀ Differs in having the middle tarsi simple and the eighth-tenth joints of antennae somewhat transverse.

The teeth of the comb are quite distinct under an ordinary Coddington lens. From some directions there appear to be faint opalescent tints on the head, prothorax and abdomen. The antennae slightly diminish in colour towards the apex, but only the first and eleventh joints could be regarded as pale, although some of the others are reddish at the extreme base.

Belongs to the long-headed section of the genus, and seems close to the description of aeneus, but base of antennae pale and with four punctures on each side of head; that species is also described as " totus aeneus."

41. *Quedius xylophilus*, n. sp.

Pale castaneous, head and elytra somewhat darker. Head and prothorax glabrous, except for a few long hairs at the sides, elsewhere rather densely pubescent; sides and apex of abdomen with long hairs.

Head, including neck, slightly longer than wide, without the neck, somewhat transverse; upper surface with two setiferous punctures close to each eye, and four near the neck. Antennae extending to base of prothorax, first joint as long as second and third combined, second slightly shorter than third, fifth feebly transverse, sixth-tenth more noticeably so. *Prothorax* with sides and base strongly rounded, with a sparse marginal row and two discal setiferous punctures. *Elytra* subquadrate; with dense fine punctures. *Abdomen* with dense fine punctures, except at the base of the three first segments. Basal joint of middle *tarsus* stout. Length, 5¾, to apex of elytra 2½ mm.

Also from Tasmania (New Norfolk).

A remarkably active species, which occurs in soft rotting timber; although there are but two specimens before me, I saw others, but was unable to catch them. The colour is not due to immaturity. From some directions the second joint of the antennae appears to be slightly longer than the third.

42. *Q. analis*, Macl.
43. *Homalota pavens*, Er.
44. *Leucocraspedum lugens*, Blackb.
45. *Creophilus erythrocephalus*, Fab.
46. *Cafius littoralis*, Fvl.
47. *C. sabulosus*, Fvl.
48. *C. sericeus*, Holme.
49. *Xantholinus phoenicopterus*, Er.
50. *Paederus cingulatus*, Macl.
51. *P. simsoni*, Blackb.
52. *Oxytetus inconstans*, Lea.
53. *O. trisulcicollis*, Lea.

SCYDMAENIDAE.

54. *Scydmaenus kingi*, n. sp.

Reddish castaneus, head and prothorax slightly darker, and legs somewhat paler than elsewhere. Rather sparsely clothed with long, yellowish pubescence, denser on base of head and margins of prothorax than elsewhere; very short on under surface.

Head almost impunctate. Eyes small and very prominent. Antennae passing base of prothorax; first joint slightly longer and stouter than second, the last four forming an elongate and loosely jointed club. Penultimate point of palpi stout, last joint very small. *Prothorax* slightly wider than long, disc flattened, front angles depressed, hind almost rectangular; with a large fovea on each side of base, the space between with distinct punctures; elsewhere almost impunctate. *Elytra* elongate-ovate, at base not much wider than prothorax, rather strongly dilated to near the middle, apex conjointly rounded, with a subfoveate depression on each side of extreme base, and a feeble longitudinal depression on each side of suture at base; with minute scattered punctures. *Femora* clavate, tibiae and tarsi long and thin. Length, 1¼—1½ mm.

Also from Tasmania (Mount Wellington).

The sexes are evidently before me, as on one of the island specimens the fourth segment of the abdomen has two strong notches at its apex, and the front tibiae are notched and hirsute near apex; in the other the front tibiae and abdomen are simple. Closer to parramattensis than any other described species known to me, but larger, more brightly coloured, elytra wider and prothoracic impressions much more pronounced.

SILPHIDAE.

55. *Ptomaphila lachrymosa*, Sch.

TRICHOPTERYGIDAE.

56. *Actinopteryx australis*, Matth.

NITIDULIDAE.

57. *Brachypeplus basalis*, Er.
58. *Haptoncura meyricki*, Blackb.
59. *Cryptarcha elegantior*, Blackb.

TROGOSITIDAE.

60. *Leperina decorata*, Er.

COLYDIIDAE.

61. *Penthelispa fuliginosa*, Er.
62. *P. secuta*, Pasc.

CUCUJIDAE.

63. *Prostomis atkinsoni*, Wath.
64. *P. cornutus*, Wath.
65. *Hyliota australis*, Er.
66. *Cryptamorpha olliffi*, Blackb.
67. *Myrabolia grouvelliana*, Rtr.
68. *M. longicornis*, Blackb.

CRYPTOPHAGIDAE.

69. *Cryptophagus tasmanicus*, Blackb.

LATHRIDIIDAE.

70. *Lathridius apicalis*, Blackb.
71. *L. nigromaculatus*, Blackb.

72. *Corticaria adelaidae*, Blackb.
73. *C. australis*, Blackb.

DERMESTIDAE.

74. *Trogoderma blackburni*, n. sp.

:k, sides of prothorax obscurely diluted with red; elytra 1, with numerous irregular blackish spots; antennae red- out first and last joints infuscate; legs reddish in parts; f abdominal segments reddish. Rather densely clothed greyish pubescence, becoming blackish on the dark parts elytra, and most of the under surface.

b apparently composed of five joints. *Prothorax* about as wide as long; with small and partially concealed punc- *Elytra* parallel sided to near apex, with slightly larger ires than on prothorax. Length, $2\frac{1}{2}$—$3\frac{1}{2}$ mm.

re are two specimens before me, both apparently females. ark spots on the elytra may be regarded as forming four rregular fasciae. To the naked eye, a large, dark, sub- spot on each elytron, appears to be margined behind by tish semicircle of pubescence. The club appears to be sed of five joints, but it is hard to determine whether sal one of these should really be considered as belonging club. The prosternal sulci are apparently subtriangular pe and feeble.

oblong-elliptic species, the general outline of which is like that of rigua, but (apart from colour) the punctures 1 prothorax and elytra are much smaller and sparser than t species. In Mr. Blackburn's[1] table of the genus it would ced in BB, but the colour of its elytra will readily dis- sh it from all the species placed there.

75. *T. froggatti*, Blackb.
76. *T. morio*, Er.
77. *T. rigua*, Er.
78. *Dermestes cadaverinus*, Fab.

BYRRHIDAE.

79. *Microchaetes scoparius*, Er.

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[1] ns. Roy. Soc. South Australia, 1891, p. 129.

Parnidae.

80. *Elmis tasmanicus*, Blackb.

Lucanidae.

81. *Syndesus cornutus*, Fabr.
82. *Ceratognathus niger*, Westw.
83. *Lissotes cancroides*, Westw.
84. *Mastochilus politus*, Burm.

Scarabaeidae.

85. *Onthophagus australis*, Guer.
86. *O. mutatus*, Har.
87. *O. posticus*, Er.
88. *O. pronus*, Er.
89. *Aphodius granarius*, Linn.
90. *Saprosites mendax*, Blackb.
91. *Diphucephala pulchella*, Wath.
92. *D. colaspidoides*, Gyll.
93. *Scitala languida*, Er.
94. *Heteronyx obesus*, Burm.
95. *H. striatipennis*, Blanch.
96. *H. tempestivus*, Er.
97. *Automolus bicolor*, Blackb.
98. *Adoryphorus couloni*, Burm.
99. *Pimelopus porcellus*, Er.
100. *Cheiropiatys moelius*, Er.

Buprestidae.

101. *Stigmodera flavopicta*, Saund.
102. *Melobasis fulgurans*, Thoms.
103. *M. hypocrita*, Er.
104. *M. prisca*, Er.

Elateridae.

105. *Monocrepidius fabrilis*, Er.
106. *Elater granulatipennis*, n. sp.

Black or blackish; antennae (basal joint sometimes infuscate), palpi and legs (femora more or less infuscate) reddish. Rather densely clothed with fine whitish pubescence.

Head convex; densely and rather coarsely punctate. Antennae extending to metasternum. *Prothorax* as long as wide, but apparently slightly longer than wide, strongly convex, sides rounded in front, basal two-thirds subparallel, hind angles moderately produced, median line almost absent, with a wide shallow basal impression on each side; punctures as dense as on head, but rather shallower and smaller. *Scutellum* granulate. *Elytra* (by measurement) about twice and one-half the length of prothorax, gently decreasing in width from near base to apex, apex obtusely pointed; with narrow, apparently impunctate, striae; interstices with small dense rounded granules. *Under* surface with dense punctures, becoming granules on apical segment, and subgranulate on basal segments of abdomen. Length, 8—9½ mm.

A beach frequenting species; also occurs near Sydney.

In general appearance somewhat resembling Acroniopus rugosus, Cand, but with tarsi (except that they are longer) as in Elater perplexus, Cand. On two of the five specimens before me the elytra are piceous brown instead of black.

107. *Melanoxanthus quadriguttatus*, Er.

108. *Cardiophorus humilis*, Cand.

109. *Corymbites suavis*, Cand.

110. *Hapatesus hirtus*, Cand.

The specimens from the island seem to represent a variety of this species, as they differ from typical ones in being smaller, with the clothing denser and longer, and the punctures in the elytral striae more pronounced; they also have the elytra more convex, and the median line of the prothorax more noticeable. I should probably have regarded them as belonging to a distinct species, but that a specimen before me has these differences even more pronounced, and was returned to me by Monsieur Candeze as var. minor of hirtus. One of the specimens was taken under bark, but seven others were taken at the roots of beach growing plants, and on which their larvae probably feed.

111. *Crepidomenus aberrans*, n. sp.

♂ Piceous-red, antennae, scutellum, prosternum and sides of meso- and of metasternum black or blackish; legs obscurely variegated. Rather densely clothed with short, silvery pubescence; on the upper surface variegated with irregular spots of rusty or golden pubescence.

Head densely punctate, with a wide, feeble depression between eyes. Antennae extending to hind coxae. *Prothorax* apparently twice as long as wide, but by actual measurement not once and one-half as long as wide, sides subparallel to near base, hind angles acute and embracing shoulders; median line rather deep and wide in middle, becoming obsolete towards apex and subobsolete towards base; punctures rather smaller and not quite so dense as on head. *Scutellum* subcordate. *Elytra* (by measurement) not thrice the length of prothorax, each semicircularly notched at inner apex; striate-punctate, punctures in striae small, but deep, interstices with moderately dense minute punctures. *Under surface* rather sparsely punctate along middle, but densely at sides; base and apex of prosternum with coarse punctures. *Tarsi* thin, fourth joint narrower than third. Length, 14—18 mm.

♀ Differs in being much wider, both prothorax and elytra less parallel-sided, antennae not passing hind angles of prothorax, and legs shorter.

Also from Tasmania (Frankford).

The long prothorax of the male and the narrow tarsi are at variance with others of the genus, and in fact at a glance the species looks like a Chrosis. The only female before me is somewhat abraded, but all of its clothing appears to be more golden than silvery; whilst on the upper surface it is decidedly golden, with a feeble mottling of sooty.

112. *C. australis*, Boi.

113. *C. decoratus*, Er.

114. *C. fulgidus*, Er.

Dascillidae.

115. *Macrohelodes niger*, n. sp.

Deep black; parts of mouth appendages and of sterna flavous; second and third joints of antennae, knees and parts of tarsi obscurely diluted with red. Upper surface glabrous, lower with fine pubescence, except in middle of metasternum.

Head with dense and fine punctures. Second and third joints of antennae combined shorter than fourth. *Prothorax* with sparse and very small punctures, becoming denser and larger at sides, but even there smaller and sparser than on head. *Elytra* with dense and not very fine punctures, smaller along suture than elsewhere. Length, 8½ mm.

Differs from the descriptions of princeps and lucidus in its entirely black upper surface (including the sides), and almost entirely black antennae and legs; princeps is also said to have the elytral punctures "sparsim," those on the elytra of lucidus are not mentioned, but the species is said to have "cetera ut M. princeps." On the present species the punctures are denser than in tasmanicus, but somewhat smaller; and they are denser than in crassus. On the type both antennae have the three terminal joints missing.

116. *Helodes victoriae*, Blackb.
117. *Cyphon ovensensis*, Blackb.
118. *C. pictus*, Blackb.
119. *C. spilotus*, Blackb.

Malacodermidae.

120. *Trichalus kershawi*, n. sp.

♂ Black; suture and margins of elytra reddish.

Antennae serrate, extending to middle of elytra. *Prothorax* moderately transverse, hind angles acutely produced; with fairly numerous and rather large punctures in front, and a row of somewhat larger punctures behind. *Scutellum* concave, apex gently arcuate. *Elytra* parallel-sided to near apex, with double rows of large transverse punctures; each elytron with three strong costae, except near base, where there are four.

Penultimate segment of *abdomen* feebly notched. Length, 10—13 mm.

♀ Differs in being more robust, with shorter and less strongly serrated antennae and simple abdomen.

The antennae of both sexes are much as in ampliatus; the entirely black prothorax will readily distinguish it from insignis, which otherwise it strongly resembles.

121. *Metriorrhynchus kingensis*, n. sp.

♀ Black, shoulders very feebly diluted with red.

Rostrum very short. Antennae strongly serrated, scarcely extending to basal third of elytra. *Prothorax* triareolate, middle areolet narrowly open in front, rather more widely open behind, middle of apex deeply notched. *Scutellum* concave, apex strongly notched. *Elytra* wide, subparallel to near apex; each with four fairly strong costae, and with double rows of large subquadrate punctures. Length, 12½ mm.

The combination of triareolate prothorax, very short rostrum and double rows of elytral punctures will readily distinguish from all other black species hitherto described. The antennae are much as in the male of atratus.

122. *M. obscuripennis*, Lea (m.s.).
123. *M. rufipennis*, Fab.
124. *Telephorus nobilitatus*, Er.
125. *T. pulchellus*, W. S. Macl.

126. *Heteromastix apiciflavus*, n. sp.

Black, middle of prothorax, tips of elytra, apical half of abdomen, trochanters, and lower parts of mouth flavous. With fine pubescence.

Head with fine punctures. Antennae extending to hind coxae, first joint almost twice the length of second, slightly longer than third, and slightly shorter than eleventh, fourth—tenth very feebly decreasing in length. *Prothorax* almost twice as wide as long, impunctate, with traces of a feeble median line, margins strongly raised and in front slightly incurved. *Elytra* with coarse and dense punctures, becoming smaller posteriorly. Length, 4¾ mm.

Belongs to section having antennae simple in both sexes, and close to discoflavus[1] from which it differs in its entirely dark elytra, except at the tip. The fifth segment of the abdomen is feebly incurved at apex. The lower portion of the basal joint of antennae is diluted with flavous. The flavous part of the prothorax extends across rather more than one-third of the width, and almost touches both base and apex. The type is probably a female.

127. *Hypattalus insularis*, n. sp.

♂ Black, with a bronzy or slightly coppery gloss; parts of three basal joints of antennae, and of prothorax, mouth parts, trochanters and base of tibiae flavous; parts of abdomen obscurely flavous. With fairly dense, pale pubescence, and with blackish hairs or setae.

Head with small, dense punctures, and with several shallow depressions in front. Antennae serrate, extending to hind coxae. *Prothorax* about twice as wide as long; with small, dense punctures. *Elytra* with dense and rather small punctures, becoming smaller posteriorly. *Abdomen* with fourth segment incurved to middle, the fifth deeply cleft, with a process at its base. *Femora* and tibiae simple. Length, $4\frac{1}{2}$ - $5\frac{1}{2}$ mm.

♀ Differs in being larger and wider, with shorter antennae and simple abdomen.

On "Boobyalla" (Myoporum insulare).

Belongs to section of genus having femora simple in both sexes, and very distinct from any other species known to me.

Regarding the prothorax as flavous, it has, in some specimens, a broad, dark band extending across the entire width, and leaving but a narrow pale stripe at the base, and a still narrower one at the apex; in other specimens the band does not quite extend to the sides, and the basal and apical stripes are wider; in others the band is fairly narrow towards the sides, but with a wide extension towards the middle of the base. The elytral punctures, though small, are distinct, and clearly defined, whilst those of the head and prothorax are very much smaller

1 The description of discoflavus is included in my revision of the Malacodermidae, now awaiting publication.

and traceable with difficulty. The abdomen of the male appears to have a heart-shaped opening at its apex, with a flavous, curved, and pointed process at the base of the fifth segment.

128. *H. exilis*, Lea (M.S.).

129. *Helcogaster effeminatus*, n. sp.

♂ Black, elytra with a faint bluish gloss; lower surface of four basal joints of antennae and trochanters more or less flavous. Sides with a few short hairs.

Head with distinct punctures in places; with a rather feeble depression open towards the sides and in front, and with a short ridge in the middle. Antennae serrate, extending past hind coxae. *Prothorax* apparently about as long as wide, with a transverse basal impression, and a very feeble one on each side of apex; impunctate. *Elytra* impunctate, at base as wide as head or slightly wider, feebly dilated posteriorly. *Legs* long and thin; basal joint of front tarsi stout and curved on its inner edge. Length, 3½, to apex of elytra 2½ mm.

The depression on the head, although very shallow for a male, from some directions appears to be fairly deep, its hinder border (excluding the lateral openings) from some directions appears to be feebly trisinuate. The abdomen is so wrinkled in the type that its sculpture cannot be described, but the front tarsi are essentially masculine. Obliquiceps and canaliculatus have the face yellow, incisicollis[1] has the prothorax incised, gagatinus has two frontal fôveae and is otherwise different; all other species with the prothorax black, have the head very differently sculptured.

CLERIDAE.

130. *Opilo sexnotatus*, Westw.

Apteropilo, n. g.

Prothorax without longitudinal and transverse impressions. Elytra obovate. Metasternum short. Apterous. Other characters mostly as in Opilo.

1 Also awaiting publication in my review of Malacodermidae.

In both Blackburn's and Gorham's tables of *Cleridae* this genus would be placed next to Opilo, which I believe to be its correct position. From Opilo it is readily distinguished by its apterous body; the other apterous genera from Australia are Cormodes and Allelidea, from the former it is distinguished by the maxillary palpi, and from the latter by its coarsely granulated and subreniform eyes.

131. *Apteropilo pictipes*, n. sp.

Dark reddish brown; antennae, palpi, coxae, trochanters, tibiae and tarsi paler; femora black on apical third (or two-fifths), almost white elsewhere. Clothed with long, straggling, blackish setae, and in places with shorter and paler setae.

Head rather large; densely covered with rather small but clearly defined punctures, in places becoming almost confluent. Eyes small, subreniform, coarsely faceted. Antennae extending to base of prothorax, club rather loosely triarticulate. *Prothorax* almost as long as wide, strongly convex, apex very feebly incurved to middle, sides gradually increasing in width to beyond the middle (where the width is greater than that across the eyes), then suddenly and strongly lessened to base; punctures much as on head, except that on the disc there are four subtuberculate or cicatrised spots. *Scutellum* concealed. *Elytra* at base the width of head, rather strongly increasing in width to beyond the middle and then strongly rounded; basal third with about eight rows, on each elytron, of large, deep punctures, elsewhere almost or quite impuncate. *Sterna* and lower surface of head with distinct punctures; abdomen with feeble punctures. *Legs* stout and moderately long. Length, 4½ mm.

In one specimen the club is somewhat darker than the rest of the antennae. The third-fifth rows of punctures on the elytra are longer than the others, but terminate before the middle. The three specimens before me were obtained near the beach, one on a plant occasionally wet with spray, the others on a thick-leaved vine which sometimes almost covers its host-plant.

132. *Natalis porcata*, Fab.

133. *Thanasimomorpha bipartita*, Blanch.

134. *Paratillus carus*, Newm.
135. *Lemidia cicatricosa*, Lea (m.s.)
136. *L. nigrovaria*, Lea (m.s.).
137. *L. simsoni*, Lea (m.s.).
138. *L. nitens*, Newm.

CIOIDAE.

139. *Cis leanus*, Blackb.

BOSTRYCHIDAE.

140. *Xylobosca bispinosa*, Macl.

TENEBRIONIDAE.

141. *Caediomorpha heteromera*, King.
142. *Prionotus serricollis*, Hope.

143. *Hyocis cancellata*, n. sp.

Black; muzzle, front margins of prothorax, and appendages reddish. Sparsely clothed with fine whitish or greyish pubescence.

Head with dense but rather indistinct punctures; a depression on each side close to antennary ridge. Antennae about the length of base of prothorax. *Prothorax* strongly transverse, sides strongly rounded, but sinuated at base; with a distinct and almost continuous median line; with dense but small and shallow punctures. *Elytra* with rows of large, round, subapproximate punctures; the interstices convex and narrower than punctures. Length, $2\frac{1}{2}$--$2\frac{3}{4}$ mm.

Also from Victoria (Melbourne) and Tasmania (Kelso).

The colour as described above is that of two specimens from the island, and two from Melbourne, but three others from Melbourne have the suture reddish, whilst another has the entire elytra more or less reddish. In fresh specimens the clothing cn the elytra causes a fine, whitish line to appear on each interstice. From some directions the elytral punctures appear to be subquadrate. The colour of the types is much as in nigra, but the species is larger, the elytra punctures are consideraly larger, and the prothoracic margins are sinuated posteriorly instead of evenly rounded; the pubescence also is sparser. The shape and punctures are much as in bakewelli. It is a beach frequenting species.

144. *Cestrinus trivialis*, Er.

145. *Phaennis fasciculata*, Champ.

146. *Sphargeris physoides*, Pasc.

147. *Achthosus westwoodi*, Pasc., var *insularis*, n. var.

There are ten specimens before me, which, after considerable hesitation, I have regarded as a variety of Westwoodi, rather than as representing a distinct species. They differ from normal specimens of that species in being much larger and wider; the bilobed tubercular elevation on the front of the head much wider and shorter; the punctures on the head more distinct and numerous; the antennae wider and flatter; the legs in places of a brighter red; but in particular by the prothoracic excavation. In shape it is much the same, except that it is larger and with the boundaries more rounded off; but in its middle portion it is densely punctured and without granules; at the sides, however, there are subobsolete granules. In typical specimens there are numerous distinct granules in the excavation, but no punctures. In the variety also there is a feeble median elevation (sometimes almost a carina) at the hind end of the excavation, and there is not a trace of this in typical specimens. The front of the prothorax is also much more strongly trisinuate in the variety. Length, 18—21; width, 7—9 mm.

148. *Saragus infelix*, Pasc.

149. *Promethis angulata*, Er.

150. *Menephilus ruficornis*, Champ., var. *insularis*, n. var.

Six specimens before me appear to represent a variety of this species. They differ from the typical form[1] in having the punctures on the basal half of the head considerably smaller, but I can find no other structural differences. In colour they vary to a certain extent, but so also do specimens of the typical form.

151. *M. colydioides*, Er.

152. *Titaena columbina*, Er.

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1 I have a co-type from Mr. Champion.

Three specimens of this species were taken on the island. They differ from Tasmanian examples in having the punctures of both prothorax and elytra larger and less numerous.

153. *Adelium licinoides*, Kirby.
154. *A. neophytum*, Pasc.
155. *A. tenebrioides*, Er.
156. *Seirotrana elongata*, Er.

CISTELIDAE.

157. *Nocar latus*, Blackb.

PYTHIDAE.

158. *Notosalpingus variipennis*, n. sp.

Of a more or less dark reddish brown, elytra and legs paler, but the former usually darker along suture and sides, and the latter usually with the femora infuscated. Upper surface glabrous.

Head large; densely and rather coarsely punctured, feebly produced in front. Eyes small. Antennae very feebly dilated to apex, extending to base of prothorax. *Prothorax* about as long as wide; sides strongly narrowed to base; base about two-thirds the width of apex; punctures much as on head, but leaving a feeble median line. *Scutellum* minute, strongly transverse. *Elytra* parallel sided to near apex; no wider than widest part of prothorax, with series of rather large punctures in feeble striae, both punctures and striae becoming smaller posteriorly. *Legs* short, femora stout, tarsi very thin. Length, 1½—1¾ mm.

Also from Tasmania (Hobart).

As the terminal joint of the tarsi is as long as the rest combined, and the antennae are non-clavate (at any rate the antennae are almost exactly as in ornatus) and most of the other characters agree with Notosalpingus I have referred the species to that genus despite the much shorter rostral prolongation of the head. From ornatus it differs in being glabrous, smaller and differently coloured, the prothorax with more evenly rounded sides, smoother surface and narrower base; the punctures are also everywhere smaller, and on the elytra more decidedly seriate in arrangement. Two specimens have the elytra entirely pale except for a slight infuscation at the sides; but the suture is usually black or at least very dark; on two specimens this dark marking is widened into a rather feeble cloud beyond the middle. On the darker specimens the elytra appear to have two wide flavous stripes.

MELANDRYIDAE.

159. *Orchesia minuta*, n. sp.

Piceous or piceous brown, with or without a slight coppery gloss; appendages paler, base of antennae and spurs of hind tibiae still paler. Densely clothed with fine pubescence.

Head almost concealed from above; with small and dense punctures. Antennae just passing middle coxae. *Prothorax* at base about twice as wide as long, strongly narrowed to apex, base feebly bisinuate; with small dense punctures, rather finer at apex than at base. *Scutellum* minute, strongly transverse. *Elytra* about five times the length of, and outline continuous with that of prothorax, at base with punctures as on base of prothorax, becoming smaller posteriorly. Spurs of hind *tibiae* almost the length of basal joint of hind tarsi. Length, 2 mm.

Also from Tasmania (Swansea, Hobart and Huon River).

In shape much like austrina, but very much smaller, none of the specimens before me exceeding 2 mm. in length. The specimens from the island are rather less robust than those from Tasmania, but I can detect no other differences.

160. *Scraptia australis*, Champ.

LAGRIIDAE.

161. *Lagria grandis*, Gyll.

ANTHICIDAE.

162. *Anthicus crassipes*, Laf.

Previously recorded from New Holland only, but a widely distributed species. In addition to numerous King Island specimens I have taken others at Sydney and in Tasmania. The male has curiously distorted hind tibiae. The apical maculae of the elytra are never so clearly defined as the basal ones, and occasionally conjoined and even joined to the basal ones. On one specimen the elytra are entirely black, except for a faint trace of red on each shoulder.

163. *A. wollastoni*, King.

MORDELLIDAE.

164. *Mordella brevis*, Lea.

Eight specimens from the island are before me, and in all of them the clothing is more yellowish than white (as in the types); but as in many other species the colour of the clothing similarly varies, I attach no importance to it. The most common form of the elytral pattern is that figured in Trans. Ent. Soc., 1902, plate 2, fig. 33; but the island specimens vary just as do those from W. Australia, especially in regard to the longitudinal basal marking.

165. *M. australis*, Boi.
166. *M. communis*, Wath.
167. *M. graphiptera*, Champ.
168. *M. limbata*, Wath.

OEDEMERIDAE.

169. *Copidita litoralis*, n. sp.

Head (base of upper surface and sides of lower surface black), prothorax (two, four or more black or blackish spots excepted), coxae, femora (tips excepted), lower surface of front tibiae and of three (or four) basal joints of antennae, and parts of palpi flavous; scutellum, meso-, metasternum, abdomen, a spot on each side of prosternum close to coxae, and antennae black; elytra metallic green. Densely clothed (but prothorax almost glabrous), with short, pale pubescence.

Head smooth, with small punctures. Eyes moderately faceted, feebly notched. Antennae extending to abdomen, third joint very slightly longer than fourth and twice the length of second. *Prothorax* longer than wide, widest near apex, apex feebly incurved to middle, impressed near base; with small and irregularly distributed punctures. *Elytra* subparallel to beyond the middle, shoulders feebly inflated; with dense and fine punctures, and each with traces of three very feebly raised lines. *Legs* long, tibial spurs short but distinct. Length, 7½—9 mm.

There are usually four black spots on the prothorax—a fairly large one on each side near the middle of the base (but not on the extreme base), and a much smaller one on each side about one-third from apex; these latter are often reduced in size and occasionally are absent; on an occasional specimen there are also two or three more small spots. Numerous specimens were taken close to the sea beach.

In Blackburn's table of the Australian Oedemeridae this species would be placed in his typical section of the genus Copidita. The claws are slightly swollen at the base as in Kershawi. The eyes are not so coarsely faceted as in punctum, still the facets are much larger than in Ischnomera sublineata.[1]

170. *Pseudolychus haemorrhoidalis*, Fab.

Twelve specimens from the island are before me, three have the typical red tip of the elytra, two have the red tip almost absent, whilst the others have the elytra entirely dark. I have seen no similar specimens as the latter from Tasmania or Australia.

171. *P. marginatus*, Guer.

CURCULIONIDAE.

172. *Prosayleus hopei*, Sch.

173. *Rhadinosomus lacordairei*, Pasc.

174. *Timareta subterranea*, n. sp.

Dark reddish brown, appendages paler. Densely clothed with white scales, usually more or less feebly mottled with brown; with dense, fine, white setae.

Eyes prominent, coarsely faceted, and rather small. Scrobes distinct from above. Antennae extending to base of prothorax, scape about the length of funicle and club combined, first joint of funicle slightly longer than second. *Prothorax* moderately

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1 There is considerable difference in the size of the facets of sublineata and atkinsoni, and according to the table these would cause the species to be generically separated.

transverse, sides regularly rounded, median line feeble; with dense, rather small punctures; and small, irregular flattened granules. *Elytra* ovate, conjointly arcuate at base; striate—punctate, punctures rather large, becoming smaller posteriorly; interstices gently convex, regular and distinctly wider than striae. *Under surface* with dense, rather small and partially concealed punctures. Abdomen with basal segment slightly concave in male, slightly convex in female. *Femora* stout; tibiae suddenly inflated at apex; claw joint long. Length, 4—5 mm.

The sculpture is described from abraded specimens, as the clothing is so dense as to entirely conceal the derm of the prothorax, and to cause the elytra to appear feebly striate—punctate, or even feebly striated only. The scales are sometimes entirely white, but they are usually mottled with very feeble brown or smoky spots on the elytra, and on the prothorax with feeble stripes. From some directions the first joint of funicle appears to be slightly shorter than the second. The granules of the prothorax are variable, as on complete abrasion of two specimens they are seen to be fairly dense and regular on one specimen, and entirely absent from some parts of the other; on another specimen they can just be traced, but the punctures are always distinct though small. The males are usually smaller than the females, and are slightly narrower, but the sexual differences are not very pronounced. In appearance it is close to some of the varities of crinita, but is rather more robust (the male is fully as wide as the female of that species), the setae on the prothorax and elytra decidedly finer and more numerous, and the abdominal punctures smaller.

Numerous specimens were obtained amongst the roots of beach-growing plants.

175. *Mandalotus caviventris*, n. sp.

Black; antennae, tarsi, knees and parts of tibiae more or less reddish. Densely clothed with greyish—white scales, occasionally feebly spotted with pale brown; and with fairly dense thin setae.

Head with small partially concealed granules between eyes; base finely corrugated. Rostrum with granules as on head;

with a thin and continuous median carina. Scape the length of funicle and club combined; first joint of funicle once and one-half the length of second. *Prothorax* about once and one-third as wide as long; with dense and more or less flattened granules. *Elytra* not much wider than prothorax, parallel-sided to near the middle, thence regularly decreasing in width to apex; striate—punctate, punctures partially concealed, interstices wide, with numerous small seta-bearing granules. Front *coxae* widely separated. Intercoxal process of mesosternum simple. Metasternum transversely corrugated. Abdomen indistinctly wrinkled; with dense, minute and subobsolete granules. *Femora* stout, tibiae bisinuate beneath. Length, 5¼—8 mm.

The male differs from the female in being smaller and narrower, with thicker antennae and femora, and with a large excavation common to the two basal segments of abdomen; these being gently convex in female.

The claw joint from its base is as long as the three basal joints combined. Each seta, except some on the appendages, arises from a granule. One specimen has the legs entirely of a dull red.

In general appearance much like many species of Polyphrades, but the tarsi are not soldered together at the base. The setae and granules of the prothorax are much as in seticollis, and the abdomen and legs, etc., are much the same; but the prothorax, although without scales in the middle, is densely clothed on the sides; and the elytral granules, although small, are quite conspicuous.

176. *M. arciferus*, Lea.

177. *M. crudus*, Erichs.

178. *M. ventralis*, Blackb.

179. *Leptops tribulus*, Fabr.

180. *Perperus costirostris*, n. sp.

Black, antennae tarsi and ocular lobes obscurely diluted with red. Densely clothed with small white scales, and with numerous more or less decumbent whitish setae.

Head with small dense punctures and with a few larger (but still small) ones scattered about. Rostrum with a narrow acute costa, commencing between the eyes and terminating at the apex in the form of a narrow triangle, apical half of sides flattened, glabrous and with sparser punctures than elsewhere. Scrobes deep and curved about antennae, but disappearing half-way between them and eyes. With feeble sublateral sulci. Antennae short; first joint of funicle distinctly longer than second, second longer than third, fourth-sixth sub-globular, seventh feebly transverse. *Prothorax* transverse, convex, sides evenly rounded except at almost extreme base and apex, usually with a feeble median impunctate line; punctures as on head. *Scutellum* small but distinct. *Elytra* elongate—subcordate, conjointly arcuate at base, with rows of fairly large but usually concealed punctures; interstices gently convex, the alternate ones very feebly raised, with dense and very small punctures. *Under surface* with small and dense punctures. *Legs* rather long; front tibiae denticulate below. Length (excluding rostrum), 8½—10½ mm.

The male differs from the female in being smaller, with narrower and more parallel-sided elytra and longer legs.

The acutely carinated rostrum and first joint of funicle decidedly longer than the second readily distinguish from most previously described species of *Perperus;* the sides of the rostrum in front are reminiscent of *Rhinaria.* In some specimens (usually females) the derm is entirely of a dark reddish brown. The scales are so readily abraded that the disc of the prothorax usually appears to be glabrous, and on the elytra large irregular patches are frequently denuded; on the elytra the scales frequently have a golden gloss; on them also they are everywhere dense, but they are rather denser on the odd than the even interstices. On the upper surface the scales are more numerous than the setae, but the reverse is the case on the under surface and legs. The hind femora are usually feebly ringed, and traces of still more feeble rings can sometimes be seen on the others.

181. *Perperus conloni*, n. sp.

Black, appendages and ocular lobes more or less red. Densely clothed with small, rounded scales, varying on individuals from fawn-coloured to muddy brown, and occasionally with a faint golden gloss; with spots or patches of white or whitish scales; with fairly dense adpressed setae.

Head with dense concealed punctures. Rostrum noncostate; with dense punctures tending to become confluent, but more or less concealed. Scrobes deep near antennae, but very short. Without sublateral sulci. Antennae rather long and thin; second joint of funicle almost twice the length of third, and considerably longer than first, none of the others transverse. *Prothorax* about once and one-third as wide as long, sides rounded, with greatest width slightly behind the middle; with dense more or less concealed punctures; and usually with traces of a very feeble median line. *Elytra* cordate, base gently and conjointly arcuate; with series of rather large but partially concealed punctures; interstices gently and regularly convex, and with minute concealed punctures. *Under surface* with dense concealed punctures. *Legs* rather long; front tibiae very feebly denticulate below. Length, $5\frac{3}{4}$—$9\frac{1}{2}$ mm.

The male differs from the female in being smaller, with less rounded elytra, narrower prothorax, longer and stouter antennae, longer legs and wider tarsi.

The derm in some females is dark brown. The femora are usually, but not always, darker than the rest of the legs. The whitish scales usually margin the eyes, form a twice interrupted stripe on each side of the prothorax, and a very irregular stripe on each side of the elytra. On the elytra they often form small scattered spots about the seriate punctures, and occasionally a small cluster of spots about the summit of the posterior declivity. The femora are usually feebly ringed. The paler scales are sometimes tinged with blue, and are sometimes golden when situated amongst very dark ones. On an occasional specimen almost the whole of the scales and setae are of a dingy white, with silvery scales taking the place of the white scales on normal specimens. Many of the prothoracic punctures appear to be in the centre of small granules. The scutellum is very small, and is concealed when the prothorax is closely applied to the elytra. The apex of the elytra is slightly produced, especially in the females.

Distinguished from *insularis* by the second joint of funicle being half as long again as the first, instead of but one-fourth longer, it is also less convex, larger, with the lateral whitish markings different; in *insularis* the seventh elytral interstice is clothed with white scales from the base almost to the apex; in the present species the white stripe is often partly on the sixth and fifth, and even on the eighth.

182. *Gonipterus exaratus*, Fhs.

183. *Atelicus atrophus*, Pasc.

Kershawcis, n. g.

Head rather long. Eyes briefly oval. Rostrum short and curved; scrobes curved in front, behind antennae suddenly directed obliquely downwards, and meeting on lower surface at junction of head and rostrum. Antennae rather stout, scape much shorter than funicle. Prothorax subcylindrical. Scutellum small and rounded. Elytra subcylindrical. Metasternum long. Abdomen long, first segment longer than second, all sutures distinct. Legs short; front coxae touching; femora stout and curved; tibiae very short, curved, denticulate below; tarsi wide, third joint subcordate, claw joint scarcely projecting beyond lobes of third; claws feeble and close together. Winged.

The third joint of the tarsi is pad-like as in Strongylorrhinus, but the claw joint scarcely projects beyond it, and the claws hang closely together instead of diverging widely as in that genus. The shape of the scrobes will readily distinguish the genus from all other Australian genera of the Diabathrariides, to which subfamily it evidently belongs.

184. *Kershawcis cylindricus*, n. sp.

Densely clothed with brownish scales, in places having a faint coppery gloss, and variegated in places with paler and darker scales; with stout pale setae in punctures.

Head with dense, small, concealed punctures, and with some scattered larger ones, slightly traceable before abrasion. Rostrum about as long as head, with a deep median groove; punctures as on head. Scape rather suddenly curved and in flated at apex; first joint of funicle stouter than, but subequal in length with second, third feebly transverse, fourth—seventh more—noticeably so; club the length of five preceding joints.

Prothorax longer than wide, base very little wider than apex, surface somewhat uneven and with large, round, deep, partially concealed punctures. *Elytra* parallel sided to near apex, about one-third wider than prothorax and about four times its length, each separately and strongly rounded at base; with rows of large, round, deep, partially concealed punctures, becoming smaller posteriorly; third and fifth interstices distinctly raised, especially the third near (but not at) the base. *Abdomen* depressed along middle of two basal segments, the others flat. Length (including rostrum), 10—12 mm.

Also from Victoria.

The derm is everywhere concealed, but varies in places from reddish brown to black. The clothing is paler on the under surface (both of the body and legs) than on the upper. On the prothorax to the naked eye there appear three pale continuous longitudinal stripes, but these are obscured under a lens. There is a short whitish stripe on each elytron, commencing near the side at about one-fourth from the base, and extending obliquely hindwards to the suture before its middle, but not reaching it; both in front of and behind these stripes there are irregular patches of darker (sometimes black) scales; the posterior declivity has feeble traces of pale spots or stripes. The scutellar scales are uniformly pale. There is a very faint remnant of an ocular lobe on each side of the prothorax, but these remnants are not ciliated. The base of the prothorax at a glance appears to be rather strongly bisinuated, but this appearance is almost entirely due to the elytra. The teeth of the tibiae are almost concealed by clothing.

184A. *Rhinaria transversa*, Boi.

185. *Lixus tasmanicus*, *Germ.*

A specimen from the island and two from Tasmania agree well with two from South Australia (the original locality), which appear to belong to this species; but the prothorax in all is closely covered with large punctures, not "dispersim punctatus" as in the original description. It is probable, however, that Germar's specimens were so densely covered with the mealy exudation given off by the beetles of this genus that many of the punctures were concealed.

186. *Orthorhinus klugii*, Boh.
187. *O. lepidotus*, Er.
188. *Rhaciodes bicaudatus*, Boi.
189. *R. granulifer*, Chev.

190. *Eristus pallidus*, n. sp.

Reddish-flavous, metasternum and basal segment of abdomen sometimes somewhat darker. Clothed with fairly stout, whitish pubescence, denser at base of prothorax and sides of metasternum than elsewhere, on the elytra more or less seriate in arrangement.

Head with numerous punctures on lower portion of forehead. Rostrum wide, flattened, feebly curved; in male about once and one-half as long as wide, in female about once and two-thirds; with numerous more or less concealed punctures on basal portion but sparse elsewhere. *Prothorax* moderately transverse, apex narrower than base, sides rather strongly rounded; with numerous punctures, but which are concealed towards base and sides. *Elytra* suboblong, considerably wider than prothorax, parallel-sided to near apex; with series of large punctures in rather feeble striae; interstices feebly convex, each with a row of small punctures. *Under surface* with rather small but distinct punctures. Abdomen with third and fourth segments feebly curved throughout. *Legs* rather stout. Length (excluding rostrum), 2 mm.

Smaller and very differently coloured to the two species (setosus and bicolor) hitherto described; but there are several closely allied undescribed species.

191. *Cyttalia sydneyensis*, Blackb.
192. *Misophrice oblonga*, Blackb.

193. *Eniopea subcaerulea*, n. sp.

Black; rostrum and appendages (parts of tarsi infuscate) reddish; elytra usually reddish, but frequently the sides and the suture near base stained with black; prothorax also often reddish, Moderately densely clothed with short stout pubescence (scarcely scales, except on the under surface), varying from white (usually with a bluish or greenish tinge) to brown.

Rostrum longer than prothorax in both sexes, but longer in female than in male; with thin carinae to insertion of antennae in male, for a shorter distance in female. *Prothorax* apparently as long as wide, sides strongly rounded, apex about two-thirds the width of base; with dense, concealed punctures. *Elytra* conjointly incurved at base; striate-punctate, striae feeble, punctures fairly large, but more or less concealed; third interstice with a small fascicle about summit of posterior declivity. Length, 2—2½ mm.

Also occurs in Tasmania (Huon River and Bruni Island)

The head and base of rostrum are moderately clothed, but there is a very decided white spot between the eyes. The prothorax has mostly whitish clothing, but with darker pubescence causing a faint (sometimes more distinct, however), stripe on each side of a thin white median line. On the elytra the clothing has a faintly mottled appearance, and frequently appears to have three feeble, transverse, infuscate fasciae—one before, one at, and one below summit of posterior declivity; often, however, these fasciae are represented by four spots, so placed as to form the angles of a square. Two of these spots are always the fascicles on the third interstices; the fascicles sometimes being very distinct on account of their colour.

In size and general appearance close to tenebricosa, and the description of amoena, but differs in the elytra being reddish, the femora (in 17 specimens before me) not infuscated in the middle, and the clothing (especially of the under surface) more or less greenish or bluish. From posticalis and sydneyensis it differs in having the rostrum larger and the clothing very different.

Elleschodes.

This is the only described Australian genus of the Tychiides having dentate femora. There are before me numerous species which agree too closely with its generic diagnosis for me to regard them as belonging to any other genus. But in general appearance they are very different to the only species[1] yet referred to it. For the present, therefore, I refer the following

1 Hamiltoni, for a specimen of which I am indebted to the Rev. T. Blackburn.

species to that genus, but it differs from Hamiltoni (apart from colour and clothing) in being narrower, in having the rostrum longer and more curved, the base of the prothorax bisinuate (it is practically truncate in Hamiltoni), the femoral teeth larger and tibiae less inflated at apex.

194. *Elleschodes eucalypti*, n. sp.

Reddish; under-surface and three spots or patches on the elytra black. Rather densely clothed with setae or stout pubescence, varying from white to ochreous or golden.

Head with partially concealed punctures. Rostrum rather thin, strongly curved, parallel sided; with rows of punctures causing an appearance as of fine costae; in male scarcely, in female noticeably longer than prothorax. Antennae thin; scape inserted two-fifths from apex of rostrum in female, one-third in male, slightly longer than funicle; funicle with first joint stouter than and the length of two following joints combined. *Prothorax* about once and one-third as wide as long; with a faint median carina or impunctate line; base bisinuate and about one-third wider than apex. *Scutellum* small, rounded, with distinct punctures. *Elytra* elongate-cordate, base not much wider than prothorax, sides parallel to near apex; with rows of fairly large punctures, separated by fine transverse lines; interstices scarcely convex, themselves with fairly dense punctures. *Under surface* with fairly dense but partially concealed punctures. *Femora* stout, acutely and rather strongly dentate. Length (excluding rostrum), 2—2⅔ mm.

Common on the foliage of young eucalypts. Also occurs in Tasmania (Frankford, Hobart, Huon River, Ulverstone, Mount Wellington, Burnie), Victoria (Emerald, Somerville) and New South Wales (Forest Reefs, Armidale, National Park).

The suture near the middle is black, and each side of the elytra from near the base to about the middle is black; the black rapidly diminishes in width, and terminates at about the sixth interstice, but occasionally it is advanced to the fourth interstice, and even sometimes to the suture; so that on such specimens there appears to be a broad, zigzag fascia; the sutural marking may be confined to the suture itself, or extended to the second or third interstice. Occasionally the sutural marking is entirely absent, and the lateral marking confined to the outer interstice. The scutellum, although apparently never black, is often darker than the elytra. The apical segment of the abdomen is frequently reddish.

The ochreous clothing of the prothorax is confined to the sides (where it is directed towards the middle) and a spot at the middle of the base, the derm elsewhere being apparently glabrous; but really with sparse clothing of similar colour to the derm. On the elytra the clothing of the suture at the base is nearly always white, and there is usually a distinct T of white or pale clothing towards the apex, of which the cross piece is about the summit of the posterior declivity, and extends to the fourth interstice on each side; at the junction of the fourth and sixth interstices there is also a pale spot, but these are occasionally joined to the head of the T and of the apex. There is usually a pale spot on the fourth interstice at its basal third; elsewhere the clothing more or less approximates in colour to the derm. On the under-surface the clothing is shorter and more or less white. The head is densely clothed between the eyes.

195. *Belus rubicundus*, Lea.

In this species the tibiae have a finely granulated external ridge. The apex of the elytra appears to be subject to variation, as in some specimens it is more produced than in others; but in all before me the sides at the apex are flattened, and the suture raised, the convex space between being, as it were, divided off by two impressed lines. In some specimens, usually males, the head and rostrum behind antennae are almost or quite black, and all the tarsi are subject to infuscation. In some specimens a faint line of pale hairs can be traced in the median prothoracic line.

The species was described from Western Australia, but occurs also in King Island, Victoria and Tasmania.

196. *Pachyura dermestiventris*, Boi.

197. *Auletes pallipes*, Lea, var. *kingi*, n. var.

A specimen from the island, and two others from Tasmania, differ from the type of pallipes in having the punctures of the head smaller, and those of the elytra smaller and less uniform; the suture is more distinctly infuscate (in the type it is just perceptibly darker than its surroundings) and the second joint of the antennae is certainly shorter than the first.

On examining the type I find that from some directions the second joint of the antennae appears to be really slightly longer than the first, but from other directions it appears to be slightly shorter, nor can I satisfy myself whether it is longer, shorter, or of equal length. Its claws are black (as are also those of the variety), and the base of its rostrum is longitudinally impressed (also as in the variety).

198. *Auletes calceatus*, Pasc., var. *insularis*, n. var.

Two specimens from the island represent a variety of this species, which[1] is readily distinguished by a circular fringe of whitish hairs near the scutellum. The variety differs from the typical form by having an infuscate prothoracic fascia, the femora entirely pale, and the tip only of the antennae infuscate. In one specimen the apical half of the abdomen is pallid. The punctures are as coarse as in typical specimens.

A specimen from Tasmania has a feeble infuscate spot only on the prothorax and the fringe of whitish hairs rather feeble.

All three specimens have the apical two-fifths of the rostrum (but not the extreme apex) of a rather bright red, the red and black parts being sharply limited.

199. *Magdalis rufimanus*, n. sp.

♂ Black, antennae and tarsi red. Upper surface with irregularly distributed and usually sparse pubescence; under with rather sparse whitish pubescence.

Head with dense but sometimes concealed punctures. Eyes very large and feebly separated. Rostrum stout, not half the length of prothorax; with dense punctures and a shallow median groove (both sometimes concealed). Antennae stout, scape shorter than club. *Prothorax* subquadrate, apex narrower than base, the latter feebly bisinuate, depressed and feebly subcarinated along middle; densely punctate. *Elytra* subcylindrical; punctate-striate; interstices with numerous

1 As noted in P.L.S N.S.W., 1898, p. 625.

small granules. *Under surface* densely punctate. *Femora* stout and acutely dentate, third tarsal joint wide. Length (excluding rostrum), 2½—4½ mm.

♀ Differs in having the eyes smaller and not so close together; the rostrum more than half the length of prothorax, moderately curved, shining, not grooved, and with smaller and never concealed punctures; the antennae, especially the scape, are also much thinner.

Also from Tasmania (Ulverstone, Hobart, Mount Wellington and Stonor), and New South Wales (Forest Reefs, Sydney, and Armidale).

Despite the great variation in clothing and size, I believe all the specimens before me belong to but one species. On many specimens the pubescence of the upper surface is confined to the angles of the prothorax, and the space between the eyes, with a little at the base of the elytra, and a little beyond their middle; it is golden as a rule, but sometimes whitish. On many others, however, the head behind the eyes and the rostrum behind the antennae are fairly densely clothed as well, and the pubescence extends over most of the prothorax (generally with such specimens most of it being reddish) with linear spots (frequently placed in two irregularly transverse series) on the middle third of the elytra. On some large specimens in addition to the two irregular transverse series of spots, the suture and base of elytra have reddish (or whitish) pubescence and similar pubescence is scattered about on most of the interstices. The club is sometimes black or infuscate, and occasionally the scape as well. On one of the King Island specimens the knees and tibiae as well as the tarsi are red, and the elytral pubescence is fairly dense and mostly red, but with two pale conjoined ellipses about the middle. On some of the largest specimens the prothorax has a distinct but very narrow carina, on most of the others the median line appears to be more or less cicatrised. The scape of the male is fully twice as thick as that of the female.

200. *Laemosaccus querulus*, Pasc.

201. *Haplonyx nigrirostris*, Chev.

202. *H. kirbyi*, Fbs.

Brachyporopterus, n. g.

Head of moderate size, partially concealed ; forehead sinuous. *Eyes* ovate, widely separated, moderately faceted. *Rostrum* moderately long and moderately curved, a shallow groove on each side above scrobe. *Antennae* moderately thin or rather stout; scape inserted nearer apex than base of rostrum, shorter than funicle; two basal joints of the latter elongate; club ovate. *Prothorax* transverse, sides rounded; ocular lobes obtuse. *Scutellum* absent. *Elytra* subovate. *Pectoral canal* rather narrow and deep. terminated between intermediate coxae. *Mesosternal receptacle* scarcely raised, walls equal throughout, emargination V-shaped; slightly cavernous. *Metasternum* very short; episterna not traceable. *Abdomen* rather large, sutures distinct; two basal segments large; first as long as second and third combined, suture incurved at apex, intercoxal process of moderate width; third and fourth combined, slightly shorter than second or fifth. *Legs* not very long; posterior coxae not touching elytra; femora slightly thickened, not grooved, edentate, posterior not extending to apex of elytra; tibiae scarcely compressed, bisinuate beneath; tarsi rather short and sparsely clothed; third joint wide and deeply bilobed, fourth elongate. Elliptic, strongly convex, squamose, tuberculate, apterous.

The very short metasternum and sinuated forehead are sufficient to denote that the genus belongs to the Poropterus group, and although the short deep form is at variance with Poropterus itself, it would probably have been referred to as an aberrant species of that genus had I not a species[1] in which its special features are still more pronounced. From Poropterus the scarcely raised mesosternal receptacle, shaped much like the half of a ring instead of strongly elevated will readily distinguish it; the claw joint is also longer than in Poropterus, and the claws are less separated.

203. *Brachyporopterus apicigriseus*, n. sp.

Black, antennae, tarsi and tibial hooks dull red. Densely clothed with dark muddy brown scales, in places variegated with grey.

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1 Verniculatus, awaiting description in my revision of the Australian Cryptorhynchides.

Head at extreme base with dense and not concealed punctures, these concealed elsewhere. Rostrum rather stout, shorter than prothorax, sides feebly incurved to middle: with dense punctures, concealed on basal third in female, on basal two-thirds in male. Antennae moderately stout; scape inserted two-fifths from apex of rostrum, the length of five following joints; first joint of funicle stouter and somewhat longer than second. *Prothorax* convex, not much wider than long, base almost truncate, sides strongly rounded, apical third strongly diminishing in width, with feeble tubercular elevations across the middle; with a short feeble concealed median carina. *Elytra* not twice the length of prothorax, and a very little wider, about once and one-half the length of greatest depth; with rows of large, round but partially concealed (less so on sides than on disc) punctures or foveae, somewhat interrupted by interstices; these usually narrower than punctures but subtuberculate in places; a small shining granule on each side of suture at base; apex trisinuate. Punctures of *under surface* entirely concealed, but second segment of abdomen shallowly transversely impressed. *Legs* rather short and stout, fourth joint distinctly longer than first, claws feebly separated. Length, 5—6½ mm.

The male has the rostrum shorter and stouter than in the female, clothed to a greater extent, and with the antennae inserted rather nearer the apex.

On the elytra the posterior declivity has the scales more grey than brown, and at the basal third there are also some obscure greyish spots; there is usually an obscure pale stripe along the middle of the prothorax and a similar one on the abdomen. There are also obscure greyish rings on the legs. In addition to the ordinary scales there are some stouter setose ones, rather more numerous on the abdomen and legs than elsewhere, but causing a fasciculate appearance on the prothoracic and elytral tubercular elevations. The elevations on the prothorax are very obtuse, and appear to be placed in two or three feeble transverse series, but the individual tubercles themselves are often obliquely placed. On each elytron there is a larger (but still obtuse) tubercle than elsewhere on the third interstice, and a somewhat smaller one on the fifth, forming (on both elytra) a transverse series of four at the summit of the posterior declivity; this is rather abrupt and thickly studded with small tubercles, the largest of which are almost apical; there are other obtuse tubercles on the third, fifth and seventh interstices. Most of the specimens before me are encrusted with mud.

204. *Poropterus rubeter*, Erichs. (*Acalles rubetra*, Erichs).

Referred by Erichson to Acalles,[1] but belongs to the group of Poropterus represented by such species as exitiosus and bisignatus; although in its deeply sulcate basal segments of abdomen[2] it is unique in the genus. There is usually a small shining tubercle on each side of the scutellar region, and the elytra when abraded appear to be vermiculate-tuberculate. The derm obliquely behind the shoulders is occasionally diluted with red. The two spots on each side of the head and the four luteous spots placed transversely on the prothorax are usually indistinct; and the median line is so faint as to be practically invisible. The apex of the prothorax appears to be feebly bifid, but this is due almost solely to the clothing.

The male has the rostrum stouter than in the female, with denser and coarser punctures, and has scales almost to the antennae instead of at the base only.

Specimens are to be taken under logs, or crawling over them at night time. I have specimens from Frankford, Ulverstone, Wilmot and Stanley in Tasmania, as well as from King Island, and have seen the type.

205. *P. conifer*, Boh.

206. *P. succisus*, Er.

207. *Microporopterus tumulosus*, Pasc.

Roptoperus, n. g.

Head moderately large, not concealed. *Eyes* ovate, widely separated, coarsely faceted. *Rostrum* rather short and wide, feebly curved. Antennae moderately stout; scape inserted closer to base than apex of rostrum and much shorter than funicle; two basal joints of funicle elongate; club ovate, much wider than funicle. *Prothorax* slightly longer than wide, or

1. Pascoe thought it belonged to Paleticus.
2. A character overlooked by Erichson, but commented upon by Blackburn.

slightly wider than long, base bisinuate, constriction feeble, ocular lobes subobtuse. *Scutellum* not traceable. *Elytra* elongate-ovate, considerably wider than and about twice the length of prothorax. *Pectoral canal* deep and wide, terminated between front part of middle coxae. *Mesosternal receptacle* feebly raised in front, about once and one-half as wide as long, emargination semicircular; cavernous. *Metasternum* moderately long but much shorter than the following segment; episterna narrow, but distinct throughout. *Abdomen* large, sutures distinct and deep except that between first and second segments; first as long as second and third combined, intercoxal process wide; third and fourth narrow, but with deep and wide sutures, the distance between second and fifth equal in length to that of either. *Legs* of moderate length; femora stout, not grooved, edentate, posterior terminated before apex of abdomen; tibiae feebly compressed and feebly bisinuate beneath, in addition to the terminal hook with a small subapical tooth; tarsi shining, thin but not very long, third joint feebly bilobed and very little wider than second, fourth elongate. *Elliptic*, moderately convex, squamose, fasciculate, apterous.

This genus appears to be intermediate in position between the Chaetectetorus and Poropterus groups, but it may be placed with the latter on account of the head being depressed at the base in all the species,[1] and on account of the narrow glabrous tarsi—so suggestive of affinity with Methidrysis. The suture between the first and second abdominal segments is deep and distinct at the sides, but (unless the clothing be removed) not traceable across the middle.

208. *Roptoperus tasmaniensis*, n. sp.

Dark brown, antennae and tarsi of a rather pale red. Very densely clothed with rather dingy fawn coloured scales; with stouter scales rather thickly scattered about and forming ten fascicles on the prothorax and about twenty on the elytra; femora and tibiae with indistinct pale rings and with rather numerous elongate scales.

Head slightly convex, base depressed; punctures concealed. Rostrum the length of prothorax, slightly longer in female than

1. Two others are known to me in addition to the one described below.

in male; basal third with coarse concealed punctures, apical two-thirds polished and lightly punctate. Funicle with the first joint slightly longer than second, the others about as long as wide. *Prothorax* slightly longer than wide, obcordate; with dense round concealed punctures; very feebly elevated beneath fascicles. *Elytra* about once and one-third the width of and fully twice the length of prothorax; with series of large, but almost entirely concealed punctures, subtuberculate beneath fascicles. *Abdomen* with dense and minute punctures; the two basal segments with moderately large round ones (two rows of similar punctures on the metasternum); third and fourth each with a row of rather small ones; all punctures entirely concealed, but the larger ones seta-bearing. Posterior *femora* extending to penultimate segment. Length 4 mm.

Also occurs in many places in Tasmania.

The fascicles on the prothorax consist of two series of four each: one across middle, the other at base (the latter often indistinct) and a rather feeble one on each side of apex; the elytral fascicles may all be of a more or less decided fawn, or some of them may be decidedly sooty; there is nearly always a large fascicle on each side at summit of posterior declivity, and usually there is a patch of greyish scales on each side of middle. In the female rather less of the base of the rostrum is clothed than in the male. Specimens are not uncommon under logs and stones, and may often be taken crawling over logs and fences at night.

209. *Hexymus australis*, Boi.

(*Cryptorhynchus australis*, Boi.; *Cryptorhynchus solidus*, Er.[1]; *Hexymus subplanatus*, Lea.)

Dr. Boisduval's description is quite worthless for the identification of this species, but I have examined his type (now in the Brussels Museum), and it is certainly a *Hexymus*, and the species described by Erichson as *Cryptorhynchus solidus* [2] and by myself as[3] *Hexymus subplanatus*.

1 Wiegm. Arch., 1842, p. 205 (omitted from Master's Catalogue).

2 I have examined a specimen from the Berlin Museum marked "Cryptorhynchus solidus, Er.; Type 35937." It is, however, probably the specimen of which Erichson said "Variat corpore toto fusco-squamoso." But, except for the colours of its scales and that the rostrum is almost entirely black, it agrees with his description.

3 From a greatly abraded specimen.

The species is variable in the colour of its clothing, and also of its rostrum. Erichson described the rostrum as *rufo*, but in most specimens it is reddish at the tip only. On the prothorax there are usually eight fascicles placed in two transverse series, but they are not always clearly defined, and often appear as if but four in number. When perfectly fresh the prothoracic carina is usually covered with scales, although always distinctly traceable. On the elytra there are usually four (but sometimes only two or three) shining granules on each side of the suture about the middle.

I have specimens from New South Wales (Nepean River and Burrawang) and Tasmania, as well as from King Island.

210. *Decilaus major*, n. sp.

Black; antennae and tarsi reddish. Densely clothed with soft, pale brown scales; on the elytra variegated with spots of paler and darker scales.

Head with sculpture entirely concealed. Rostrum with dense punctures. Antennae inserted about one-third from apex of rostrum in male, two-fifths in female; scape the length of five basal joints of funicle; of these the first is as long as the third and fourth combined and slightly longer than the second. *Prothorax* about once and one-half as wide as long, sides strongly diminishing in width from near base to apex; with dense, fairly large, round punctures, uniform in size except at apex. *Elytra* with outline almost continuous with that of prothorax; with rows of large somewhat rounded, but almost entirely concealed punctures; each interstice with a row of round, shining and very conspicuous granules. *Abdomen* with dense and fairly large punctures on two basal segments; the second not much shorter than first along the middle. Length, 7—9 mm.

The scales on the prothorax are stout, each is set in a puncture and rises above the derm; on the elytra the scales are smaller and denser than on the prothorax, except for a row of semidecumbent and rather pale ones on each interstice. On the elytra there are usually numerous small and somewhat sooty spots scattered about, with a few pale spots in places. On some the scales are almost uniform in colour, but on many a faint pale V can be traced, commencing on each shoulder and directed towards the sutural third; immediately behind the V is a large, irregular, indistinct dark triangle on each side. The V and the triangles are never sharply defined. The male has the rostrum clothed more than half way to the antennae; whilst in the female the scales are confined to the base. The species is the largest known of its genus.

211. *Decilaus sobrinus*, n. sp.

Black, antennae and tarsi reddish, tibiae somewhat darker. Sparsely clothed with whitish scales, becoming pale brown in places; each elytron with a distinct and fairly large pale spot near the apex.

Head with dense and moderately coarse punctures, becoming smaller posteriorly. Rostrum with crowded punctures, decidedly coarser than on head. Scape inserted one-third from apex of rostrum, not much shorter than funicle; first joint of the latter distinctly longer than second; club apparently continuous with funicle. *Prothorax* about once and one-third as wide as long, sides strongly diminishing to apex on apical half only; with dense, round and fairly coarse punctures, decreasing in size to apex. *Elytra* widest near base; with rows of large, round punctures; interstices convex, each with a row of small and distinct, but seldom conspicuous granules. *Abdomen* with fairly numerous and moderately large punctures on two basal segments, suture between these almost obliterated in middle. *Tibiae* with fine carinae partially concealing rows of punctures. Length, 4—4½ mm.

Also from Victoria.

An obscure species close to perditus, but much more sparsely clothed, prothorax narrower and with larger punctures, abdomen with larger and sparser punctures, the elytral interstices feebly granulated and more convex. The abdominal punctures are smaller and more numerous than in memnonius, and those on the prothorax are smaller, denser and shallower.

212. *Decilaus mixtus*, n. sp.

Black or piceous-brown; elytra sometimes paler than prothorax; antennae and tarsi reddish. Densely clothed with soft scales varying from snowy white to sooty.

Head with dense and fairly large, but quite concealed punctures. Rostrum with crowded and fairly large, but more or less concealed punctures. Scape inserted almost in exact middle of side of rostrum, less than half the length of funicle and club combined; two basal joints of funicle elongate and equal in length. *Prothorax* about once and one-third as wide as long, strongly diminishing in width from near base to apex; with dense, large, round, deep punctures. *Elytra* with outline almost continuous with that of prothorax; with rows of large, scarcely rounded punctures, only partially concealed by clothing. *Abdomen* with dense, partially concealed and (for the genus) rather small punctures; second segment not much shorter than first along the middle, its suture with that segment very distinct throughout. Length, $4\frac{1}{2}$—$5\frac{1}{2}$ mm.

On the prothorax the scales are stout and each arises from a puncture. On the elytra the scales are smaller and uniform in size, and mostly sooty brown, but with numerous irregularly defined spots or patches of pale brown or ochreous, and with snowy white scales scattered singly or in small spots, causing a speckled appearance. On the prothorax the scales also vary in colour, but they are not condensed into spots. On the under surface the white scales are absent, but there are a few on the legs. Where the clothing has been abraded minute granules can sometimes be found on the elytra, but they are quite concealed by the clothing; the derm, both there and on the prothorax, appears to be very finely wrinkled.

In general appearance somewhat close to apicatus, but the scales much smaller and the punctures totally different. Ovatus has much denser clothing, and its sculpture is very different. Coryssopus is more densely and differently clothed, and has armed femora; from squamipennis it differs in being larger, punctures of prothorax more concealed by the scales (which are individually larger) and by its unarmed femora. From all the other described species it is very distinct.

213. *Decilaus mollis*, n. sp.

Black or blackish brown, elytra reddish brown, rostrum antennae and tarsi paler. Densely clothed with large soft scales; interspersed with numerous stout suberect setae.

Rostrum wide, feebly curved, shining; with numerous small punctures. Scape stout, inserted almost in exact middle of side of rostrum, much shorter than funicle. *Prothorax* not much wider than long, sides strongly rounded, apex less than half the width of base; with dense, large, round, concealed punctures. *Elytra* subcordate, base almost truncate, rather strongly inflated near base and then strongly diminishing in width to near apex; with rows of large, round, concealed punctures; interstices rather strongly and almost equally convex. *Abdomen* with large, partially concealed punctures. Length, $1\frac{3}{4}$ - $2\frac{1}{4}$ mm.

The clothing is so dense that the derm is almost everywhere concealed, and the elytra appear to be finely striated only. The scales, however, are absent from all but the base of the rostrum. The scales on the prothorax and abdomen are larger than elsewhere, but on the prothorax they are wider and more closely applied to the derm than on the abdomen. Most of the scales are of a pale muddy grey, but on each elytron there is usually an irregular triangle of black scales, the base of which is on the side, and the apex nearly touching the suture about its middle; but the triangle is sometimes broken up into small and irregular spots, or appears as an irregular fascia. There are usually some snowy white scales on the elytra. The legs are usually feebly annulated. On the elytra the darker setae usually form two loose fascicles on the third interstice—one near the base, the other median. I have a pair taken *in cop.*, but cannot detect any sexual differences, apart from a thickening of the male femora.

Nearer noctivagus than any other described species, but smaller, with more variegated clothing, and which on the under surface is sparser; the scape shorter, stouter and more median, and the mesosternal receptacle less raised and thinner.

214. *Decilaus auricomus*, Lea., var. *insularis*, n. var.

A single specimen from the island evidently represents a variety of this species; it differs from the types in having the body (but not the appendages) entirely black; the clothing is more variegated, and on the elytra the scales are distinctly less rounded; this latter character would probably have been regarded as of specific importance, but that the clothing of the abdomen is of the same remarkable nature as in the types.

215. *Decilaus acerosus*, Er.

Referred by Erichson to Acalles, but belongs to this genus. It is a common species near the coast, both on King Island and Tasmania.

216. *Achopera subulosa*, n. sp.

Black or blackish-brown, antennae and tarsi reddish. Very densely clothed with large, soft, round scales, closely applied to the derm; sides of prothorax, alternate interstices of elytra and under surface with larger semidecumbent and not rounded scales, usually fawn-coloured: legs with setose scales and setae. *Antennae* short, inserted almost in exact middle of sides of rostrum; scape very stout, not much more than half the length of funicle; the latter with first joint longer and stouter than second, third to seventh transverse. *Prothorax* apparently as long as wide, but really slightly transverse, base bisinuate. *Elytra* conjointly trisinuate at base, apparently lightly striate. Length, 4—5 mm.

Also from Tasmania (Hobart and Ulverstone).

The derm and punctures (except sometimes that some of those in the elytral striae can be traced) are entirely concealed before abrasion. The scales are mostly of a pale fawn colour, but more or less mottled with white or whitish and pale brown, dark brown and blackish scales. There is usually a whitish somewhat oblique spot on each elytron about the basal third on the fourth interstice (usually also extending to the third and fifth), and a sooty spot on each side of the base of the prothorax. The ordinary scales of the abdomen are much darker along the middle than on the sides. On the legs faint traces of rings are usually to be seen.

On abrasion the head is seen to be densely covered with small round punctures, becoming smaller on the rostrum (on the rostrum of the female they are normally exposed except at the base, whilst in the male they are exposed only towards the apex). On the prothorax they are equally as dense and rather larger. The punctures in the elytral striae are large and close together; the interstices are gently and regularly convex, wider than the striae and closely covered with small punctures. The punctures of the under surface are rather smaller than on the prothorax, but the abdomen has a few larger ones scattered about. In the male the abdomen and metasternum are conjointly widely and shallowly concave, but convex in the female.

In some respects close to lachrymosa, but larger, stouter, more convex, with paler clothing, the larger scales of the elytra always confined to the alternate interstices and almost invariably pale (those of lachrymosa being frequently dark); the punctures of the abdomen larger (except that the larger ones are smaller than the larger ones of lachrymosa), base of elytra less strongly trisinuate, femora stouter and the setose clothing of the legs more pronounced. It is also a beach frequenting species, whilst lachrymosa is common on rotting logs. As in other species of the genus many specimens rapidly become greasy, when the appearance of the scales is considerably altered.

217. *Ephrycus parvus*, n. sp.

Brownish red; antennae and tarsi paler, but derm usually concealed. Upper surface with dense scales, varying from dingy white to sooty-black; scutellum with white scales; under surface and legs with sparser scales than on upper surface, the scales mostly white; basal third of rostrum squamose. Prothorax with eight fascicles: two at apex, two at base, and four across middle, the two apical and two mediolateral usually composed of reddish-brown scales, the others of blackish scales; each elytron with about six fascicles, and with scattered erect scales.

Rostrum feebly curved, slightly increasing in width to apex, apical two-thirds finely punctate. Scape stout, inserted nearer base than apex of rostrum, half the length of funicle and club combined. *Prothorax* gently convex; punctures entirely concealed; apex more than half the width of base. *Elytra* about once and one-third the width of prothorax, shoulders strongly rounded; striate punctate, striae distinct, but punctures concealed. *Under surface* with moderately dense and strong but partially concealed punctures. *Legs* rather long; femora edentate. Length, 1 5-6—2 mm.

Also from Tasmania (Hobart, Bruni Island and Huon River).

The fascicles of the prothorax are sometimes very ill-defined; on the elytra there is usually a more or less distinct patch of reddish scales on the suture, behind the scutellum. The species is the smallest of the Chaetectetorus group known to me.

218. *Menios sordidatus*, n. sp.

Red, but colour (except of rostrum and antennae) concealed; rostrum shining towards apex. Densely clothed with soft slaty-brown scales; under surface and femora with dingy whitish scales. Prothorax with six fascicles: two at apex and four across middle; suture, third and fifth interstices with rather numerous small fascicles.

Head depressed between eyes. Rostrum straight, sides feebly incurved to middle; apical half feebly punctured. Scape inserted almost in exact middle of side of rostrum. *Prothorax* moderately transverse, apex much narrower than base, sides rounded and increasing in width to base, base bisinuate; with dense but concealed punctures. *Elytra* closely applied to prothorax and very little wider, base trisinuate; striate-punctate, striae distinct, but punctures almost concealed, third and fifth interstices feebly elevated towards base; preapical callus scarcely traceable. *Under surface* with dense concealed punctures. *Femora* moderately strongly and equally dentate, the front pair from some directions apparently edentate. Length, 4—4½ mm.

Also from W. Australia (Albany) and New South Wales (Sydney).

On one of the specimens there are a few obscure whitish spots on the elytra.

219. *Phlaoglymma mixta*, n. sp.

Dark reddish-brown, in places becoming black; antennae (club excepted) and claws reddish. Densely clothed with scales varying from white to black, and forming feeble fascicles in places.

Head with dense concealed punctures. Rostrum rather wide and lightly curved, slightly shorter than prothorax; with dense punctures, concealed on basal third in male, on basal fourth in female. Antennae inserted nearer base than apex of rostrum, scape about half the length of funicle and club combined; two basal joints of funicle the length of four following combined, third to seventh transverse. *Prothorax* about once and one-third as wide as long, apex much narrower than base; with dense and fairly large, but quite concealed punctures. *Scutellum* small but distinct. *Elytra* elongate-subcordate, shoulders feebly produced; with rows of large, more or less concealed punctures, in feeble striae; interstices with dense, concealed punctures, and subtuberculate beneath fascicles. *Under surface* with dense more or less concealed punctures. *Femora* acutely dentate; tibiae angular at external base. Length 5½—6½ mm.

The clothing is so dense as to entirely conceal the derm. On the head and base of rostrum the scales are mostly pale ochreous with numerous black scales interspersed; on the prothorax the scales are somewhat similar, but wider, and there is usually a pale median line, on each side of the apex of which is a feeble black fascicle. On each elytron there is a pale (sometimes almost white) oblique stripe from in line with the shoulder to near the suture at about the middle, but touching neither suture nor shoulder (the two to the naked eye appearing like a feeble V); parallel with this and about half way between it and apex are traces of another feeble stripe, and there is usually a small whitish spot close to apex. There are feeble black fascicles on the second and fourth (and sometimes on the sixth) interstices about the middle, on the third and fifth near the base, and a few still more feeble ones elsewhere. The clothing of the under surface and legs is paler than elsewhere, and the black scales are entirely absent.

In shape it closely resembles alternans, but is considerably larger, with denser clothing (without lineate arrangement of colours except the very indistinct median line of prothorax), and with the rostrum decidedly shorter and wider.

Microcryptorhynchus, n. g.

Head large, invisible from above. *Eyes* small, ovate, widely separated, coarsely faceted. *Rostrum* short, stout and almost straight. *Antennae* rather stout; scape inserted at about the middle of rostrum, shorter than funicle; two basal joints of funicle elongate; club subcontinuous with funicle. *Prothorax* longer than wide, sides slightly rounded, base and apex almost equal in width, ocular lobes obtuse. *Scutellum* not traceable. *Elytra* slightly wider than prothorax, oblong-elliptic. *Pectoral canal* deep and wide, terminated between intermediate coxae. *Mesosternal receptacle* scarcely raised, emargination semi-circular; cavernous. *Metasternum* slightly shorter than the following segment; episterna not traceable. *Abdomen* moderately large, two basal segments large, the three apical depressed. *Legs* moderately long; femora not grooved or dentate, posterior not extending to apex of abdomen; tibiae stout, almost straight; tarsi short, 3rd joint wide and deeply bilobed, 4th elongate. Subcylindrical, elongate, squamose, apterous.

In addition to the species described below, two others are known to me. I do not know any closely allied genus and its position in the Cryptorhynchides is very uncertain. For the present it may be placed at the end of the allies of Poropterus, although the appearance of the head and rostrum is not unlike many of the allies of Chaetectetorus.

220. *Microcryptorhynchus pygmaeus*, n. sp.

Dull red or brownish red. Densely clothed with muddy scales; and with numerous semierect setae scattered about.

Head with rather coarse but concealed punctures. Rostrum with distinct punctures on apical half in female, on apical third in male; elsewhere concealed. *Prothorax* very little wider than long, sides moderately rounded, apex about two-thirds the width of base; with dense and coarse but concealed punctures. *Elytra* elongate-cordate, gently elevated to about the middle, thence strongly rounded to apex; with rows of large concealed punctures, interstices as wide as and slightly narrower than punctures, the alternate ones distinctly raised. Two basal segments of *abdomen* with dense, large, concealed punctures. Length, $1\frac{1}{3}$—$1\frac{1}{2}$ mm.

The smallest Australian species of the sub-family as yet described. Before abrasion the sculpture is almost entirely concealed. The derm is sometimes of a dingy brown, especially in the males. The scales are always muddy looking, and not individually traceable. The setae are stout and more or less erect, but not long, but longer on the elytra than on the prothorax; they are nowhere condensed into fascicles. Both scales and setae appear to be easily abraded, and specimens are usually very dirty when obtained. The sexes are readily distinguished by the clothing of the rostrum.

Two specimens from Tasmania (Mount Wellington) may represent a variety; they differ in being almost black except for the antennae, tarsi, and part of the rostrum.

Wiburdia, n. g.

Head rather large. Eyes rather small, distant, finely faceted. Rostrum rather short, stout, feebly curved; scrobes considerably widened posteriorly and partially visible from above. Antennae rather stout, submedian; first joint of funicle moderately long, the seventh widely transverse and apparently forming portion of club. Prothorax transverse, apex narrow and subtubular, base bisinuate, ocular lobes almost rectangular. Scutellum distinct. Elytra subcylindrical, base trisinuate. Pectoral canal deep and wide, terminated before middle coxae. Mesosternal receptacle thick, not raised and slightly concave. Metasternum elongate. Abdomen with all sutures distinct. Femora edentate,[1] not grooved; tibiae with subapical tooth as well as with terminal hook; third tarsal joint wide, deeply bilobed, fourth elongate. Winged.

In general appearance resembling Metyrus and the genus to which Cryptorhynchus sirius, Er. belongs, but with the mesosternal receptacle[2] totally different to any of the allies of Chaetectetorus and somewhat resembling that organ in Therebus, and some of the other allies of Psepholax: for the present, however, it may be placed near Metyrus. The seventh joint of the funicle, although apparently belonging to the club, has clothing as the rest of the funicle. The genus is named after Mr. J. C. Wiburd, of Jenolan Caves, from whom specimens of the only known species were first received.

221. *Wiburdia scrobiculata*, n. sp.

Black or piceous-black, in places obscurely diluted with red; antennae claws and tibial hooks (and sometimes parts of the

1. On each of the femora there is a feeble ridge on the under surface, and this ridge being rather suddenly terminated, causes an appearance of a very small and obtuse tooth.

2. When looked at from above the receptacle appears to be solid, but when viewed in a good light along the canal, or if probed with a pin, it is seen to be slightly cavernous, although not of the usual vaulted character.

femora and tibiae) dull red. Rather densely clothed with soft, dingy brown scales, but in places varying to black and to a pale brown; and paler on the under surface, legs, head and rostrum than elsewhere. Prothorax with seven feeble fascicles; elytra with very feeble fascicles.

Head rather strongly convex, with dense but usually concealed punctures. Rostrum increasing in width from base to near apex; with dense punctures, which, towards base, are usually concealed; more than half the length of scrobes visible from above. *Prothorax* feebly transverse, apex rather suddenly narrowed and subtubular, sides subparallel towards base, base strongly bisinuate, scarcely tuberculate beneath fascicles, but with a very short median (and usually concealed) carina; with small, dense, round, concealed punctures. *Elytra* slightly wider than prothorax, parallel-sided to near apex, shoulders feebly produced; with rather large suboblong punctures, in rather feeble striae; interstices wide, scarcely separately convex; with dense punctures and small granules, but both usually concealed. *Under surface* with dense but partially concealed punctures; metasternal episternum with a single irregular row of punctures. Abdomen with second segment slightly shorter than first, third and fourth fairly large, but their combined length slightly less than that of second or fifth. *Legs* not very long; hind femora almost extending to apex of abdomen. Length, 8—11½ mm.

Also from Victoria (Warragul) and New South Wales (Jenolan).

Of the prothoracic fascicles there are two at the apex and five across the middle, but they are all feeble and easily abraded, and the median one is often so feeble that it would probably be best not to regard it as a fascicle at all. The elytra in several specimens appear to be totally without fascicles, but in others numerous very feeble ones are present, unless indeed they should be regarded as small spots of darker scales. On the specimen from Warragul there are numerous feeble pale spots transversely arranged on the elytra, but with four more distinct at the summit of the posterior declivity. The specimens from the island are rather wider and the clothing slightly more mottled than on mainland ones.

222. *Ampagia femoralis*, Er.

Referred by Erichson to Cryptorhynchus, but belongs to Ampagia. It is a common species near the coast, both on King Island and Tasmania.

Conlonia, n. g.

Head convex. Eyes small, distant, coarsely faceted. Rostrum about half the width of apex of prothorax and much shorter than that segment, distinctly curved. Antennae inserted about the middle of rostrum, rather thin; scape passing eyes, rather suddenly curved and thickened at apex; funicle five jointed; club briefly ovate. Prothorax convex, base distinctly wider than apex, with very feeble ocular lobes. Scutellum absent. Elytra elongate-elliptic, base truncate, apex widely rounded. Metasternum elongate. Abdomen with two basal segments elongate; suture between first and second indistinct at sides, invisible across middle, third and fourth short, with deep and wide sutures. Femora moderately stout, edentate; tibiae rather thin, almost straight, terminated by a strong curved hook; tarsi not very wide, third joint rather feebly bilobed, fourth somewhat shorter than three preceding combined. Apterous.

Belongs to the sub-family Cossonides, and in Wollaston's table of that sub-family would be placed in III. bbb. Four genera of that sub-family having the funicle five-jointed have been recorded as Australian. Of these Halorhynchus is blind. Pentarthrum and Cossonideus have the scutellum conspicuous, whilst Pentamimus has the rostrum very much shorter and wider. In Australian catalogues the genus should be placed close to Pentarthrum. In the species described below each eye is composed of about fifteen facets.

223. *Conlonia litoralis*, n. sp.

Black or dark brown, appendages reddish. Glabrous.

Head smooth and impunctate, ocular fovea minute. Rostrum parallel-sided, about two-thirds the length of prothorax, with fairly numerous and small but distinct punctures. *Prothorax* apparently longer than wide, sides increasing in width to near base, and then strongly lessened, with small and sparse but distinct punctures. *Elytra* not twice the length of, and slightly narrower than prothorax, parallel-sided to beyond the middle, extreme base slightly raised and slightly rugose; with almost regular series of small punctures, and with very feeble traces of striation. *Under surface* with small and sparse punctures, larger on meso and metasternum than elsewhere. Length (including rostrum), 1½—3 mm.

Fairly common under drift wood on beaches; and occurs in similar situations in Tasmania (Sorell, Hobart and Nubeena).

The difference in size and appearance of some of the specimens is very great, but I am satisfied that they all belong to but one species. The larger specimens are nearly always black, whilst the smaller ones are often of a deep reddish brown; occasionally the prothorax only is reddish-brown, or its sides and the sides of the elytra may be so coloured.

224. *Pentamimus canaliculatus*, Woll.

225. *Pentarthrum nigrum*, Woll.

ANTHRIBIDAE.

226. *Epargemus tridens*, n. sp.

Black, the legs and antennae in places reddish, the elytra in places diluted with red. Densely clothed with short setae or pubescence, varying from white, through various shades of yellow and brown, to black, and in places forming fascicles; legs annulated.

Head with dense partially concealed punctures. Rostrum strongly inflated towards the apex, with three narrow shining carinae, of which the median one is longer than the others; punctures as on head. Antennae not extending to base of prothorax, first joint slightly shorter than second, the combined length of both not much greater than that of third, the others rather strongly decreasing in length, but none transverse. *Prothorax* about as long as its greatest width, which is just behind the middle, sides strongly rounded; towards base with a strong sinuous carina, interrupted in its middle, and at the sides directed obliquely forwards; with dense partially concealed punctures, and with three very feeble tubercles transversely placed across the middle. *Elytra* parallel-sided to near apex, somewhat flattened along middle; with rows of moderate sized, but partially concealed punctures; third, fifth and seventh interstices raised, the third subtuberculate and distinctly fasciculate near base, and near summit of posterior declivity; with few and feeble fascicles elsewhere. *Under surface* with dense and partially concealed punctures, fourth abdominal segment strongly incurved at apex; pygidium with a strong but short carina. Length, $10\frac{1}{2}$ mm.

In many respects this species agrees with the description of Tropideres musivus, but its rostrum is strongly dilated towards the apex (not "apice leviter dilatatum.") Erichson also makes no mention of the conspicuous rostral carinae, and the size he men before me.[1] At a glance it appears to be close to Entromus gives ($2\frac{1}{2}$ German lines) is less than that of the smallest speci- dorsoplagiatus, but the rostrum and prothoracic carina are very different from those of that species.

On the basal half of the rostrum most of the pubescence is white, and the clothing of this colour extends backwards on to the head in the form of a trident, the outer prongs of which margin the eyes. On the prothorax there are numerous scattered spots of whitish and yellowish pubescence. The scutellar clothing is entirely pale. On the elytra there is a large subquadrate pale patch extending from about one-fifth from the base to near the middle, elsewhere there are numerous spots of variable colours. The legs are prettily variegated with red and black, and with rings of black and white pubescence. Between the district prothoracic carina and the base another but much more feeble one can be traced, and between these two there are traces of two still more feeble ones.

In addition to the type and above described specimen there are three others before me. Of these one from Jenolan (New South Wales) is slightly smaller ($9\frac{3}{4}$ mm.) than the type and the subquadrate patch of pale scales on the elytra is much smaller and much less distinct. One from Mount Kosciusko (New South Wales) is still smaller (8 mm.), and the patch can scarcely be

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1 Since this was written I have examined the type of Tropideres musivus, Er.; it cerainly belongs to Epargemus, and in fact is very close in appearance to the Huon River speoimen, but is smaller, less robust and with the rostral carinae (if present) quite concealed by the clothing, the prothoracic carinae are identical. Erichson's description of the rostrum is misleading, as it is quite strongly dilated towards the apex.

traced. The last from the Huon River (Tasmania) is smaller still ($7\frac{1}{2}$ mm.), the patch is also very indistinct, the antennae (excepting the club) are entirely pale, the legs are also pale with the exception of the tips of the tibiae, and the prothorax and elytra are reddish. On all four specimens the suture, near and on the posterior declivity, is alternately marked with black and white spots.

227. *Xynotropis micans*, Blackb.

CERAMBYCIDAE.

228. *Toxeutes arcuatus*, Fabr.
229. *Enneaphyllus aeneipennis*, Wath.
230. *Phacodes obscurus*, Fab.
231. *P. personatus*, Er.
232. *Epithora dorsalis*, W. S. Macl.
233. *Callidiopsis scutellaris*, Fab.
234. *Gracilia pygmaea*, Fab.
235. *Pterostenus concolor*, W. S. M.
236. *P. suturalis*, Oliv.
237. *Amphirhoe decora*, Newm.

238. *Macrones purpureipes*, n. sp.

Black, in places blackish brown; appendages with a decided bluish or purplish gloss; elytra whitish and semi-transparent, but with the thickened parts blackish brown; hind tarsi with first and second joints flavous, the third dark brown, and the fourth reddish. Under surface with dense, fine, greyish pubescence.

Head with numerous regularly distributed punctures; with a deeply impressed median line from near base to near clypeus. Antennae extending to second segment of abdomen, first joint as long as three following combined, third longer than fourth, the others regularly decreasing in length, but eleventh once and one-half the length of tenth. *Prothorax* longer than wide, irregularly transversely wrinkled, with three tubercles (of which one is lateral and the median one is very feeble) transversely placed at the basal third, and a feeble tubercular elevation on each side of middle, at apical third. *Scutellum* subtriangular, with irregular punctures. *Elytra* passing base of penultimate segment of abdomen, strongly narrowed to basal third, thence line-like to apex; each with two punctate or granulate discal costae, which towards the base curve round to and become conjoined by rugulosities on the shoulder; sides and margins raised; semitransparent portion with shallow obscure punctures. *Under surface* with dense minute punctures, and dense fine transverse impressions. Length, 30 mm.

Also from Tasmania (Hobart).

A large species second only in size to *rufus*. The rugose parts at the shoulders are less in area than in that species, and the scupture of the prothorax is very different. In general appearance (except that it is much larger) it somewhat resembles exilis, but the femora are not reddish at the base. I have described a Tasmanian specimen, as the only one from King Island before me is evidently immature.

239. *M. subclavatus* Pasc.

240. *Ancita marginicollis*, Boi.

CHRYSOMELIDAE.

241. *Cryptocephalus pallens*, Lea.

Numerous specimens obtained from *Melaleuca* and *Leptospermum* scrub.

In some of the females the whole of the under surface, the head, scutellum and legs are pallid; and in some males the abdomen, except at apex, is almost entirely infuscate. The second joint of the antennae is distinctly shorter than the third, not "almost as long," as previously described; in some specimens, however, it is slightly longer than in others.

242. *C. subfasciatus*, Saund.

243. *Cadmus australis*, Boi.

244. *C. cognatus*, Saund.

245. *Loxopleurus viridis*, Saund.

246. *Lachnabothra saundersi*, Baly.

247. *Tomyris viridula*, Er.

248. *Paropsis acclivis*, Blackb.

249. *P. subfasciata*, Chp., var. *planior*, Blackb.
250. *P. agricola*, Chp.
250A. *P. agricola*, Chp., var.
251. *P. debilis*, Chp.
252. *P. fallax*, Newm.
253. *P. lutea*, Marsh.
254. *P. obliterata*, Er.
255. *P. orphana*, Er.
256. *P. porosa*, Er.
257. *P. reticulata*, Marsh.
258. *Chalcolampra hursti*, Blackb.
259. *Arsipoda variegata*, Wath. var. *kingensis*, Blackb.
260. *A. erichsoni*, Baly.
261. *Haltica gravida*, Blackb.
262. *Monolepta sordidula*, Blackb.

EROTYLLIDAE.

263. *Thallis vinula*, Er.

COCCINELLIDAE.

264. *Leis conformis*, Boi.

Four specimens from the island have the markings covering a greater area than any others I have seen, the spots on the elytra are all more or less conjoined, and the prothoracic markings are conjoined on the basal half.

265. *Halyzia mellyi*, Muls.
266. *Novius cardinalis*, Muls.

267. *Scymnus corticalis*, n. sp.

Black; a wide median stripe on each elytron, tarsi, tibiae antennae and palpi more or less red. Moderately clothed with short, whitish pubescence, on the elytra sinuously disposed.

Upper surface with dense minute punctures, larger and sparser on elytra than elsewhere. Intercoxal process of prosternum almost parallel-sided, sides very finely carinated. Metasternum and abdomen with dense, small punctures, sparser in middle than elsewhere; lamellae touching suture, the latter very feeble across middle. Length, $1\frac{2}{3}$—$2\frac{1}{2}$ mm.

Also common under bark in Tasmania (Hobart and New Norfolk).

The reddish elytral stripes commence near the base and become conjoined near the apex, on their outer margins their outline is regular, but on their inner sides they are sometimes angularly encroached upon about the middle. Usually the front angles of the prothorax are reddish at their tips and occasionally the extreme apex is reddish. On a small specimen from Hobart the elytra are mostly red, with a fairly large oval piceous spot extending from the base to the middle, and with the margins very narrowly infuscated on the basal half. The tibiae are usually somewhat infuscated..

A depressed species close to description of yarrensis, but larger and mostly deep black (including the head and femora). In colour and size it is somewhat close to vittipennis, but the stripes do not commence at the base itself as in that species, and meet across the suture (except for the finely raised portion of the suture itself) instead of terminating before it. It is also flatter than that species, with denser punctures on elytra, wider prothorax, darker legs and epipleurae entirely dark.

268. *S. flavifrons*, Blackb.

269. *Rhizobius nigrovarius*, n. sp.

Flavous with black or infuscate markings. Moderately clothed with fine whitish pubescence.

Head and prothorax with minute punctures; elytra with small punctures, but, except when concealed by clothing, clearly defined. Intercoxal process of prosternum wide, gently convex, dilated to apex, sides very finely carinated. Sides of metasternum and of abdomen with distinct punctures, elsewhere shining and almost or quite impunctate; lamellae extending rather more than half-way to suture. Length, $1\frac{1}{4}$—$1\frac{1}{2}$ mm.

Also from Tasmania (Frankford, Ulverstone, Launceston and New Norfolk).

Although there are 33 specimens before me, hardly any two are identical in all their markings. The head is sometimes entirely pale, sometimes infuscated and sometimes almost entirely black. The prothorax usually has a large infuscate blotch in the middle, the blotch occasionally occupying the entire surface except for a very narrow border, whilst sometimes a very faint stain only can be traced. The elytral markings are very variable and not always clearly defined; the suture appears to be always narrowly infuscated throughout, at about its basal third there is a blackish blotch (in some specimens this blotch is heart-shaped, in others it is connected with discal markings, whilst in a common form it is represented by a rounded spot on each side close to, but not of, the suture), and at about its apical third it is again, but less strongly dilated; in many specimens, however, the subapical dilatation is entirely absent. On the disc there is usually a sinuous line extending from near the base to one-third from the apex, where it becomes transversely dilated and terminates; sometimes after proceeding a short distance it bifurcates, but the two arms in such cases become conjoined at one-third from the apex. The meso and metasternum are always more or less dark, but the abdomen varies from entirely pale to entirely infuscate.

On one specimen the elytral markings consist of a conspicuous zig-zag fascia at the basal third (extending across the suture but not to the margins), and a feebly infuscated spot at about one-third from the apex. On several there is a feebly infuscated spot on each side of the suture at its basal third, and a very feeble oblique stripe between this and the margin. Usually, however, the sinuous line can be traced in parts. The specimens from the island, as a rule, are less distinctly marked than those from Tasmania.

In general appearance somewhat like alphabeticus, but smaller, comparatively wider, with smaller punctures and different markings on elytra. In size and shape it is close to occidentalis, but the elytral punctures are much more distinct than in that species.

270. *Rhizobius blackburni*, n. sp.

Black or blackish, head (infuscated posteriorly) front and sides of prothorax, sides and apex of elytra, abdomen (the base infuscated) and appendages more or less reddish. Clothed with short pale yellowish pubescence interspersed with subsetose but similarly coloured pubescence.

Head and prothorax with small dense punctures. Elytra with slightly larger and sparser punctures, interspersed with numerous larger (but still small) punctures. Under surface with sparse and small punctures, becoming very dense at sides. Intercoxal process of prosternum moderately convex, carinate at apex but not at sides. Lamellae extending to about one-fifth from suture. Length, $3\frac{1}{4}$—$3\frac{1}{2}$ mm.

Also from Tasmania (Hobart).

A greatly depressed species apparently close to aurantii, but the prosternum convex instead of concave along the middle, and apparently with smaller punctures, those on the elytra being decidedly smaller and denser than on discolor, and uneven in places; the punctures on the prothorax are rather denser than on the elytra and are decidedly small.

The pale portion at the apex of the prothorax is very narrow; on each elytron it commences at the base, close to but not on the margin itself,[1] and dilates till it becomes marginal, and still dilates till it occupies about one-third of the apex. On one specimen, however, it commences behind the middle and becomes marginal only near the apex. On the elytra the pubescence is somewhat sinuously disposed in places, and on abrasion very faint traces, as of striation, become visible.

271. *Rhizobius kingensis*, n. sp,

Black, elytra with a coppery gloss; head, apex and sides of prothorax, apex of abdomen, tarsi, tibiae (the four hind ones somewhat infuscated), knees, trochanters, antennae and palpi reddish. Moderately clothed with rather long, whitish, curved pubescence, interspersed with suberect fine brownish setae.

Upper surface with small punctures of even size, but denser on head than on prothorax, and on prothorax than on elytra. Intercoxal process of prosternum flat, sides scarcely carinated. Metasternum and abdomen with small and sparse punctures in middle, becoming dense at sides; lamellae extending to about one-fourth from suture. Length, 2 mm.

Close to lindi, but smaller and darker, pubescence longer and setae shorter and sparser. From plebejus (except that it is

1 On one specimen, however, it is marginal at the base.

about the same size) it differs in the same particulars. Compared with a specimen of hirtellus of the same size it differs (apart from colour) in having the pubescence longer, the setae shorter, elytral punctures rather smaller and those on the prothorax decidedly denser.

272. *R. alphabeticus*, Lea.

273. *R. discolor*, Er.

274. *R. ventralis*, Er.

CORYLOPHIDAE.

275. *Clypeaster elliptica*, Lea.

A specimen from the island probably represents a variety of this species; its elytra are of a dark red, with a large blotch about the scutellum, and an obscure subfasciate blotch towards apex, but the shoulders not infuscate. Beyond the subapical blotch the colour is paler than elsewhere.

The description of the colour of the elytra of the type is somewhat misleading; it should have been given as:—"Deep red; with a large blackish blotch at the base, partly extended along the suture and sides." The two colours, however, are not sharply defined.

276. *Sericoderus basipennis*, Lea.

277. *S. hardcastlei*, Lea.

278. *S. obesus*, Lea.

[PROC. ROY. SOC. VICTORIA, 20 (N.S.), PT. II., 1907.]

ART. XIV.—*New or Little-known Victorian Fossils in the National Museum.*

PART IX.—SOME TERTIARY SPECIES.

BY FREDERICK CHAPMAN, A.L.S., &c.,

National Museum.

(With Plates XVII.-XIX.).

[Read 12th December, 1907].

The following notes are based on some tertiary fossils which have been set aside from time to time as deserving of description or further comment. With regard to the echinoids, no new forms are here described, since other workers are engaged upon this group; but the opportunity is taken to figure, and record a new locality for Linthia antiaustralis, and to record additional localities and stratigraphical information regarding three other interesting species.

The forms here dealt with are:—

Cliona mammillata, sp. nov.
? Cliona peregrinator, sp. nov.
Ecionema newberyi, McCoy, sp.
Heliastraea tasmaniensis, Duncan.
Comoseris (Oroseris) australis, sp. nov.
Studeria elegans, Laube sp.
Linthia antiaustralis, Tate.
Maretia anomala, Duncan.
Eupatagus rotundus, Duncan.
Ischnochiton (Ischnoplax) granulosus, Ashby and Torr sp.

Class—SPONGIDA.

Order—*Monactinellida.*

Genus—*Cliona*, Grant.

Cliona mammillata, sp. nov.

(Pl. XVIII., Fig. 3).

Specific Characters.—The chambers excavated by the sponge are comparatively large, irregularly spheroidal and depressed.

In nearly all cases they bore smaller loculi on their lateral walls, and these appear in the casts as mammillate protuberances. Cavities connected by rather long and and conspicuously curved stolons. Average diameter of chambers, 4 mm.; length of connecting stolons, about 3 mm.; width, 0.5 mm.

These borings occur on the surface of the internal cast of a Voluta having a length of 16.5 cm., and the Cliona crypts entirely cover the spire and a large part of the body-whorl.

Observations.—In the absence of spicules it is difficult to separate the fossil casts of the boring sponge Cliona by characters which may be regarded as specific. In the present instance, however, certain features are exhibited which we can use for future reference, and we may therefore reasonably give it a distinguishing name. As an example of Cliona borings already specifically described we may refer to Cliona ("Entobia") cretacea, Portlock[1] a common form in Cretaceous shells in Britain and elsewhere, which is recognised by its regularly spheroidal form, crowded chambers and comparatively fine, radiating system of stolons.

Locality and Horizon.—Swan Reach, Bairnsdale Lakes. Tertiary (Kalimnan). Pres. by Mr. H. J. Hauschildt. [9146].

? Cliona peregrinator, sp. nov.

(Pl. XVIII., Fig. 4).

Specific Characters.—Crypts globular to pyriform, sometimes united into a more or less lengthy tube. The passages from chamber to chamber are often reduced to a mere constriction and there is also evidence of occasional, long slender stolons. Diameter of an average-size globular chamber, 2.5 mm.; length of pyriform chambers, rather less. The habit of this organism in the wandering manner of its growth is unlike the majority of Clionae. The fossil occurs on the surface of a limestone cast of a coral, Comoseris, into the coenenchyma of which it had bored in the errant manner described.

Locality and Horizon.—Valley of the Moorabool at Maude. Tertiary (Barwonian). Coll. Geol. Surv., Vict. WTM2. [9153].

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1 Geol. Londonderry, 1843, p. 360. See also Clionites conybeari, Morris; Ann. Mag. Nat. Hist., vol. viii., 1851, pl. viii., fig. 9.

Order—TETRACTINELLIDA.

Genus—*Ecionema*, Bowerbank.

Ecionema newberyi, McCoy sp.

(Pl. XVII., Figs. 1-13).

Tethya newberyi, McCoy, 1877, Prod. Palaeont. Vict., Dec. V., p. 31, Pl. XLVIII., Fig. 1.

Observations.—Having recently examined the above type specimen [9145], I am able to record the presence of typical tetractinellid spicules (protriaene), in reference to which McCoy remarked[1] as follows:—"I have not seen any triradiate terminations to any of the spicules such as occasionally occur with the simple forms in the recent Tethya, but they are so brittle that such may yet well be found." In his description, McCoy compares this fossil sponge with Tethya cranium, which species is now removed to the genus Craniella, Schmidt. Among the spicules of the Victorian fossil sponge are numerous microscleres, which are absent in all the forms of Craniella referred to by Sollas,[2] excepting C. schmidtii. This species alone possesses sigmaspires: the microscleres of our fossil, however, are represented, amongst other forms, by the simpler modification, the microstrongyles. The known species of Craniella are distinguished by numerous megaloscleres of the form anatriaene, but these are absent in our specimen.

With regard to Tethya, the definition of the genus as now restricted and given by Sollas (op. cit. p. 427) is as follows:—

"Tethyidae of more or less spherical form, in which the rhabdus is a strongyloxea. The chamber-system is diplodal." This definition excludes our fossil, since all the oxea are bluntly pointed, in contradistinction to the cylindrical strongyloxea.

The genus with which the Victorian fossil appears to show most agreement, both in regard to form and spicular structure, is Ecionema, which includes at least two species found in southern Australian waters—viz., E. australiense, Carter sp. and E. bacilliferum, var. robusta, Carter var.

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1 Loc. cit., p. 31.

2 Chall. Rep., vol. xxv., 1888. Report on the Tetractinellida, pp. 30-41.

The genus Ecionema is defined by Sollas[1] as "Rhabdastrose Stellettidae, in which the ectosome does not form a cortex, with two forms of microscleres, one of them being a microrabd, derived either from an anthaster or a chiaster by reduction in the number of the actines to two."

In the present specimen there are at least four types of microscleres; spherasters, sterrasters, microstrongyles and the microrabds (probably derived from a chiaster). It may subsequently be found necessary to form a new genus for the reception of this sponge should other specimens occur, but for the present it may be referred to Ecionema.

Extended Description.—In addition to the characters noted by McCoy, we may state that the spicules consist both of the large (megaloscleres) and the small types (microscleres). The former consist of—(1) long arcuate or sigmoidal spicules pointed at both ends (oxea), generally smooth, sometimes slightly spinose; and (2) tetraradiate spicules of the form protriaene, with the three short rays directed away from the main axis, sometimes curved, but more often straight, forming an angle of about 45 deg. from the axis of the rhabdus produced. There are also occasional dichotriaene, in which the three radial cladi are bifurcate, and with the main actines suppressed, after the manner of Ecionema nana, Carter sp.[2] The microscleres consist of —(1) arcuate or open V-shaped microrabds, cylindrical and with rounded ends (microstrongyles), bearing surface tuberculations and depressions; (2) a ?spiraster, with blunt spines, especially near one extremity; (3) a microxea with whorls of spines; (4) a spheraster, with moderately long arms carrying two or more spines at the extreme tips; (5) a depressed ellipsoidal sterraster, with ?hilum nearly central; and (6) a sanidaster slightly tapering to one end, and armed with numerous short-spines.

Dimensions of the Spicules.—The chief skeletal spicules are the oxea, which are nearly always slightly curved: the greatest length they appear to attain is about 5 mm., although McCoy says "some apparently about 1 inch long."[3] They are massed

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1 Loc. supra cit., p. 195.
2 Annals and Mag. Nat. Hist., ser. v., vol. vi., 1880, pl. vii., f. 43.
3 Loc. cit., p. 31.

together in a closely fasciculate manner. The examples now figured measure as follows:—(Pl. XVII., Fig. 1). Length, 2.346 mm.; greatest breadth, 0.0721 mm. A slightly sigmoidal spicule (Pl. XVII., Fig. 2), length, 1.6 mm.

Protriaene.—A variety with straight cladi, 0.423 mm. long; length of cladi, 0.154 mm. Cladi making an angle of 48 deg. with the produced rhabdus. A variety with curved cladi having a length of 0.481 mm.; cladi forming an angle of 30 deg. A variety with the cladi sigmoidally curved, 0.461 mm. in length; width of chord, 0.25 mm.

Dichotriaene.—Rays of the trivium lying nearly in the same plane. That which would ordinarily be considered the principal actine is almost entirely suppressed. An example from this sponge has an extreme diameter of 0.48 mm.

Microstrongyles.—Length of an average example, 0.423 mm.; width, 0.0384 mm.

The ?spiraster.—Length, 0.346 mm.

Microxea with spines in whorls.—Length, 0.25 mm.; width, 0.1 mm.

Spheraster.—Diameter of centrum, 0.0576; length of longest rays, 0.0432 mm.

An ellipsoidal sterraster.—Longer diameter, 0.153 mm; shorter diameter, 0.11 mm.

A sanidaster with a length of 0.336 mm.

Class—ANTHOZOA.

Family—*Astraeidae.*

Genus—*Heliastraea*, Ed. and Haime.

Heliastraea tasmaniensis, Duncan.

H. tasmaniensis, Duncan, 1876, Quart. Journ. Geol. Soc., Vol. XXXII., p. 342, Pl. XXII., Figs. 1-3.

Observations.—An example of this coral occurs as a cast in ironstone, and is sufficiently well preserved to furnish a sharp wax impression, clearly showing the number of primary and secondary septa and their quaternary arrangement, as described by Duncan. The corallum measures about 4 cm. square, whilst the calices have a diameter of about 4 mm.

Near to one side of the corallum in this specimen there occurs what is evidently a malformed calice of the same stock, forming a funnel-shape depression about 15 mm. across, and surrounded by a ring of calices of the normal form. The malformed calice suggests at first sight that of an Agaricia, but a cast of the bottom of the calice shows it to be similar to that of the smoller corallites of the group.

Locality and Horizon.—Flemington ("Royal Park"). Probably from the Vict. Geol. Surv. coll. Tertiary (Barwonian). [9155].

Family—THAMNASTRAEIDAE.

Genus—*Comoseris*, D'Orbigny.

Sub-Genus—*Oroseris*, Edwards and Haime.

Comoseris (Oroseris) australis, sp. nov.

(Pl. XVIII., Figs. 1, 2).

Description.—The present example occurs in the form of a ferruginous limestone cast. Base of corallum encrusting. Calices measuring about 6 mm. in diameter; arranged in a widely flexuous series, and divided by moderately high, rounded, flexuous ridges. Septa (trabeculae) sinuous, strongly curved or angulate, granulate on the sides, and united by synapticula; about 20 main septal plates, some of which branch into two, usually at a distance of about one and a half millimetres from the centre of the calice, continuous with the costae of the ridges. Sometimes the branching of the septa occurs nearly at the summit of the ridge. Columella small, formed of the united ends of the septa. Depth of calices about 5 mm. From top of ridge to bottom of calice, 9 mm.

Observations.—The corallum of the type species has been extensively invaded by a boring sponge (? Cliona), the casts of whose crypts stand up prominently on the fossil coral.

The coral before us bears some resemblance to certain forms of Stylomaeandra and Latimaeandra, both of which have the calices situated between collines or ridges; the former genus having a styliform columella, whilst the latter is deficient in that respect. A closer examination of the septal arrangement and the habit of the serial extension of the calices, together with the presence of a rudimentary or papillose columella, show its affinity with the Thamnastraeans. The subgenus Oroseris is distinguished from Comoseris by the limited extent of the collines, which do not traverse the entire length of the colony as in Comoseris, and in this respect our specimen is in agreement.[1] A closely allied species to ours is Comoseris (Oroseris) regularis, Fromentel, which, however, has fewer septa, and a more pronounced papillate columella.[2] This subgenus is represented in the Jurassic, Neocomian, Cretaceous, Eocene and Miocene formations. In the Eocene it is known from Europe, and in the Miocene from Italy.

Locality and Horizon.—Valley of the Moorabool, at Maude. "From irregular bands of limestone not more than 2 ft. thick, interstratified in the upper part of the older basalt." C. S. Wilkinson, Dec., 1865. Coll. Geol. Surv., Vict. (WTM2). Tertiary (Barwonian). [9153].

Class—ECHINOIDEA.

Family—*Cassidulidae.*

Genus—*Studeria*, Duncan.

Studeria elegans, Laube sp.

Catopygus elegans, Laube, 1869, Sitz. d.k. Akad. d. Wissensch. Wien, Vol. LIX, p. 190, Pl. Figs. 8, 8 a-c. Tristomanthus elegans, Bittner, 1892, Sitz. d.k. Akad. d. Wissensch. Wien, Vol. CI., p. 352, Pl. IV., Fig. 3.

Observations.—Hitherto this echinoid has been recorded for Victoria only from the mouth of the Glenelg River, near the S. Australian Border, and from Apsley. In S. Australia it occurs at the Murray River and Mt. Gambier.[3] It is therefore interesting to record its occurrence at another, widely removed, locality in Victoria. The specimens, of which there are six

1 See Duncan, "Revision of the Families and Genera of the Madreporaria," Journ. Linn. Soc. Lond., Zoology, vol. xviii., 1885, p. 163.

2 Pal. Franç., vol. viii., p. 478, pl. 117, figs. 2, 2a.

3 See Dennant and Kitson, Catalogue of the Described Species of Fossils in the Cainozoic Fauna of Victoria, S. Australia and Tasmania. Records of the Geol. Surv. Vict., vol. i., 1903, pt. ii., p. 131.

examples, were collected some years ago by Mr. J. H. Gatliff, who has presented them to the Museum collection. They are somewhat small, but otherwise typical, so far as can be said of a species in which no two examples are exactly alike in form.

Locality and Horizon.—Spring Creek Beds at Torquay. Tertiary (Janjukian). [9147-52].

Family—SPATANGIDAE.

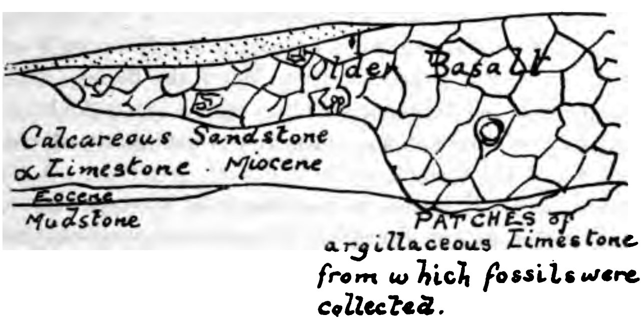
Genus—*Linthia*, Merian.

Linthia antiaustralis, Tate.

(Pl. XIX.).

L. antiaustralis, Tate, 1885, Southern Science Record, Vol. I. (New Ser.), No. 1, p. 4.

Observations.—The above species was described by Tate from the Murray River Cliffs, but there has been no previous record of its occurrence in Victoria. The example now recorded from Curlewis was collected by R. Daintree, and it was sent to the National Museum with other tertiary specimens from the Geological Survey Office in April, 1861. Daintree's note as to the precise spot where the fossils were obtained is as follows:—"These fossils were collected from the base of the cliff on



COPY OF SKETCH-SECTION TO SHOW SUPERPOSITION OF STRATA AT CURLEWIS (Ad 12), BY RICHD DAINTREE, APRIL, 1861.

which a fenced-in grave stands; the argillaceous limestone from which they were taken has been upheaved by the intrusive basalt, and where the limestone was sufficiently pure it has been converted into a coarse kind of marble." The Survey reference to the locality is Ad. 12, Section 23, Block 1, Parish of Moolap. A sketch is added by Daintree, which is here reproduced. Linthia antiaustralis was described, but not figured by Professor Tate. It may therefore be appropriate to give illustrations of the present example. The species differs from the living L. australis, as Tate points out, amongst other features, in its greater height, less tumid sides, and the shallower ambulacral zones having the anterior pair a little longer than the posterior, as compared with L. australis, in which they are of about equal length. Another important character is the difference in the angle of divergence in the posterior pair of ambulacra in the two forms, that of L. antiaustralis being 50 deg., whilst in the living species it is 43 deg.

Locality and Horizon.—Curlewis, near Geelong. Tertiary (Barwonian). [9154].

Genus—*Maretia*, Gray.

Maretia anomala, Duncan.

Maretia anomala, Duncan, 1877, Quart. Journ. Geol. Soc., Vol. XXIII., p. 52, PI. IV., Figs. 1-4.

Observations.—An incomplete specimen of a very large example of this handsome echinoid occurs in the National Museum collection. It was purchased from Mr. J. F. Bailey, who obtained it from the Beaumaris Cliffs. There is no doubt as to the accuracy of this locality, since this is sufficiently shown by the matrix of the specimen.

Duncan gives 2¾ inches as the length of his type specimen, and 2½ inches as the breadth. The present specimen has a breadth of 3¼ inches, while the length when complete would have been about 3¾ inches. The locality which Duncan gives for the type specimen is the Mouth of the Sherbrook River (loc. cit., p. 53). Messrs. Dennant and Kitson, in their Catalogue of Cainozoic Fossils,[1] give an additional locality, Aldinga.

1 Records Geol. Surv. Vict., vol. i., pt. ii., 1903, p. 131.

The present record is made from a higher horizon than that of the Sherbrook River. Further specimens from the same locality may show a varietal difference, but so far as can be seen ours agrees in all essential characters, and only differs in size.

Locality and Horizon.—Beaumaris, Port Phillip. Tertiary (Kalimnan). [4829].

Genus—*Eupatagus*, Agassiz.

Eupatagus rotundus, Duncan.

Eupatagus rotundus, Duncan, 1877, Quart. Journ. Geol. Soc., Vol. XXXIII., p. 53, Pl. III., Figs. 14-17.

Observations.—This species is not very abundant in our Tertiary beds. It is readily recognised by its exceptionally large size compared with the other Australian examples of the genus, the almost circular ambitus, the greater proportional height of the vertex, which is $\frac{2}{3}$ the length of the test, the nearly centric position of the apical system, and the sharply angulated peripetalous fasciole.

A fine specimen of this echinoid has been presented by Mr. F. P. Spry to the Museum collection [9156]. The test is partly encrusted by a hard pink or reddish brown limestone, and the fossil itself is of a brick-red colour. This specimen was said to be from Muddy Creek, but the exact locality was open to doubt. During a recent visit to the Hamilton District I was able to locate the bed of limestone from whence the present example was obtained. It is best developed at the junction of the Muddy Creek with the Grange Burn, and this particular fossil must have come from near the junction or below, on on the Grange Burn, since it is there that the reddish-coloured limestone occurs. The latter occurs as a very thick bed of foraminiferal and polyzoal rock (Amphistegina and Cellepora being the predominant genera), and throughout the bed are scattered numerous tests of echinoids, chiefly of Eupatagus rotundus. I also found a portion of a very large echinoid, probably referable to Linthia gigas, McCoy sp. This bed of foraminiferal and polyzoal limestone occupies a position immediately over the richly fossiliferous clays best seen elsewhere at Clifton Bank;

and it can be traced up the Grange Burn to within a short distance of Forsyth's, where it is overlain by the nodule bed and the Kalimnan shelly deposits. By the percolation of surface water the limestone has been fretted and excavated into numerous "swallow-holes" and caves on the Grange Burn opposite Mr. Henty's farm, where it perhaps attains its maximum thickness.

Duncan's original locality for this species is the Tertiaries of the Murray River (loc. supra cit.). Since then the species has been discovered in several localities, but apparently not at Muddy Creek. Messrs. Dennant and Kitson[1] have given the distribution of E. rotundus as follows:—Aire Coast?, Gellibrand River, Glen Aire, Calder River, Maude, Waurn Ponds, Murray River, Spring Creek, to which should now be added Muddy Creek and Grange Burn, near their junction.

Order—POLYPLACOPHORA.

Family—*Ischnochitonidae.*

Genus—*Ischnochiton*, Gray.

Sub-Genus—*Ischnoplax*, Carpenter.

Ischnochiton (Ischnoplax) granulosus, Ashby and Torr sp.

(Pl. XVIII., Figs. 5-7).

Acanthochites (Notoplax) granulosus, Ashby and Torr, 1901, Trans. Roy. Soc., S. Aust., Vol. XXV., p. 139, Pl. IV., Fig. 9.

Observations.—The above species was founded on median valves from the Balcombian clays of Schnapper Point (Balcombe's Bay, Port Phillip). Curiously, three out of five specimens of this fossil in the National Museum collection are tail-valves, and since this part of the external covering has not yet been described, details are now given, with drawings from two of the specimens.

This species must be transferred of the genus Ischnochiton, occasioned by the discovery of the tail-valve, particularly characterised by a callus-termination of the posterior border of the articulamentum; and to the sub-genus Ischnoplax, since the shape

1 Op. cit., p. 132.

of the valves indicate a narrow body, with an elevated posterior valve and a posteriorly situated mucro. In view of the fact that Acanthochites, subgenus Notoplax, is distinguished by the numerous slits in the articulamentum of the tail-valve, which latter also projects beyond the integumentum posteriorly, it is difficult to discern the ground upon which the original authors of this species founded their conclusions as to the genus in which it should be placed, seeing that they record only median valves.

Description of Posterior Valve.—Dimensions — Specimen a. [4843]: Length, 7 mm.; greatest width, 7 mm. Specimen b. [4842]: Length, 8.5 mm.; greatest width, 9 mm. Distance from point of mucro to external posterior border, 2.5 mm. Height at anterior margin, 3.75 mm. (specimen a). Width of sinus (spec. a), 3 mm.; (spec. b), 3.75 mm.

Dorsal area bluntly wedge-shape, the summit, ending in the mucro, roundly ridged and bearing about 16 longitudinal striae, which become broken at the sides into rows of elliptical or elongate-subquadrate beads. There are about 14 of these bead-like striae on each side of the dorsal slope, over which they are disposed in a radiately curved manner, and focussed on or around the mucro. There are two beaded striae to one intermediate and shorter. Area behind mucro, plane, undulate or slightly concave, ornamented with numerous small pustules arranged in a rather obscurely quincuncial pattern. The outer borders of these pustules each carry a pigmented centre, slightly depressed, showing the presence of the rudimentary eyes. The articulamentum is of a pale creamy yellow, contrasting with the pale sage-green colour of the tegmentum. As seen from the under side, it is thickened and wrinkled by divergent ridges on either side of the mucronal pit, and is delicately crenulated on the posterior border. The sutural laminae are produced 1.25 mm. beyond the tegmentum, as seen from the upper surface.

Affinities.—Of living species of the sub-genus there appears to be only one well-authenticated example—viz., Ischnochiton (Ischnoplax) pectinatus, Sowerby sp.,[1] whose habitat is in the West Indies (Cuba, Guadaloupe and Barbados). The salient differences between the recent and the fossil form are the den-

1 Chiton pectinatus, Sow.; Ann. Mag. Nat. Hist., 1840 (June), p. 288, pl. xvi., fig. 3. See also Tryon and Pilsbry, Manual of Conchology, vol. xiv., p. 64, pl. xvii., figs. 25-30.

ticulate posterior margin of the articulamentum of the tail valve, and the slightly greater elevation of the dorsal area in the former.

Locality and Horizon.—Balcombe's Bay, Port Phillip. Tertiary (Balcombian). Collected by Mr. W. Kershaw.

For valuable assistance in comparing these fossils with the living types, I am much indebted to Mr. R. A. Bastow.

EXPLANATION OF PLATES.

Plate XVII.

Fig. 1.—Spicules of *Ecionema newberyi*, McCoy sp. An oxea; slightly curved form (the principal skeletal spicules).

Fig. 2.—An oxea, having a sigmoidal curve.

Fig. 3.—Protriaene, with straight cladi.

Fig. 4.—Protriaene with curved cladi.

Fig. 5.—Dichotriaene.

Fig. 6.—Another, fragmentary specimen.

Fig. 7.—Microrabd (microstrongyle), showing pitted surface.

Fig. 8.—Probably a spiraster, with spines developed towards one end.

Fig. 9.—Microxea, with whorls of spines.

Fig. 10.—Spheraster, with arms terminated by spines.

Fig. 11.—Sterraster.

Fig. 12.—Sanidaster.

Fig. 13.—Protriaene, with sigmoidally curved cladi.

All figures on the above plate magnified 52 diameters.

Plate XVIII.

Fig. 1.—Comoseris (Oroseris) australis, sp. nov. A drawing from a wax squeeze. × 2.

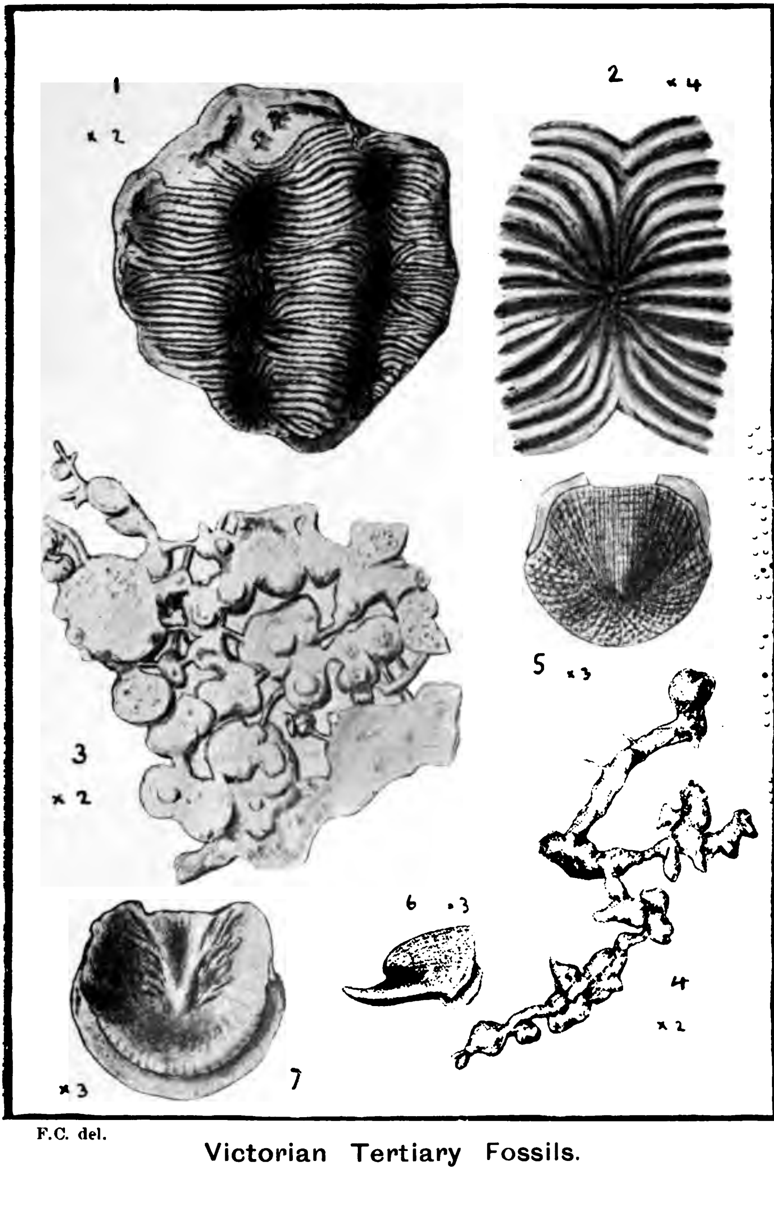
Fig. 2.—The same. A calice more highly magnified. × 4.

Fig. 3.—Cliona mammillata, sp. nov. Natural casts of the chambers. × 2.

Fig. 4.—? Cliona peregrinator, sp. nov. A natural cast. × 2.

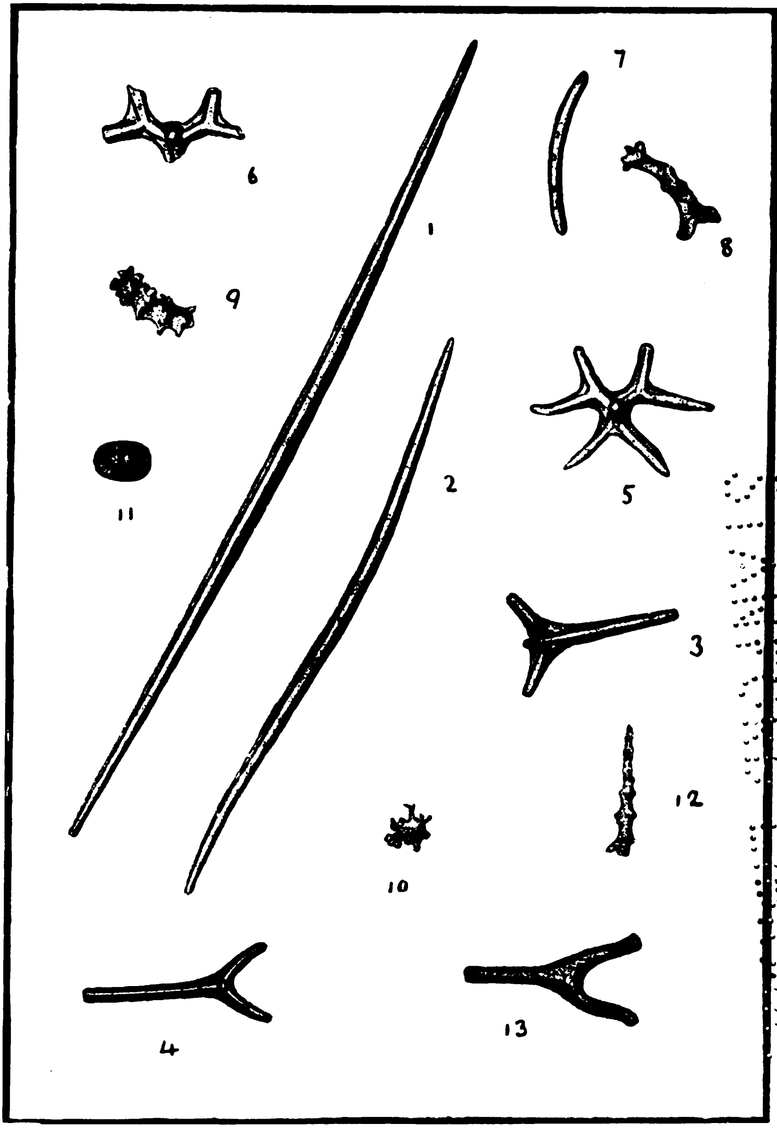
Fig. 5.—Ischnochiton (Ischnoplax) granulosus, Ashby and Torr. sp. Posterior valve, dorsal view. × 3.

Fig. 6.—The same; side view. × 3.



F.C. del.

Victorian Tertiary Fossils.



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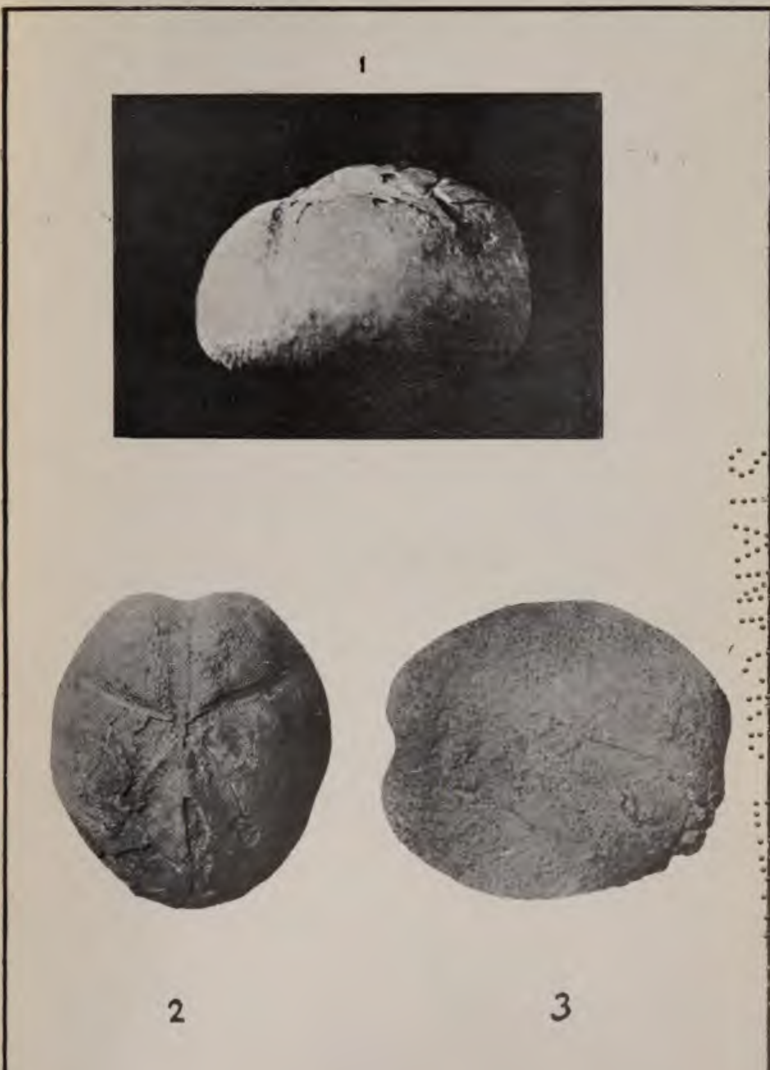
Spicules of Ecionema newberyi, McCoy, sp. (× 52).



F.C. photo.

Linthia antiaustralis, Tate.

Fig. 7.—Another specimen; ventral aspect, showing the articulamentum with the thickened area and crenulated border. × 3.

Plate XIX.

Fig. 1.—Linthia antiaustralis, Tate. Profile.
Fig. 2.—Linthia antiaustralis, Tate. Dorsal view.
Fig. 3.—Linthia antiaustralis, Tate. Ventral view.

All figures natural size.

[Proc. Roy. Soc. Victoria, 20 (N.S.), Pt. II., 1907.]

Art. XV.—*The Anatomy of Some Australian Amphibia.*

Part I.

A.—The Openings of the Nephrostomes from the Coelom.

B.—The Connection of the Vasa efferentia with the Kidney.

By GEORGINA SWEET, D.Sc. (Melb. Univ.).

(With Plates XX., XXI.).

[Read 12th December, 1907].

INTRODUCTION.

The research, of which the following is a record, was suggested in the first instance by the conspicuous character of the Nephrostomes in the common "green" frog of Victoria, *Hyla aurea*, especially in connection with Professor Sedgwick's statement, so recently as 1905, of his doubt of the correctness of the descriptions of previous workers on the European and American genus, Rana. So far as I have been able to find, Rana, Bufo, Discoglossus, Bombinator and Alytes are the only genera of the Anura which have received any attention from workers in reference to the points herein discussed. The remainder of the Bufonidae, the Hylidae and the Cystignathidae, have been untouched heretofore. These three families are well represented in Australia, especially the Cystignathidae. I have therefore endeavoured to fill the gap by this work on the following eight forms:—

Hylidæ.

Hyla aurea. *H. lesueurii*

Bufonidæ.

Notaden bennetti. *Pseudophryne australis.*

CYSTIGNATHIDÆ.

Crinia signifera.	*Chiroleptes alboguttatus.*
Heleioporus pictus	*Limnodynastes dorsalis.*

In the consideration of the two points especially dealt with in this paper, a study of the general structure of the kidney and testis also becomes necessary.

A.—THE OPENINGS OF THE NEPHROSTOMES FROM THE COELOM.

The special interest of the Nephrostomes, or openings from the body cavity, in connection with the kidneys, as has previously been pointed out, lies in (1) the fact that they exhibit according to the findings of Marshall, Bles, Frankl and Farrington *(vide infra)* in the forms examined by them, a good example of transference of the structural relationships and function of an embryonic organ during development, and (2) the importance of determining the exact forms in which an organ present in the embryo loses its function or ceases to exist in the adult. That these nephrostomes are present in the larval Amphibian, as well as in the embryo of other groups, is well known: that they persist in the adult of many of the Fishes and of the Urodeles or "tailed-Amphibia," still with their embryonic relationship to the uriniferous tubules of the kidney is also an accepted fact, their function in this case being doubtless the passage of fluid material from the coelom to the exterior. Moreover it is just as certain that they do not normally persist in the adult of the higher Vertebrata. It becomes desirable then to ascertain just where these structures disappear as a feature of the adult, and what changes take place in their relationships and function during their disappearance.

Historical.

The history of the discussion as to the presence and relationships of the nephrostomes in the Anura is a very interesting one. I give it here in brief outline:—

1874. Heidenhain. [Ecker, pp. 327, 336] was unable to find them.

1875. Spengel. [Spengel, '77, and Marshall and Bles, '90, p. 147] stated that the nephrostomes open on the surface of the kidney. He found them in Rana, Bufo, Bombinator and Discoglossus. There may be one nephrostome to two tubules, or one to four nephrostomes to one tubule. They are connected with the fourth part of the uriniferous tubule.

1875. Meyer. [Ecker, pp. 328 and 336, and Marshall and Bles, '90, p. 147]. Quite independently and unknown to each other, Meyer confirms Spengel's work. He found 250-360 in Rana.

1877. Nussbaum. [Farrington, '93, p. 309], confirmed previous work as to the internal opening.

1880. Nussbaum. [Ecker, p. 328, 336: Nussbaum, '80], stated that the nephrostome is connected with the neck of the tubule in the larva, but opened into the Renal Portal Vein in the adult.

Weidersheim, according to Haslam [Ecker, p. 336], at one time stated that the nephrostomes had no openings at all on the surface.

1886. Nussbaum and Wichmann. [Marshall and Bles, '90, p. 150]. These found that in Rana fusca, R. esculenta, Bufo calamites, and Alytes obstetricans, they open into the Renal Veins and so to the Inferior Vena Cava.

1886. Hoffmann. [Hoffman, '86], asserted that they end blindly in the adult, though connected with the neck of the capsule in the larva.

1886. Wiedersheim. [Wiedersheim, 86, p. 756], accepts Nussbaum's work of 1886 with the remark that the peritoneal fluid is no longer lost, but is returned to the general circulation like the rest of the lymph.

1889. Haslam. [Ecker, p. 336], states that he could not find any trace of them, and that if present (1) they are very difficult to find, (2) they do not form a free communicating path between any part of the uriniferous tubules and the abdominal cavity, and (3) their superficial terminations have no free cilia.

1890. Marshall and Bles. [Marshall and Bles, '90, p. 133]. They are easily seen, though not in every section in a series; also, the whole length of a nephrostome is rarely seen in one single section. The nephrostome-tubule has no relation except of apposition with the urinary tubules, and opens by a conspicuous aperture through which a tuft of flagella projects into the Renal Vein.

1893. Farrington. [Farrington, '93], states that in Rana catesbiana, and R. virescens, they may open directly inwards, or take a short horizontal first. He could not trace the internal opening with certainty: though ciliary action was seen at the external openings. By injection, he obtained almost conclusive proof of their connection with the Renal veins near the ventral surface.

1898. Bles. [Bles, '98], finding considerable scepticism regarding the point, exhibited before the Cambridge Philosophical Society 4 sections, "showing a nephrostome tubule opening into a narrow space lined with endothelium and containing a blood-corpuscle, the space being continuous with venous spaces in neighbouring sections."

1898. Frankl of Vienna. [Frankl, '98], attacking an allied problem finds incidentally by injection that there is no connection between the nephrostomes and urinary tubules.

1898. Beissner. [Beissner, '98], confirms the statements of Nussbaum [1886] Marshall and Bles.

1902. Marshall's "Frog." In the 8th edition of this work, the Editor confirms and accepts Marshall's and Bles' findings in 1890 and 1898, i.e., that the nephrostomes open into the Renal Veins.

1902. Howes. [Howes, '02, Pl. VII., Figs. XXXV., and XXXVI.], shows clearly the opening into these blood-vessels.

1905. Sedgwick, in the new edition of his text-book of Zoology ['05, p. 295], writes: "In the Anura nephrostomes are present. . . . It has been asserted that they open into the Renal Veins. This statement must be accepted with caution. It appears more probable that they have lost their connection with the renal tubules, and persist as ciliated cups on the surface of the kidney."

1906. Holmes, ['06, p. 204] accepts the internal opening of the nephrostomes as into the branches of the Renal Vein.

It was then with the hope that our Australian forms might throw some light on this problem, that this part of the work has been done.

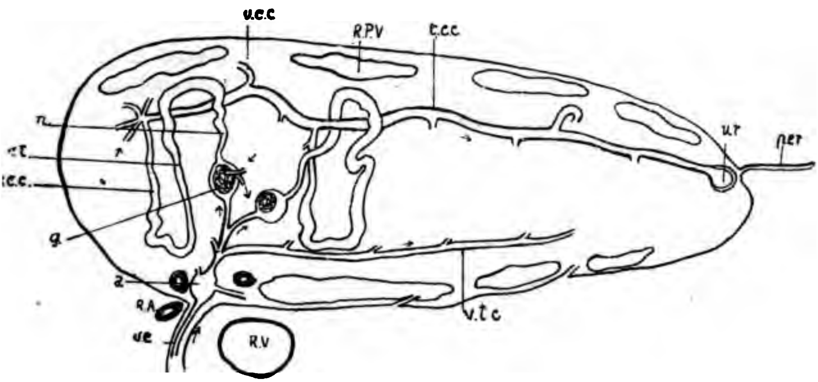
Structure.

In general external form and position, the kidneys of the forms examined do not differ materially from those of Rana, being flattened bodies, three to four times as long as they are broad, and one-third to one-quarter of their width in thickness. [See Pl. XX., fig. 1.] Situated just ventral to the dorsal body wall, in the abdominal lymph space, they are covered ventrally by the peritoneum which keeps them in position against the dorsal body wall. The ventral surface is generally flat or occasionally distinctly concave, while the dorsal surface is always more or less convex. The outer edge of each kidney is formed by the ureter which arises by branches in the substance of the kidney, and runs back behind the kidney dorsal to the large intestine, to open into the roof of the cloaca.

Blood-vessels.—The Renal Arteries vary in number, being generally in 5 or 6 pairs. They enter the kidney usually at about one-third of its width from the inner edge, and break up at once into numerous branches. Somewhat dorsal to the ureter runs the Renal Portal Vein often receiving one or more lumbar veins from the body wall. This vein breaks up into numerous branches running inwards across the dorsal surface of the kidney, breaking up as they do so. The Renal Veins arise on the ventral surface of the kidney, sometimes nearer to the inner edge than the entrance of the Renal Arteries (e.g., in Crinia signifera). More often these veins leave the kidney on the outer side of the arteries (e.g., in Hyla aurea, Pseudophryne australis, Heleioporus pictus, Notaden bennetti, and

Chiroleptes alboguttatus), in which latter they arise from the middle of the kidney. In a few forms, these veins are very short, the kidneys being so closely apposed as to appear as one mass ventrally, as in Pseudophryne australis and Notaden bennetti. Rarely the kidneys are distinctly unequal in length as in Chiroleptes alboguttatus, where the right kidney is fully 2 mm. longer than the left.

In the more detailed structure of the kidney, considerable variations are found.



Scheme of Amphibian Kidney seen in transverse section—to show the relationships of the male reproductive ducts and the uriniferous tubules.

a.	=	Ampulla on longitudinal Bidder's canal.
c. t.	=	Ciliated part of uriniferous tubule.
g.	=	Glomerulus of Malpighian body.
n.	=	Neck of uriniferous tubule.
per.	=	Peritoneum.
R. A.	=	Renal Artery.
R. P. V.	=	Renal Portal Vein.
R. V.	=	Renal Vein.
t. c. c.	=	Transverse collecting canal.
ur.	=	Ureter.
v. c. c.	=	Vertical collecting canal.
v. e.	=	Vas efferens.
v. t. c.	=	Ventral transverse canal.

Hylidae.

Hyla aurea.

This may be taken as the normal type. [See Pl. XX., fig. 1.] In transverse section the kidney is more or less triangular, the base being towards the middle line of the body. The branches of the Renal Veins occupy much of the outer part of the ventral side, the Renal Arteries entering nearer the inner edge of the kidney. The peritoneum is continued dorsally on the kidney for a short distance from the outer edge, but leaves the kidney well before it reaches the inner edge of the ventral surface. An "adrenal body" is present on the ventral part of each kidney.

The fibrous connective tissue supporting the tubules and blood-vessels is present here, to much the same extent as in Rana, where it has been known as "kidney-parenchyma" by some German writers [Cf. Pl. XXI., fig. 3.] The Malpighian bodies are often very much elongated, but not always, their greatest length being found in the inner part of the kidney. They form a more or less irregular layer in the upper part of the ventral half of the kidney. The neck emerges from the dorsal part of the Capsule, and runs more or less vertically upwards. The blood-vessels enter and leave the side of the glomerulus. There are no special points of difference in the microscopic structure of the tubules calling for comment—the pavement epithelium of Bowman's Capsule, the ciliated cubical epithelium of the neck, the large-celled convoluted portion often pigmented, and the collecting tubes with their wider cavities and more or less cubical epithelium, being very similar to corresponding parts found in other forms such as Rana.

Under favourable conditions, there may be seen under a hand-lens numerous minute pit-like structures on the ventral surface of the kidney. These are the external openings of the nephrostomes. These funnel-shaped depressions are situated chiefly on the inner half of the ventral surface of the kidney, and pierce the peritoneum which is loosely attached to the kidney wall. The walls of the "funnel" are formed of large cubical flagellated cells, with round, sharply defined nuclei—the flagella are always directed inwards, away from the surface of the kidney. [Cf. Pl. XXI., fig. 3.] Throughout this paper, the word "cilia" will be used instead of "flagella" for convenience —though the latter is undoubtedly more correct.] In number the nephrostomes vary considerably—from 150 to 200—[Cf. Rana catesbiana with 150 at most, and R. esculenta with 250 to 360, Farrington, '93]. In diameter they average in this form 0.04 mm., i.e., somewhat larger than in Rana; in length or depth, the funnel averages 0.09 mm. In H. aurea we occasionally find long branched ciliated tubules present as direct internal prolongations of the funnels, these run parallel to the surface, or at other times towards the centre of the kidney for about one-third of its thickness, from the ventral edge. I have not been able to detect any division or union of these finer tubes, such as has been described by Spengel in Rana [Spengel, '77, p. 330]. Not infrequently, a large funnel is seen close to the outer edge of the kidney where the parietal peritoneum leaves the kidney to become attached to the body-wall.

The effects of the activity of their cilia may sometimes be seen on the surface of the kidney, in the currents set up by their movement, e.g., when the living kidney is placed in salt solution containing finely divided carmine. In such a case, in H. aurea, I have seen undoubted though small movement of the suspended particles of carmine, all external source of movement having been carefully eliminated—although Haslam and Farrington state that they have been unable to detect any such evidence of ciliary movement, in the forms examined by them.

Their internal relations are by no means easy to make out, owing to two circumstances. Not only must the internal opening (if such exist) be very minute, else the corpuscles may be forced through it outwards, but it is also extremely likely that even if it be not collapsed at death, it will contract during fixation. After the examination, however, of numerous complete series of sections, amounting to many thousands in number, there is not the slightest doubt as to the existence of an internal opening [Cf. Pl. XXI., fig. 3], and that this leads into the Renal Veins, or into blood spaces directly continuous with these veins, the long cilia protruding into these cavities among the corpuscles much in the same way as in Rana [Bles, '98, p. 75; Howes, Pl. VII., Figs. XXXV., XXXVI.]. The actual internal opening has only been found in other forms among the

Anura, so far as I am aware, by Nussbaum and Wichmann, Marshall and Bles, in the genera Rana, Bufo, Bombinator, and Alytes. Several others speak of the close relationship of the internal end with the blood-vessels, but state that the opening could not be traced with certainty. In no case, however, is there any semblance of a connection with the Renal tubules.

In order to further test the truth of this observation, various experiments were made. In the first of these, a modification of Nussbaum's method, carmine was injected into the body cavities of freshly pithed frogs, so that the carmine might if possible be taken in through the ciliated funnels. Upon examination, the carmine was found to have entered the kidney by these openings and to be present only in the blood-vessels of the ventral surface, in the Renal Veins, and in the Posterior Vena Cava. In the second experiments, carmine was carefully injected into the Renal Portal Vein of a freshly-killed frog, an opening being made in a branch of the Truncus Arteriosus. After proper fixing, staining, embedding and sectioning, the carmine was found to be present in all the venous spaces of the kidney, some having escaped under the considerable pressure exerted, through the nephrostomes, the particles being entangled among the cilia of these funnels. But I was not able to find any carmine within the kidney tubules. Farrington ['93, p. 312] found considerable difficulty in preventing the carmine particles from being scattered by the knife, through every part of the kidney; but in these experiments of mine, no such difficulty appeared, as the carmine was present in such a manner in the blood spaces as to leave no room for doubt as to the method of its distribution.

Hyla lesueurii.

The general relations of the kidney are as in H. aurea. The adrenal body is very well developed.

The nephrostomes are comparatively few in number, averaging about 30 in each kidney. Here also I have been able to detect an internal opening from the nephrostomial funnels into the blood spaces on the ventral surface of the kidney. This observation is confirmed by the results of injection. After injection of the body cavity of freshly-pithed frogs as previously described for H. aurea, the carmine particles were found in the nephrostomial tubes and throughout all the blood-spaces of the kidney and in the Renal and Renal Portal Veins, in which the particles were embedded in the mass of coagulum, but none in the uriniferous tubules or ureter. Apparently the pressure in the Posterior Vena Cava was so great in this instance that the carmine found it easier to spread back into the branches of the Renal Portal Vein than to pass on into the Posterior Vena Cava.

BUFONIDAE.

Pseudophryne australis.

The kidneys in this form are much more triangular in transverse section than those of Hyla aurea, the outer edge being formed by the ureter ventrally and Renal Portal Vein dorsally. The Renal Veins emerge at the ventral edge of the inner side, while the Renal Arteries enter the kidney just internal or dorsal to the exit of the Renal Veins, and the Vasa efferentia enter immediately to the outer side of these veins.

The general arrangement of the uriniferous tubules seems to be as in Hyla aurea, the difference in character between the glandular and conducting parts of the tubules being specially well-marked. The Malpighian bodies are almost spherical and somewhat less numerous than in Hyla aurea. There is but little supportive fibrous tissue, though the blood-spaces are still small and normal in relationship. The nephrostomes are most numerous posterior to the plane of the hinder end of the Testes, and from the median line of each kidney outwards. Their funnels run more lengthwise and obliquely in the kidney in this form than in the previous forms, so that they are less often cut longitudinally in transverse sections of the kidneys. However, here, as in Hyla aurea and H. lesueurii, they open into the blood-spaces directly connected with the Renal Veins, their internal ends being always surrounded by a mass of blood corpuscles.

Notaden bennetti.

The kidneys of this form show the same tendency to adpression of the inner part of their dorsal surfaces as has already been found in Pseudophryne australis. Here also the Renal

Veins are short and enormously large, causing often deep depressions on the ventral surface of the kidney. The ureter in some specimens of this species lies right outside the kidney in the parietal peritoneum. Seen in transverse section [see Pl. XX., fig. 2], especially in the posterior half, the kidney of Notaden is conspicuously unlike any of the forms so far described. The vertical disposition of the tubules is very strongly marked, in places forming radiating lines from the midventral line of the kidney. The tubules have often pigmented walls. There is practically no "kidney-parenchyma," the whole kidney being extremely vascular, more so than in any other form of which I have any knowledge, though Chiroleptes alboguttatus, and Heleioporus pictus are also remarkably vascular. The extreme posterior end has comparatively small blood-spaces, but they increase very rapidly in size and number forwards from this point. Along the midventral line of each kidney is developed as a core or "pelvis" occupying one-third to one-half the thickness of the kidney, a series of large venous spaces traversed or subdivided by a network of trabeculae, the blood-spaces in which are connected on the one hand with the Renal Veins, and on the other with the radiating blood-spaces of the general kidney-substance. The general appearance of the kidney microscopically is that of a groundwork of corpuscles in which the tubules and Malpighian bodies are embedded. The Malpighian bodies are normal in number, round and somewhat small in comparison with the size of the kidney. Those in the outer half are often quite close to the ventral surface of the kidney, while those elsewhere form two or three irregular rows at about the middle of the kidney thickness. The differences in structure and appearance between the necks of the Capsules, the conducting, glandular and collecting tubules, though similar in character to that found typically as in Hyla aurea, are very much more strongly marked. The nuclei of the cells forming the necks, and the conducting tubules stain very deeply indeed with nuclear stains, so that it is only by careful tracing of the tubules along their length that one can believe that these parts and the glandular parts are really connected.

In nephrostomes also, Notaden bennetti is quite unlike previously-described forms. They are extremely numerous posteriorly where the venous spaces form nearly half the thickness of the kidney, and diminish in number somewhat irregularly towards the anterior end. In one kidney alone I counted 1067 external openings of nephrostome funnels: I have seen as many as 10 external openings in a single thin section across one kidney. There are here several totally different types of nephrostomes. The first are the normal ones like those found most frequently in Hyla aurea, which are wide, short and unbranched, and run almost horizontally beneath the kidney surface, and emptying directly into the main venous spaces, very much like that figured for another form in Fig. 4, except that there is no supporting tissue in Notaden bennetti. The second set, although resembling some of those in Hyla aurea in that they branch, are quite distinct from those in the structure of the "funnel." This is long, narrow and more tubular than in any form previously described: it branches freely, running a considerable distance into the centre of the kidney. The branches, of which there may be as many as five from one nephrostome, run generally along the trabeculae and then leaving them, end in a blood-space. There I believe them to open, though I have not been able to detect the actual aperture. These nephrostomes are especially numerous on either side of the main venous space.

Just within the inner and outer edges of each kidney, especially in the outer edge, are here and there coils of small thin-walled tubes, whose cells have deeply staining nuclei, resembling generally the second or branching type of nephrostomial-tubule. Sometimes these open clearly to the exterior—some even on the dorsal side of the outer edge and anteriorly (though still through the peritoneum which often is continued on to the dorsal side of the kidney for a short distance)—at other times they do not open, but are still connected with the surface of the kidney, and may end blindly internally in a swollen mass of cells—or, one, two, or three nephrostomes may open into a single uriniferous tubule in its 4th part—or, yet again, may apparently come into relationship with a smaller type of Malpighian body than that usual elsewhere, while in yet others, the Malpighian body is still there, but is very degenerate.

It is, I think, evident that here we have exactly what Spengel [Spengel, '77] and Meyer have described in Rana, viz., that the nephrostomes open into the 4th part of the uriniferous tubules, and that two or more funnels may open into one tubule and vice versa. It is curious that after 20 years, during which time no one has confirmed Spengel's and Meyer's work, but on the contrary everyone has shown it not to be true in the generality of cases, one should come across a similar condition evidently as a passing stage in a form such as Notaden belonging to quite a different group of the Anura.

Forms of Notaden bennetti have been examined from New South Wales as well as Central Australia. The description above given refers to the Central Australian form. There is no comparison in the amount of blood supply in the two sets of forms, the New South Wales form being practically normal as regards its general vascularity, though there is still a lack of supporting tissue, and a tendency to a central arrangement of large venous spaces such as are so marked in the Central Australian form of Notaden, and to a less extent in Heleioporus, as will be seen later. It should be added, however, that in the New South Wales, as well as the Central Australian forms, the various types of nephrostomial tubules are present, although the total number of external nephrostome openings is very much less.

Notaden, it may be remembered, is one of the burrowing forms met with frequently in Northern Central Australia, where during the drought season they remain underground, in permanent burrows, having first filled themselves out with water [Spencer, '96, pp. 159, 163, etc.]. This water is apparently taken in through the mouth, and probably through the skin also, during the time of plentiful water, being then absorbed into the vascular system, and excreted by the kidneys, passing into the urinary bladder. It will be found that in the Report of the Horn Expediton [loc. cit.] Professor Baldwin Spencer has described this water as being in the body-cavity of these frogs, but he informs me that on subsequent visits to Central Australia and dissection of a considerable number of forms, he has discovered that it is stored in the urinary bladder and not in the body cavity. In Notaden bennetti there is always a considerable amount of coagulum along the ventral surface of the kidney, showing the presence of considerable lymph in the body cavity also. How the presence of so much water in the bladder is related to the tremendous development of the nephrostomes in this form is not at all easy to see, though there is certainly an intimate relationship between the two facts. It seems most probable that the water from the extremely thin-walled bladder soaks out into the body-cavity, and is passed back by the nephrostomes into the blood vascular system whence what is required may be taken by the organs of the body, the surplus being again excreted into the bladder, and so on; thus maintaining a constant circulation of this water for the benefit of the body generally. This return of waste with the water from the bladder would be less injurious than in the ordinary frog, since in these aestivating frogs oxidation of the tissue will be at a minimum, probably only sufficient to maintain life.

Cystignathidae.

Crinia signifera.

The general kidney arrangement does not call for any special comment, the relationships of the kidney tubules, blood-spaces and supportive tissue resembling those found in Hyla aurea. The glomeruli are spherical, very few in number, and situated close to the ventral surface. The nephrostomes also are very few in number, what there are being chiefly at the anterior end. Their walls, however, are very easily distinguishable from those of the uriniferous tubules. They are often not much more than a slit, in some cases no cavity or cilia being visible, but wherever determinable, they open into the venous blood-spaces on the ventral surface.

The body cavity of this form also was injected, with the result that the carmine was drawn through the nephrostomes into the blood-spaces of the ventral one-third of the kidney, though to a very much less extent than in other forms similarly treated. The small number of nephrostomes, their frequently diminished cavity, and their apparently smaller functional activity would seem to indicate that in Crinia signifera, they are rapidly losing their function and ceasing to exist, compared with other forms herein described, unless possibly Hyla lesueurii.

Chiroleptes alboguttatus.

This form, like Notaden bennetti, is a burrowing one which stores up water in its body while aestivating. Its kidneys are almost oval in transverse section, and seem peculiarly liable to be folded back against one another, their inner edges with the Renal Veins forming the ventral edge of the mass (Cf. also Pseudophryne australis, and Notaden bennetti). The dorsal surface of the kidney is the more convex. The kidneys resemble those of Notaden in having the minimum of fibrous tissue and very large blood-spaces, though the large central venous space found in Notaden is lacking here, the Renal Veins arising in the usual way in Chiroleptes alboguttatus. The general vertical (dorso-ventral) arrangement of the tubules and blood-spaces is very strongly marked as seen in transverse sections, the tubules being much pigmented and the blood-spaces crammed full of corpuscles. The Malpighian bodies are rounded, very few in number, and remarkably small in comparison with the size of the kidney. Indeed one often comes across sections in which no sign of Malpighian bodies is to be seen. They are found in the ventral one-third of the kidney thickness. The nephrostomes, on the other hand, are numerous and well-developed, though not nearly to such an extent as in Notaden bennetti. In number I found in one kidney, 210 external openings, the number diminishing from the anterior end backwards. There is hardly a section in a full series through the whole length of the kidneys, in which the nephrostomes are absent, while there may be as many as six in one section. To a certain extent they resemble Notaden in having two kinds of "funnels," though the branched forms are much less developed than in Notaden. These slope inwards as a rule, at an angle of 20 to 30 deg. for a short distance, and then branch: the branches coil more or less through the substance of the kidney, but always end in blood-spaces, where their cilia protrude among the corpuscles which are so densely packed around these internal openings. There is also, near the median edge of the kidney a series of large short nephrostomial funnels which open immediately without branching into the main Renal Veins.

The strength of the blood pressure in the kidney, as well as a corroboration of the connection of the funnels with the blood-spaces, is shown in the fact that in two or three cases the red corpuscles had been forced through the internal opening of the nephrostome funnel, and were lying entangled among its cilia. As may be inferred from this statement, the cavity in many of these funnels is much greater than in some others of the previous genera. Here, too, although the development of nephrostomes is not so great as in Notaden bennetti, the association of intense vascularity of the kidney with aestivation is very evident.

Heleioporus pictus.

Here also the kidneys are almost oval in transverse section. The Ureter and Renal Portal Vein lie on the dorsal surface, near but not at the outer edge. Heleioporus pictus is another of the burrowing aestivating forms, and, as in Notaden bennetti and Chiroleptes alboguttatus, we have here a very vascular kidney somewhat resembling Notaden in type, but much less developed. As in those forms also, the connective tissue is very small in amount, and the blood-spaces are so crammed full of corpuscles that no definite walls are often to be found. The regular dorsal-ventral arrangement of the kidney is interfered with somewhat by the greater convolution of the glandular part of the kidney tubules. The glomeruli are spherical and much more numerous than in the last two forms. The neck of the tubule opens dorsally from the Malpighian body, while the blood vessels enter and leave the outer side of the glomerulus [see Text figure and Pl. XXI., fig. 4]. The nephrostomes are not as numerous as in the last numbering in each kidney 105. They are almost entirely absent at the anterior end, gradually increasing in number to the beginning of the posterior one-third of the length of the kidney, and then diminishing very rapidly to the posterior end. They have been found to open some into the general venous blood-spaces of the kidney, where their cilia may be seen protruding inwards and surrounded by blood corpuscles: others lying on either side of the main branches of the Renal Veins may open directly into them. The funnels are large and long [see Pl. XXI., fig. 4], and in the case of the former, which are branching forms, after entering the kidney obliquely they run horizontally for some distance and then branch, their branches running along the trabeculae far into the ventral half of the kidney thickness. These branching forms of nephrostominal tubules resemble those of Hyla aurea, and Chiroleptes albogut-tatus, rather than the more strongly defined type found in Notaden. I have examined specimens from Central Australia and from Victoria, and find very little difference in the kidneys of the forms from the two areas.

Limnodynastes dorsalis.

The kidneys are here much flattened ventrally and convex dorsally, the adrenal body forming in transverse sections a conspicuous structure along the middle of the kidney. In general the internal structure is very similar to that found in Hyla aurea, the connective tissue being considerable in amount [see Plate XXI, fig. 3], and the blood-spaces small and empty and well-defined compared with those of the last three forms—the glomeruli are round and fairly numerous. The nephrostome funnels are short and unbranched and somewhat larger than in Rana catesbiana (.035 mm. in diameter according to Farrington ['93, p. 310]), while those of Limnodynastes dorsalis are .037 to .04 mm. They have a well-marked cavity, their internal ends projecting into the blood-spacas [Pl. XXI., fig. 3] among the corpuscles when these are present. I have not detected any funnels opening into the main branches of the Renal Veins as in some forms previously described herein. In specimens injected from the Renal Portal Veins under pressure, the carmine was found to be present throughout the blood-spaces, and had been forced out by the pressure into the funnels where the particles were found entangled among the cilia.

B.—The Connection of the Vasa efferentia with the Kidney.

Here, as in Part A, the object in view is to find a sequence of forms in this case illustrating the manner in which in the course of the evolution of the group, the male reproductive ducts have been gradually separated off from the kidney tubules. In the Fishes and in the Urodeles and Coecilidae, the male reproductive ducts are very closely connected with the anterior sexual part of the kidney. In Bufo and Rana esculenta, they are closely connected with the Malpighian bodies of the urinary tubules of the kidney; in Rana fusca the connection is less close, being only with the collecting tubules. The severance increases in Bombinator and Discoglossus, till in Alytes the male ducts open quite independently of the kidney, into the ureter: i.e., a portion of the mesonephric duct separates off as a duct for the testis, and at the level of the wider end of the kidney this joins the remnant of the original mesonephric duct which functions as a kidney duct.

The question of the relationships in Rana has been a much vexed one from the time of Bidder's work in 1846, but as most of it has arisen through the confusion of the two species R. esculenta and R. fusca, its results may be summed up as above. Nussbaum's work ['97, p. 425.], and that of Beissner ['98, p. 168.] practically settle the main connections as given above for these two species, the only variation between the two being that Nussbaum has only found the longitudinal Bidder's canal in R. esculenta, while Beissner describes it in R. fusca also.

General Structure and Relationships of Ducts.

The testes lie ventrally to the anterior portion of the kidney, being kept in position by the mesorchium, the fold of peritoneum which encloses them entirely, except for one part of their inner surfaces where the blood-vessels and ducts enter or leave them. [See Pl. XX., fig. 1.] In shape and size, they vary greatly in different individuals and at different times of the year—and as most of my material was spirit-preserved, except Hyla aurea, Crinia signifera and Limnodynastes dorsalis, due allowance has to be made for distortion by pressure of other organs.

HYLIDAE.

Hyla aurea. [Pl. XX., fig. 1].

When fully developed, the testes are long, whitish cylindrical bodies, each end being rounded. They average 10 or 11 mm. in length and 3 mm. in diameter. The Vasa efferentia run straight from the testis to the kidney, and then entering the latter spread directly dorsalwards, branching to enter the ventral ends of the long Malpighian capsules, as in Bufo [Spengel, '77] and Rana esculenta [Nussbaum, '97, 1 and 2, and Beissner, '98]. These canals have narrow cavities, and thin walls of small cubical cells with large darkly staining nuclei, and, as a rule, they stand out conspicuously in sections across the kidney of this form. I have not been able to make certain of the existence of a Bidder's canal in Hyla aurea, comparable to that described for Bufo cinereus by Spengel ['77], and by Nussbaum ['97, p. 425] for Rana esculenta, and by Beissner ['98, p. 168] for R. fusca also. There is no doubt, however, that the vasa efferentia do open into the Malpighian Capsules, unlike R. fusca, Bombinator, Discoglossus, and Alytes [Wiedersheim, '86 p. 784], where they open either into the collecting tubules (Cf. R. fusca), or into the ureter itself. As the testis in all male specimens examined by me was comparatively little developed, and no spermatozoa were present in the vasa efferentia, either inside or outside the kidney, it is possible that the Bidder's canal may be present, but small and contracted, and so evade recognition. It is chiefly the Malpighian capsules near the inner edge of the kidney which are thus connected with the vasa efferentia.

BUFONIDAE.

Pseudophryne australis.

Here the testes were large, flat, irregular in outline, together hiding fully two-thirds of the kidneys when viewed from the ventral surface, extending also anteriorly and laterally beyond each kidney. Here, as in all other forms of which male specimens were examined, the Vasa efferentia of each testis run in the mesorchium dorsalwards to the kidney of its own side. They then in Pseudophryne, enter the kidney at the outer edge of the Renal Veins without any previous branching. They appear to run straight in and without forming a Bidder's canal enter the Malpighian capsules at their ventral edge as in Hyla aurea. Curiously, although the testes in the specimens examined are large and well-developed, I could find no sperm in the vasa efferentia, the kidney or ureter. I have, however, no doubt as to the connection of the branches of the Vasa efferentia with the Malpighian capsules as above described. [Cf. Pl. XX., fig. 1.]

Notaden bennetti.

In the male specimens of this species available, the testes were spherical bodies having about the same diameter as the kidney itself, but quite unsymmetrically placed—the one at about the middle of the length of its kidney, the other at the posterior end of its kidney—each lying laterally to the kidney of its own side, the mark * [in Pl. XX., fig. 2] indicating the inner edge of the testis lying in the mesorchium. As stated in Part I. A., the ureter lies often in the peritoneum lateral to the kidney, and often, near the hinder end of the kidney and posterior to this, it swells out to form a large glandular Vesicula seminalis. The Vasa efferentia pass in along the mesorchium, and entering the kidney run straight out to open into the Bowman's capsules of the Malpighian bodies in the inner one-third of the kidney. I have been unable to find any longitudinal Bidder's canal.

Chiroleptes alboguttatus.

In this form the testes are long and thin, and in the specimens examined very feebly developed, probably owing to the season of the year. They were approximately one-half the length of the kidney and one-third its average width. The Vasa efferentia pass into the kidney at its inner edge from the inner side of the testis as usual, and spread out at once into the kidney substance without forming any longitudinal canal. Apparently they enter the ventral part of Bowman's capsule, as in previous forms. Owing to the extreme vascularity of the kidney and the great number of corpuscles present in all the blood-spaces, it is difficult to make out the relationship of these ducts further than as indicated above.

Heleioporus pictus.

The testes of H. pictus are very irregular in shape, and unequally developed on each side—that on the one side being nearly the full length of the kidney, and that on the other only half that length. The path followed by the sperm on its way to the exterior is more clearly seen here than in any other form examined by me, as not only were the testes very large and well developed, but the sperm could be traced right through the kidney to the ureter.

The Vasa efferentia leaving the testis run dorsally, forming a network in the mesorchium, to open into a longitudinal Bidder's canal. Both network and canal are continued posteriorly and also anteriorly to the plane of the testis. The canal lies further from the middle line than the Renal Arteries, and both are nearer the middle line than the Renal Veins. From the ampullae on this canal ducts pass both dorsally and laterally, dividing up greatly—one ventral branch runs ventrally towards the outer edge of the kidney forming the ventral transverse canal, as seen in the Text-figure. The branches of these canals open into the ventral part of the Malpighian Capsules. In many cases, this Bowman's capsule is greatly distended by the masses of sperm [See Pl. XXI., fig. 5], the glomerulus being pushed quite to one side. All the Malpighian bodies are not so connected with the sperm ducts, and there is certainly a relationship between the position of the Malpighian body and its connection or otherwise with the sperm ducts. Thus no sperm is to be found in the Malpighian bodies occupying the outer one-third of the width of the kidney even when sperm is present in the tubules near by. One is apt to be misled as to the existence of such connection, since it does not follow invariably that even when the sperm ducts, and the uriniferous tubules are both full of sperm, that any will be found in the Bowman's capsule to and from which they are clearly open. Nevertheless, I have not been able to find any sperm ducts opening into the Capsules along the outer edge of either kidney (Cf. previous forms, e.g., Hyla aurea, and Notaden bennetti). From the Malpighian bodies, the sperm passes by the ordinary uriniferous tubules into the transverse collecting tubes which run outwards parallel with the dorsal surface of the kidney to pass their contents into the ureter where the sperm may be seen in great numbers.

Lying in the coelom ventral to the kidney is a flat branching structure nearly coextensive in length with the testis on either side. It is attached to the mesorchium on the outer side of the latter, by connective tissue across which small arteries pass from the Renal Arteries, and small veins to the Renal Veins. In appearance it is somewhat lymphoid, and might be regarded as a rudimentary fat-body, this being absent in the specimens examined, but for its position. That structure is attached normally to the anterior end of the testis, while this lies between the kidney and the testis for almost the whole extent of the latter. A very rudimentary condition of what is apparently the same structure was seen in one instance in Notaden bennetti, where it is in much closer relationship to the kidney surface. I am unable at this stage to add any further evidence as to its homologies or function.

Limnodynastes dorsalis.

Here the testes are very similar to those of Hyla aurea, except that occasionally the testis may lie quite anterior to the kidney. The arrangement of the Vasa efferentia, of the sperm ducts in the kidney and their entrance into the Malpighian capsules, are all similar to that already described in previous forms. As in Hyla aurea, Pseudophryne australis and Notaden bennetti, I have not been able to find any longitudinal Bidder's canal, the Vasa efferentia apparently going straight into the substance of the kidney.

Summary.

The results of this enquiry may be briefly summed up thus:—

1. Nephrostomial openings from the coelom are present in each of the eight species examined—viz., Hyla aurea and H. lesueurii; Pseudophryne australis and Notaden bennetti; Crinia signifera, Chiroleptes alboguttatus, Heleiporus pictus and Limnodynastes dorsalis.

2. There are five main types of nephrostomes and nephrostomial tubules.

3. The first, which never branch, open directly into the main branches of the Renal Veins. These are present in all forms.

4. Those of the second type are unbranched nephrostomes opening into the uriniferous tubules, as first described by Spengel in Rana. These are found in Notaden bennetti only.

5. The third type consists of branched nephrostomial tubules opening into the venous spaces. These are found in all forms, and especially well developed in Notaden bennetti.

6. The fourth type is also branched nephrostomial tubes opening however into the uriniferous tubules. This is found in Notaden bennetti only.

7. The fifth type is a third form of branched nephrostome tube, which is closed at either or both ends. These are only known in Notaden bennetti.

8. It will thus be seen that in all forms, nephrostomes opening into the Renal Veins are present, these being the only type present in most; in one form Notaden bennetti, all five kinds of internal connections are found.

9. It appears evident that these structures are undergoing very rapid modification at the present time.

10. In Notaden bennetti and Chiroleptes alboguttatus, the vascularity of the kidney is very strongly marked—the uriniferous tubules appearing to lie in a series of much branched sinuses—the epithelial lining being in many cases almost impossible to determine. The same is true, though to a less extent, in Heleioporus pictus. The vascularity would thus appear to be associated with the capacity of these frogs for storing water in the urinary bladder while aestivating in their burrows during the dry seasons.

11. There is also a marked difference in the number of nephrostome openings in one kidney from a minimum of 30 in Hyla lesueurii, to a maximum of 1067 in Notaden bennetti.

12. Hyla lesueurii and Crinia signifera are the most degenerate in respect of their nephrostomes.

13. Evidence from frogs injected with carmine indicates that the nephrostomes do function for the conveyance of material from the body cavity into the kidney.

14. In all forms, the Vasa efferentia enter the kidney just external to the Renal Arteries.

15. In Heleioporus pictus a well-marked longitudinal Bidder's canal is present, as possibly also in Hyla aurea, though

not in Pseudophryne australis, Chiroleptes alboguttatus, Notaden bennetti, or Limnodynastes dorsalis.

16. In all forms examined the Vasa efferentia branch and enter the ventral part of Bowman's capsules, in the inner one-third or two-thirds of the kidney.

Conclusions.

It must be conceded that there is considerable evidence given by the forms herein described, that in the course of their disappearance in the adult condition during the evolution of the group, the nephrostomes have been subjected to well-marked modification—their original connection with the kidney tubules being transferred to the Renal Veins, with a correlated change of function from the passage of fluid to the exterior from the body cavity, to that of lymph vessels. Moreover their degree of development seems to be to a great extent individual or characteristic of the species, varying greatly in harmony with their functional importance both in turn being associated apparently with differences in the habit of the animal. In Notaden bennetti for some reason or other, alongside the greater development in one direction, there seems to have been a check to the harmonious development of these structures in all parts of the kidney, since there are still present along the edges, nephrostomial tubules in various stages of modification, as to their internal connections.

In all the species here described, of which male specimens were obtained, we find that the separation of the male reproductive ducts from the excretory ducts has not yet begun, the condition being comparable to that found in Rana esculenta, the higher stage found in Rana fusca not being present in the Australian species so far examined. They are therefore far less specialised than are the corresponding parts in Alytes obstetricans, the most specialised known in the Anura.

I have again to thank Professor Baldwin Spencer for the use of the Biological Laboratory in the University of Melbourne, where this work has been done, and for the use of his collection of specimens, and those of the Biological Museum, as well as for much kindly interest and valued advice.

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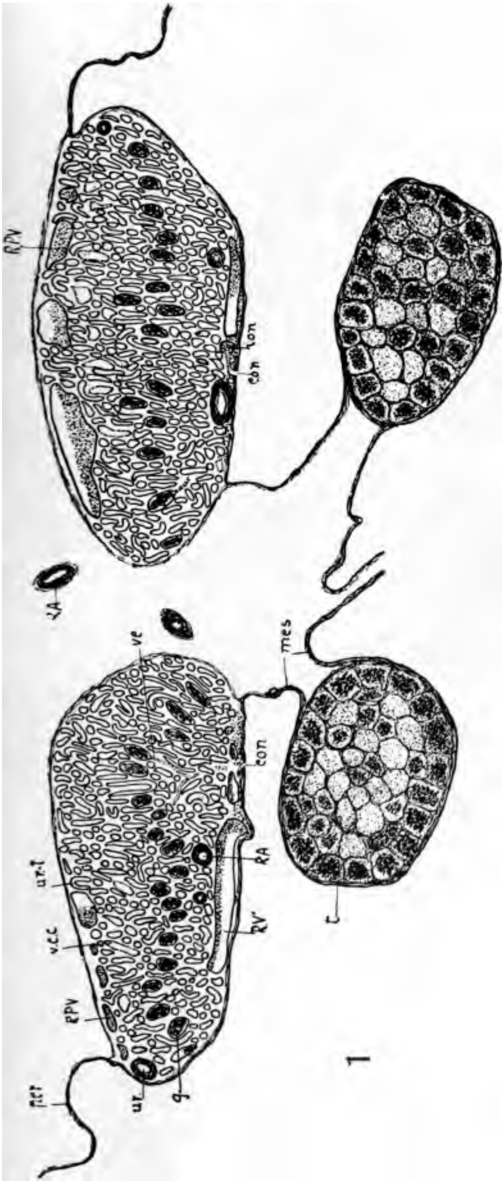
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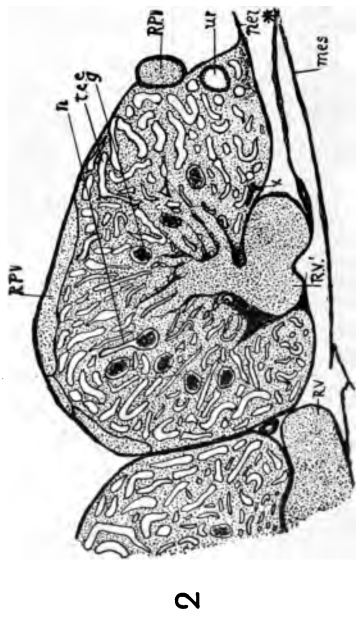
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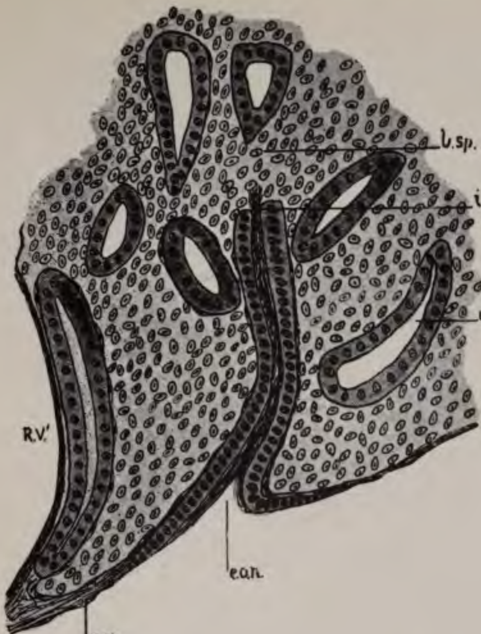
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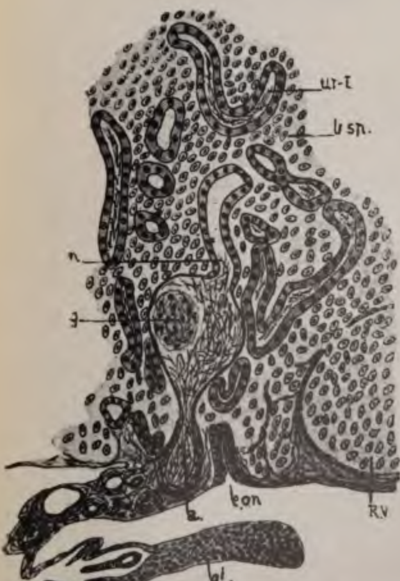
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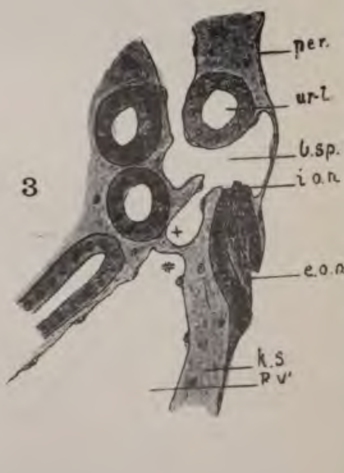
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EXPLANATION OF PLATES XX., XXI.

Reference Letters.

a.	= Ampulla on longitudinal Bidder's canal.
b. sp.	= Blood-space.
c. t.	= Ciliated part of uriniferous tubule.
e. o. n.	= External opening of nephrostome.
g.	= Glomerulus in Malpighian body.
gl.	= Gland (?)
i. o. n.	= Internal opening of nephrostome.
k. s.	= Connective tissue forming supportive substance of kidney.
mes.	= Mesorchium.
n.	= Neck of uriniferous tubule

per. = Peritoneum.
R. A. = Renal artery,
R. P. V. = Renal portal vein.
R. V. = Renal vein.
R. V_1. = Main branch of Renal vein.
t. = Testis.
t. c. c. = Transverse collecting canal.
ur. = Ureter.
ur. t. = Uriniferous tubule.
v. c. c. = Vertical collecting canal.
v. e. = Vas efferens.
v. t. c. = Ventral transverse canal.

All figures except Fig. 1 were drawn by the aid of the Camera lucida.

FIGURE 1.

Transverse vertical section through both kidneys and testes of Hyla aurea, showing general structure and relationships of kidney and Testis. The blood capillaries among the tubules are much too small to be shown in this figure. $\times 12$.

FIGURE 2.

Transverse vertical section through the kidney of Notaden bennetti, showing the tendency to form a "hilus" and the marked vascularity compared with that of Hyla aurea. The testis is not represented in the figure, but is enclosed by the mesorchium lying on the outer side of *. The section drawn is one taken through the region where the nephrostomes are least numerous; one, however, is shown at X, its openings being in succeeding sections. $\times 12$.

FIGURE 3.

Small portion of ventral edge of a transverse vertical section across the kidney of Limnodynastes dorsalis, showing the internal (i.o.n.) and external (e.o.n.) openings of a typical nephrostome; and its relationships to the blood-spaces (b. sp.) and uriniferous tubules (ur. t.). The blood-spaces marked $\pm$ and $+$, communicate directly with each other in the section succeeding the one drawn—± being situated in a main branch of the Renal Vein (R.V.). The amount of supportive connective tissue present in this form should be noted as characteristic of one type of kidney. × 200.

FIGURE 4.

Small portion of ventral edge of a transverse vertical section across the kidney of Heleioporus pictus. In contrast to Figure 3, there is to be noted here, the remarkable development of blood-spaces (b. sp.)—often without walls of their own—at the expense of the supportive connective tissue. The length of the nephrostomes is well seen, as also the internal opening (i.o.n.) with the cilia protruding among the blood corpuscles in the blood-space. For the sake of clearness, the blood corpuscles have been represented as much fewer than they really are, the whole space being crammed full of them in this form. × 200.

FIGURE 5.

Section similar to that in Figure 4, though much anterior to it, and less magnified, showing the gland (?) (gl.), and the connection of a Vas efferens with the ampulla (a), on Bidder's longitudinal canal, and especially the opening of a branch from the ampulla directly into the Malpighian capsule, where the mass of sperm has pushed the glomerulus (g.) quite to one side. The presence of sperm in the uriniferous tubules is also shown. × 60.

[PROC. ROY. SOC. VICTORIA, 20 (N.S.), PT. II., 1907.]

ART. XVI.—*The Highlands and Main Divide of Western Victoria.*

BY T. S. HART, M.A., F.G.S.

(With Plates XXII.-XXVI.).

[Read 12th December, 1907.]

The highlands of Western Victoria form an area mostly occupied by ancient rocks between the north-western and south-western plains. The line of Division on these highlands between the north and south flowing streams is variously spoken of as the Main Divide or the Dividing Range; to the latter name the words "Main" and "Great" are often prefixed. These names are also applied to the rest of the main watershed line throughout the State.

The name Great Dividing Range had a very simple origin. In the days of early settlement exact description of localities was desirable, and the colony was divided into counties. For the most part the boundary lines of these counties are the streams, as being easily located natural boundaries; hence the main watershed became the boundary between the counties of the south slope and those of the north. This watershed is an actual fact on the land, usually easily located, though not always conspicuous. For the most part it forms a range in the popular sense of the word. It divides adjacent valleys, and from the fact that it forms the dividing line between a series of northern and a series of southern valleys, it easily became known as the Great Dividing Range. The first official use of the term was in connection with the definition of county boundaries,[1] purely as a descriptive term without reference to its varying character. But apart from any geological examination the early surveyors must have known that its aspect varied considerably, and that occasionally it required careful observation to exactly decide

1 N. S. Wales Government Gazette, 1848.

its position. The use of the term did not imply that it was a Mountain Range in an exact geological sense (the date of introduction of the term should be remembered), nor do geologists ever seem to have regarded it as such.

Rather strangely Professor Gregory[1] has described Mr. Reginald Murray as supporting the term, and connects with this supposed support its frequent use. Murray's "Geology and Physical Geography" was published in 1887, nearly forty years after the term had first been officially used. But we find on reference to the book that Murray does not use the term Great Dividing Range, but consistently speaks of the "Main Divide." Apparently his supposed support consisted in describing a main divide in Victoria running from east to west, whereas Brough Smyth[2] had previously described the principal dividing line as running south to Wilson's Promontory. But Selwyn[3] had already dealt with this idea, tracing it to Count Strzelecki in a map published in 1845.

Every objection which is urged against the Great Dividing Range can be used with at least equal force against this line to the Promontory. It does not conform to the arrangement of the ancient folded rocks; it is composed of residual ridges of denudation, and further it crosses the Mesozoic trough (a feature which cannot be paralleled on the Main Divide); so that on this southern line the continuity of any early high land area was soon interrupted. Brough Smyth himself uses the terms "Dividing Range" and "Great Dividing Range," and applies the shorter term even to the Mt. Ararat ridge far distant from his main dividing line, and subsequent to the date at which he had described the latter.[4]

On the geological map of Victoria the term Great Dividing Range appears, but its use is not due to Murray. He distinctly says[5] that "the latest Geological Sketch map is—with the addition of being geologically coloured—the topographical map issued from the Crown Lands Department." Even here the con-

1 The Geography of Victoria, 1903, p. 62.
2 Goldfields and Mineral Districts of Victoria, 1869.
3 Notes on the Physical Geography and Geology of Victoria, 1867.
4 Report of Progress of the Geological Survey of Victoria, II., 1874, p. 18; III., 1875, p. 17.
5 Op. cit., p. 8.

spicuousness of the Divide is largely due to the fact that in addition to the hill-shading there is the broken line used to denote the county boundary. The boundary is an actual fact in the configuration of the surface, but without the hill-shading would have been shown in the same way as the point-to-point lines which have to do duty as boundaries in some parts of the plains.[1]

North-west of Ballarat is a part of the range which Professor Gregory particularly criticises. He presents what is said to be an actual view of the country, and states that a number of persons would vary considerably in their location of the Divide at this point. I have put the question to a class of students on the road between Blowhard and Ascot, and though most of them were quite unacquainted with the place they had no difficulty in determining its position, and were all in agreement. I have, however, good information that the photograph reproduced in illustration was not taken on the Divide at all. Certainly it does not truly represent the character of the Divide at this point.

Enough has probably been said to show that Murray cannot be regarded as in any way responsible for the use of the term. and that its use and the prominence assigned to it by the Lands Department is not, from their point of view, unreasonable.

Professor Gregory goes further, and says that the Great Dividing Range is "a misleading geographical myth." We have seen that the Divide is certainly an actual fact; the name may be badly chosen, but it is ordinary current language, and makes no claim to be a scientific term. It does not seem to have misled many scientific investigators, though it may have been misleading in the teaching of geography by teachers with little scientific knowledge. Professor Gregory attacks the biological evidence. He depreciates the support of the biologists by hinting that it biassed and selects out of the mass of evidence, two items for his argument of disproof, the distribution of the eel and of the varieties of magpies. He says that he has heard from fishermen of eels being taken from the tributaries of the Murray; so have most people, but unfor-

1 See boundaries of the County of Ripon on the Geological Map of Victoria.

tunately for the argument the Murray eels turn out on investigation to be either lampreys or importations, though it is quite in accordance with the known habits of eels to wriggle across the Divide occasionally, as they can travel some distance on land during heavy rains. The magpie is scarcely worth consideration in this connection; it can fly across the Divide if it likes If one variety is northern and the other southern, there is nothing to keep either exactly in its place. In spite of anything that can be said, the fact remains that there is a greater difference between the plants and animals of northern and southern Victoria than there is between those of southern Victoria and Tasmania.[1] This is all the more remarkable when we consider the Divide closely. Differences in climate and soil have a large share in producing this result, but we can only explain its importance in this respect by considering it a Divide which has been much longer established than Bass' Strait.

There is little doubt, however, that Bass' Strait dates from within the human period in Victoria.[2]

The Main Divide, from a geographical point of view, is a watershed line of composite character between the north and south flowing streams. Biologically it is an area of highlands sufficient to offer some direct obstruction to the migration of plants and animals, and to establish a climatic difference which further affects their distribution. Commercially and industrially it is important, not only for this climatic difference, but because it is a sufficient barrier to have determined trade routes by its easiest passes. Politically it has become incorporated as a boundary line of districts in much of our administrative system.

I propose now to consider the character of the western highlands as a whole, then of the Divide as we now see it, then its origin and early history.

The rocks of the western highlands are for the most part coloured as Ordovician on the geological maps, though direct evidence of fossils has not yet been obtained over the greater

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1 A. H. S. Lucas, "On some facts in the Geographical Distribution of Land and Fresh-water Vertebrates in Victoria." Proc. Roy. Soc. Victoria, IX., new series, 1897.

2 A. W. Howitt, Australasian Association for the Advancement of Science, Sydney, 1898. Presidential Address, Section G.

part of the area. With these are associated granitic and metamorphic rocks and a few small patches of more basic igneous rocks. In the extreme west a considerable area of sandstones usually regarded as Upper Palaeozoic occurs, resting on the granitic, metamorphic and other old rocks. A few scattered patches of the Permo-carboniferous glacial series also occur, though these are absent from the greater part of the area.

The Mesozoic rocks we may regard as outside our present subject. The supposed occurrence of this series at Skipton requires further evidence before it can be accepted as definitely of this age.[1]

Overlying the older rocks on the highlands are fluviatile, lacustrine and volcanic rocks of Cainozoic age. On the margins of the highlands some of these beds may be litoral or estuarine. The fluviatile deposits are in some cases remnants, and then usually at a high level; in other cases they are well preserved continuous valley deposits, forming deep leads either above or below the present valley levels.

The present surface configuration is not determined by the folding of the older rocks. To quote Selwyn, "the strike of the older rocks constituting the mass of the main range is at right angles to the axis of the range itself, and quite uninfluenced by the granitic and other plutonic or basaltic rocks occasionally met with equally on the range as on either side of, and remote from, its axis."

From almost any eminence one of the first features of the landscape which attracts attention is the occurrence of long lines of nearly level-topped or undulating ridges. Occasionally these ridges may abruptly end or be continued at a lower level. Here and there an isolated volcanic hill rises, or it may be a group of such hills, and more rarely there are solitary hills and ranges of other appearance. The general character is that of a plateau which has been deeply trenched by a series of valleys. Between these valleys are the residual ridges, the remnants of the old high plain.

If we imagine the high plain restored following the line of the present nearly level hill crests, we would have a plain

1 R. A. F. Murray, Report on the Skipton Coal Seams. Report of Progress Geol. Surv. Victoria, VII., 188

often with an appreciable slope and with marked difference of level at different parts. Abrupt inequalities would be found at places, as, for instance, on the east face of the Grampians, the south face of the Pyrenees, and to the south-west of Bacchus Marsh. In other cases the fall would be gradual as from Daylesford south-westerly. We must bear in mind, however, that it is possible for a long gradual slope of the summits to be a result of denudation of a once level surface; as the lower parts of the valleys are likely to be deeper and wider, the ridges between them, if narrow, may be reduced in height.

The plain clearly does not conform to the folds of the underlying rocks, and is a plain due to excavation, not accumulation of material. As the superficial deposits of the plain are of terrestrial origin we may regard the plain as due to subaerial denudation, and as representing a peneplain formed by long continued erosion.

Possibly a few low ridges older than the peneplain may still be recognised. The present highest point in Western Victoria is Mt. William, 3827 feet above sea level; Mt. Buangor in the Pyrenees reaches 3247. Mt. Buangor is, however, simply a part of the sloping plateau stretching far to the north. If it were part of an older peneplain we would expect more advanced dissection of the mass, whereas the steep valleys of the south slope of the Pyrenees are clearly of no great antiquity. Also if Mt. William and the accompanying ridges had existed before the peneplain was established, we would expect them to be either more dissected, or that we would find marine deposits extending into their deep valleys. Both of these are best regarded as most elevated parts of the peneplain itself. The peak of Mt. Ararat is in the hard contact rocks adjacent to the granitic rock, and with the present small width of the ridge would naturally result from denudation of a late date, and still in progress.

The granitic hills of Mts. Beckworth, Bolton and Misery appear to be possible peaks rising above the peneplain; the highest points of the first two of these, at whatever date established, are due to the resistant character of a fine grained granite poor in mica. Their relation to the general level of the peneplain is obscured by the extensive basaltic covering on both sides of them. Most probably they stand above it. Mt. Doran stands up well above the level of a flat ledge on its east side. On this ledge are the Lal Lal iron ores, but recent deep valleys running down to the Moorabool have reduced both ledge and iron ores to a series of fragments. Probably the ledge represents the peneplain level. Mt. Egerton may be similar to Mt. Doran.

The great volcanic plains are subsequent to the elevation and partial dissection of the peneplain.

As to age, it appears most reasonable to assign the peneplain to the long continued Mesozoic denudation reaching its final condition at the commencement of the Cainozoic. The oldest of the fluviatile deposits on its surface, commonly called the oldest gold drift, afford no fossils, but on field evidence both on the Moorabool and at Stawell, they are to be regarded as equivalents of some part of the Barwonian series in the marine beds, and probably of its lower part.[1]

The older volcanic Rocks in many parts of Eastern Victoria bury lacustrine deposits with fossils of early Tertiary age. The Older Volcanic has been shown to be Barwonian by Messrs. Hall and Pritchard,[2] and it appears to occupy in some cases positions which are practically level with the peneplain as if it had flowed in and filled the earliest valleys of the first stages of elevation.

The elevation which stopped the formation of the peneplain and introduced a new period of deep valleys, may not have been simultaneous in all parts of Victoria, nor was it without interruption as is seen by the advance of the marine deposits over fluviatile at the Welcome Rush, Stawell,[3] and by oscillations of level proved in the marine tertiaries.

The folding of the old sediments and their invasion by the granitic rocks had long ceased before the formation of the peneplain. But unequal movements were no doubt still in progress through the Mesozoic period. The Mesozoic rocks occur in defi-

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1 N. Taylor, Report on the Stawell Goldfield. Progress Report Geol. Surv. Vic., II. and III.

2 Hall and Pritchard, "The Older Tertiaries of Maude, etc." Proc. Roy. Soc. Victoria, VII., New Series, 1895.

3 N. Taylor, loc. cit.

nite areas to the south; they probably have never extended across the present highlands. If the surface had been made almost flat the appearance of granites on the peneplain would be simply a question of the level reached by the granites. This would depend partly on the level it originally reached at the time of its intrusion, and partly on later movements, which it might share with adjacent sediments. The granitic rocks of Victoria do not as a rule appear in well marked axial lines, but in places they show very straight boundaries on the peneplain; the south edge of the Mt. Cole granite in the Pyrenees is an example, though on the map the straight boundary is obscured by the accumulation of detritus at the mouth of a short valley. A fault had probably already existed while the peneplain was forming, and the more elevated granite to the north had been exposed by denudation. On its northern boundary this granitic area meets the sedimentary and metamorphic rocks on irregular lines. A similar explanation might be given of many other granitic boundaries in Victoria. Selwyn had already in 1857 referred to a fault line on the east coast of Port Phillip, making the boundary of the granitic areas there.[1]

We have not only to consider in connection with the positions occupied by granites, the height to which they were brought at the time of their intrusion, but also the subsequent movements as inert masses. In the formation of the peneplain it is evident that a point of maximum elevation is a point of maximum denudation, and consequent more probable exposure of deep seated rocks. On the other hand the downthrow side of a fault is, other things being equal, a point favourable for the preservation of the newer and more superficial deposits. This may have been the reason of the survival of a small glacial area at the Midas mines[2] north of Ballarat. Messrs. Officer and Hogg[3] have also described the glacial rocks as terminating north of Coimaidai at a steep bank of Ordovician rocks, and though they regard it as a pre-existent valley wall, it seems to me that

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1 See Hall and Pritchard. Some Sections Illustrating the Geological Structure of the Country about Mornington. Proc. Roy. Soc. Victoria, XIV., pt. I., New Series.

2 E. J. Dunn, Notes on the Glacial Conglomerate, Wild Duck Creek, Department of Mines, Melbourne, 1892.

3 Proc. Roy. Soc. Victoria, X., pt. II., New Series, 1898.

it may also be a fault line, north of which the glacial beds are lost by denudation.

Before considering the history of the elevation and dissection of the peneplain, we may look further at the present condition of the highlands.

On the whole the valleys run to north and south, though there are some peculiar exceptions, especially in the head waters of the Loddon and the Wimmera, and the course of the water from the north of Ballarat to the Hopkins. Going westward from Ballarat by rail it is apparent that the present surface is occupied by a number of north and south ridges and intervening valleys, and a wider acquaintance with the district not only confirms this view, but shows that the north flowing and the south flowing stream at places seem to occupy the two ends of one great valley.

Taking them in order from the west there is a great valley between the Grampians and the Mt. Ararat Range. This drains north by the Little Wimmera or Mt. William Creek and south into the Hopkins; there is no perceptible Divide for some distance in the floor of the valley. On the map the county boundary takes a straight line from the spur of Mt. William to a spur of Mt. Ararat. This is not part of the line marked as the Great Dividing Range; it stops on the spur from Mt. Ararat. The Mt. Ararat Range runs nearly north and south and is continuous (with a slight irregularity in its line) with the Black Range south of Stawell. West of this range is another valley. The railway rises up its south end, crosses to the north fall at an elevation of 1070 feet above sea level, and follows down the valley of the Concongella Creek to Stawell. In view of the barrier presented by the long Mt. Ararat range on the west, this will probably long remain the chief entrance to north-western Victoria.

By the next valley the Ararat-Avoca railway passes to the north of the Divide, crossing it in a gap at an elevation of 1104 feet; it thus enters the valley of the Upper Wimmera, and follows it up eastward through the Pyrenees to Mt. Direction, where by another pass at an elevation of 1214 feet it enters the Glenlogie valley and thence to the Avoca.

One of the most remarkable of these meridional valleys lies between Larne-Gerin and Mt. Buangor. To the north the Mt. Cole Creek runs down to the Wimmera. But as one stands on Ben Nevis, some miles to the north of the Divide, there is an uninterrupted view down the valleys of Middle Creek and Fiery Creek into the south-western plains. The Divide in this valley needs looking for. Standing on Ben Nevis more than a thousand feet above it, it sinks into insignificance. From Mt. Cole looking south similar meridional valleys and ridges are seen on the lower country. The Larne-Gerin range continues south of the railway line, and is sufficiently important to cause the road and railway to run to the same low notch close up to Larne-Gerin.

East of the Mt. Cole Ranges the same north and south ridges continue, but with less elevations. The road from Chute to Lexton crosses a low Divide, but is flanked on either side by more prominent ridges. In fact this portion of the Divide, from the heads of the Glenelg to the heads of Trawalla Creek, is composed of two differing constituents. It is high where it crosses the meridional ridges or continues along them for some distance; it is usually low where it crosses the intervening valleys. As the head of each valley is to some extent independent of the next one, the Divide sometimes acquires a distinctly angular character, most marked in the rectangular portion at the head of Mt. Cole Creek.

But a short distance to the south-east of Lexton the character of the Divide changes. The old rocks disappear, and, instead, the summit of the watershed is composed of Volcanic rocks. Out of a great area of volcanic rocks there stand up the peaks of Mt. Misery, Bolton and Beckworth, none of them actually on the present Divide, but forming the highest points of a meridional ridge buried by the volcanic rocks. If these rocks are supposed removed we would have two more great valleys. We may call the western one, from the parish name, the Ercildoun Gap, and the eastern, similarly, the Ascot Gap. The latter is the lower, and even with its extensive lava streams and volcanic hills is still the easiest and lowest level pass across the Divide between Kilmore and the neighbourhood of Ararat. Here four main roads and two railways cross the Divide from Ballarat, and the situation of Ballarat is at the entrance to a large area of north-central Victoria just as Ararat stands at the gate of the north-west.

Further east the Divide is again composed of Ordovician Ranges, but the meridional ridges are prominent even in them in spite of the existence of the west flowing heads of the Burrumbeet and Yarrowee Creeks. From west of Creswick a ridge runs south to far beyond Buninyong. The complete infilling of the valley on its east side by basalts has diverted waters across this ridge into the Yarrowee, but this is clearly a late modification. In this eastern valley the Divide is again buried under basalts in what we may call the Dean Gap. The area south of this is commonly known in Ballarat as the Eastern Plateau. Mt. Warrenheip stands on it, but contributes very little to it. The plateau lavas are from the north near the hills on the present Divide, and its surface falls with an unbroken slope past the east side of Warrenheip. Further east the Divide follows Ordovician rocks with gradually rising levels to the vicinity of Daylesford.

I have attempted to illustrate these features of the Divide by the accompanying plans and sketches. On the general plan of the Divide I have indicated some of the north and south ridges. I have had to compile this from various sources. Two early maps of Ripon County issued by the Lands Department both note the absence of a distinct ridge west of Mt. Ararat. One of these marks the ridge south of Larne-Gerin, and states that it was noticed by Mitchell. From these maps also I have obtained the position of the volcanic hills in the Ercildoun Gap. I have obtained other information from the Geological maps of Ararat and of Learmonth. The view taken from the summit of Mt. Buninyong shows the south ends of a succession of ridges and the intervening valleys. The line of sight to Larne-Gerin crosses the Divide so that the slope of that hill facing the observer drains north by Mt. Cole Creek.

The view from Mt. Blowhard shows the series of Volcanic hills which form the Divide in the Ascot Gap. The broken line round the base of each hill on the map shows the approximate extent of the slope from that hill. The Divide is formed by the coalescence of the bases of the volcanic hills, and hence may be at any height which was sufficient to turn the waters of the adjacent valley. Thus the drainage of the south slope of the Mt. Bolton Range is diverted northward. A Divide is obtained which, though usually quite distinct, is yet at a low level, and we have a remarkable feature of the levels of the Waubra Railway that it is everywhere at a higher level than close to the Divide, falling from 1508 feet at Waubra Junction to 1350 at Learmonth, then crossing the Divide at about 1360 and ascending a valley to Waubra. There are several swamps close to the Divide where the slopes of the volcanic hills meet. Lake Learmonth only differs from these swamps in being larger and practically permanent, which has been helped by building up its outlet and bringing in water across the Divide.

Beneath the extensive volcanic area both north-west and north-east of Ballarat there is still some uncertainty as to the courses of the old Divide and of the old valleys. We may safely say that the whole area which now drains north also drained north before the lava flows. In the Ercildoun Gap is a lead falling north; in the Ascot Gap another lead also falling to the north, and a north falling lead exists not far north of the present Divide at Dean. But south of the Divide there are three areas which present difficulties, the Burrumbeet Basin, the western leads of Ballarat and the Haddon leads, and the area about Warrenheip and Bungaree. Investigations have usually proceeded on the assumption of the non-disturbance of relative levels at different points, but we have sufficient evidence that this is not absolutely safe. We must take account of local disturbances[1] and of unequal movements affecting large areas, as will be shown below.

The question is further complicated by changes of the flow of streams by the ordinary process of river capture, and by the fact that various lava streams which have altered the flow or influenced it are not absolutely, and sometimes not approximately, contemporaneous even within the one drainage area. By this means a great change might be produced in one part of a valley while another part of the same valley was unaffected.

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1 Notes on the Stony Creek Basin, Daylesford, and references there. Proc. Roy. Soc. Victoria, XVII., pt. II., New Series.

From Smythesdale certainly a lead was worked with a fall northward under the present south flowing Smythe's Creek. The alteration was probably due to the lava streams. From near Staffordshire Reef a large valley falls to the north to join the Yarrowee Creek, and its waters are turned south again down that creek. The Yarrowee valley itself west and south of Buninyong, and the old Durham Lead which preceded it, are comparatively narrow. The Lal Lal Basin cannot have drained south at the west end of Mt. Doran. We find thus a considerable east and west Divide many miles south of the present Divide. (Such a Divide is mentioned without the evidence being quoted in Professor Gregory's Geography. It can, however, scarcely turn to the north-east as shown in the figure there.) At Smythesdale it has long been recognised.

It must not be assumed that this was a Main Divide from which the streams flowed north to the Murray. North of Mt. Doran we find an outlet to the east. Alluvial sands just show below the basalt at the foot of the Lal Lal Falls. Half a mile east, just below the little falls of the Western Moorabool, the basalt for a short distance comes down to the bed of the river. On a creek a little further east a considerable width of sands is exposed and not bottomed. On the Eastern Moorabool at Bungeeltap, they are much wider, and show also in some of the creeks in the parish of Bungal. Thence the volcanic plain is unbroken till we reach the Parwan valley, where the estuarine beds appear and are well exposed as far as the steep descent on the Rowsley fault. There is little doubt that this is the original outlet from the Lal Lal Basin. (The actual area of the brown coal at Lal Lal may be regarded as a local subsidence.) This eastward valley could scarcely have drained any appreciable area west of Mt. Buninyong. It received, no doubt, a part of the drainage of the country buried under the southern edge of the Eastern Plateau. Further north a part of the area north of Warrenheip may have discharged its waters past Gordon and thence also to the Parwan Estuary.

To return to the lead at Smythesdale. The main Trunk Lead has been worked for some distance north, but not far enough to leave its final course without doubt. From the Ballarat Common westward, the railway follows down the gentle slope of a lava stream to the Burrumbeet Creek. Beneath it is a valley into which the Trunk Lead flows, but opinions have been divided as to whether the outlet of this valley is towards Burrumbeet or in the opposite direction, and thence to the Ascot Gap. If the fall is into the Burrumbeet Basin, we are still in doubt as to the outlet from that Basin. Parts of that area may drain northward by the Ercildoun Gap, north-east to the Ascot Gap or south-west by a route near the present outlet.

The western leads of Ballarat are subject to the same uncertainty as the Trunk lead. But even with regard to the Golden Point Gutter itself there is still some diversity of opinion. Close to the south limit of Ballarat City a point is reached at which there is a broad lead to the west, and a comparatively narrow lead to the south. Both have been worked. The question as to which was the real outlet of the stream above was discussed by Murray,[1] and he decided for the southern—that is, that the lead followed the same valley as the present Yarrowee. But the decision was based on small differences of levels. Either way the average gradient for some distance is much less than in the lead upstream. Against the southern outlet are the change in width and perhaps some minor features of the lead itself, the narrow valley of the Yarrowee downstream and the decided north fall from near Staffordshire Reef. Recent bores[2] show that an outlet is possible to the west. There is thus a double uncertainty in the course of the old valley, both as to the direction the waters took at Ballarat and as to the subsequent course of the Western Leads. Probably at Ballarat both outlets have been used, the head waters of the lead having been captured and diverted.

The present drainage system at Ballarat is determined largely by the volcanic centres. From the Ballarat Common extensive flows of lava have run to north, south, and west. Murray considered, from the records of the rock passed through in the Bonshaw shaft, that the uppermost lava stream or "first rock" is here missing. This shaft is in a valley at the south end of Sebastopol. In the present condition of the creek, the second rock, much decomposed on its surface, is seen exposed under

1 Report of Progress Geol. Surv. Vic., I.

2 Annual Report, Mines Department, Victoria, 1892.

the first rock. The first rock is missing from the shaft, but it continues on the opposite side of the little creek, and is traceable to the south end of the Buninyong Estate.

There is no reason to regard Lake Wendouree as a crater; it is only a shallow depression on the edge of the lava stream. But the source of the Ballarat "first rock" at least must be placed on the Common close to Wendouree. There is no cone of volcanic fragments; explosive action appears to have been of little magnitude at the emission of this lava. This is the present limit of the waters received by the Yarrowee; the north slope of the Common drains to the Burrumbeet Creek. The barrier of volcanic hills in the Ascot Gap quite prevents a northern outlet, and the Burrumbeet Creek is forced to flow west, and eventually to the Hopkins, though ordinarily the waters do not pass Lake Burrumbeet.

The original drainage of the elevating peneplain was then probably as follows:—In the western part one principal east and west crest divided a north and a south fall, but in the neighbourhood of Ballarat there was another important crest further south. It is not demonstrated, however, that any part of this formed a Main Divide, from which the waters flowed north to the Murray. In its western part it is uncertain, but in the eastern part the Parwan Estuary lay between the southern crest and a crest near the present Divide. Much of the waters from the north would formerly reach the Parwan, but they have been diverted by the volcanic barrier of Mts. Ingliston, Darriwill, Gorong, and an unnamed centre near Ballan. This has caused the formation of the present rugged Werribee Gorge in the old rocks, contrasting strongly with the smooth outlines of the Parwan valley in its soft materials. Further north there may have been an east and west ridge at Tarrengower.

Various suggestions have been made as to the possible origin of the Divide or of these parallel crests. Selwyn suggests "that the first outline of the existing main watershed was determined by some slight and almost accidental undulation, that may either have pre-existed on the old sea bed, or been produced during one of the earliest broad and equable upheavals, that resulted in a dry land surface." Professor Gregory regards it as connected with the intrusion of a series of granitic masses forming a Primitive Mountain Chain. Apparently this is regarded as Devonian in age. Mr. T. S. Hall[1] has ascribed it to cross folding connected with the pitch commonly observed in the folds of the older rocks.

I think it can be shown that any feature produced prior to the development of the peneplain must be of minor importance in determining the position of the Main Divide.

The gradient of the streams which formed the peneplain must have been very slight by the time that operation was finished. Without taking the estimated grade as low as 1 in 50,000,[2] we may say that if as low as 3 feet to the mile (about the gradient of a large part of the Thames), it would be quite inadequate to account for even the more moderate inequalities of level of the peneplain. Some other cause has established far greater differences of elevation than those of the peneplain as formed, and this cause must have operated subsequent to the formation of the peneplain. At Warrenheip the peneplain level is about 1750 feet above the sea level. Thirty miles to the south are contemporaneous marine beds which even allowing for depth of water may be stated as elevated less than 700 feet. This gives a difference in elevation equal to 1000 feet in 30 miles. From the south-west of Daylesford to Warrenheip the general level of the peneplain falls from about 2350 to 1750, or about 30 feet to the mile. These would give slopes quite sufficient to overcome the slopes of the original peneplain, though it would not necessarily reverse the original slope in the vicinity of a ridge. And it must be remembered that the ridge remaining on the peneplain would only be a very much modified remnant of an older eminence.

The more marked differences of elevation about the Grampians and Pyrenees would be correspondingly more effective in overcoming older inequalities.

Selwyn's suggestion leaves the question very open if we substitute peneplain for original sea bottom. Professor Gregory's Primitive Chain, if it existed, would have been reduced to insignificance in the formation of the peneplain, but there are great difficulties in supposing its existence. In the first

1 Victorian Year Book, 1905-6.

2 Gregory, op cit., p. 78.

place our granitic rocks do not, as a rule, present the character of axes of even small mountain masses. The dip and strike of adjacent rocks are little affected by them (except perhaps as will be noticed below). He states[1] that the Warrenheip granite affects the direction of the beds at Ballarat, but he has stated the direction of the granite boundary wrongly, and missed the abundant evidence of folding. His argument on this point at Ballarat completely fails on examination. It is far more probable that most of our granitic intrusions were introduced by a "stoping" process with foundering and absorption of the adjacent rock overhead. In addition a Primitive Divide as early as the granitic intrusions does not provide for the southern origin of the glacial series.[2]

With regard to Mr. T. S. Hall's suggestion, we require a good deal more evidence on the matter of pitch, particularly as to the extent to which it is persistent, and how it varies from place to place. It may be supposed to originate in many ways, and may be consistent or inconsistent in neighbouring folds. It is liable to be inconsistent if it is due to the making and dying away of individual folds, or if due to local disturbance as by a fault affecting a small area. Besides these it is possible that pitch may originate by varying intensity of the folding from place to place, so that the fold is sharper at one place than at another, and is curved in its strike. Or it may be due to the fact that compression in a solid produces a tendency to expand in a direction at right angles to the pressure, and this, if prevented, may give rise to a simultaneous transverse folding. Or it may be due to subsequent crossfolding. Or to the settlement of an imperfectly supported area over an invading granite. Or finally to the tilting of folded blocks the folds themselves being inert.

Settlement on an invading granite might be suggested in the case of the southward pitch from Bendigo, and the northward pitch from Keilor. But there are other cases which cannot be so explained. Mr. W. Baragwanath, jun., has called my attention to the pitch at Ballarat East, northerly at Black Hill, and southerly at Magpie Gully, and neither of them near granite.

1 Memoirs Geol. Survey, Vic., No. 4, 1907.
2 Officer and Hogg, loc. cit.

Pitch certainly influences details of hill and cliff shapes especially when combined with steep dip joints at right angles to the pitch. Examples of this are found at the Werribee Gorge and at Bendigo.

If crossfolding determined the original crests of the elevating plain, it must have been a cross folding produced concurrently with the elevation, and I think the pitch of our older folded rocks will as a rule be better explained by some cause nearly or quite contemporaneous with the main folding.

The clue to the cause of the early Divide on the elevating plain is to be found in the movements of elevating and tilting fault blocks.

The most conspicuous feature of the southern limit of the Victorian highlands is that they terminate at a practically straight line. The restoration on the latest geological map of Victoria of the granitic areas near Mt. Elephant makes this still more evident. It must be remembered that the volcanic area north of these granitic inliers is gradually rising to the north and though not very high at the foot of Mt. Elephant it rises gradually and continuously to the Divide in the Ercildoun Gap. Similarly in Eastern Victoria two straight lines terminate the main mass of the highlands. These lines are independent of the rock folding, cross various rocks, and are no doubt fault lines forming the north limit of a relatively depressed area. Movement on these lines, or near them may have been both pre-tertiary and later. Consequently the comparison of levels on the north and south of these lines does not give a safe estimate of the amount of tilting, apart from dislocation, of the peneplain, if such peneplain be regarded as continuing beneath the tertiary areas, or merging in a plain of marine denudation.

It is likely, but not altogether certain, that similar movements had already formed the Mesozoic trough. In Western Victoria it is largely a question of what Mesozoic rocks are buried under the tertiary—a point which has not yet been investigated.

At the east edge of the Ballarat Plateau we have the wall at Bacchus Marsh. This does not coincide with the bank of Ordovician rocks against which the glacial rocks rest. Even the importance of that bank may be exaggerated; it must be kept in mind that remnants of the glacial series are also found west of it.

A note to Daintree and Wilkinson's map of 1866 (¼-sheet 12NE), states that the basalts seem to have flowed over a steep declivity, and further north the accompanying section shows inclined beds of the early tertiary rocks. These comparatively steep beds are in contact with a mass of intrusive older volcanic rocks, and I had the impression formerly that the inclination was regarded as an effect of the basaltic intrusion, but I do not find it described as such. West of the disturbed portion the tertiaries continue at higher levels and horizontal, and a better explanation is that at this point on the north side of the Werribee there is a monocline probably faulted and further south along the edge of the high basaltic plateau, a fault scarp over which the lavas have flowed. It continues further south still with a curve a little to the west, and the quarter-sheet 12SE to the south shows the Ordovician rocks terminated a straight line which is also the edge of the higher land to the west. Down this a number of short steep valleys flow. The aspect of the locality as seen from any point of vantage to the north agrees with this. As the line of fault passes between the old township of Rowsley and the railway station of the same name I would call it the Rowsley fault.

On the east or depressed side the surface of the plain below is overspread with detrital material. This evidently is material carried by the streams down their steep courses from the highland, but which they could not transport across the plain. The Parwan Creek has cut its valley down to the base of the present wall, but with its slighter fall it has not cut through the basalt on the lower country. Its level is here temporarily kept up, and it has attained a gentle slope in its bed above the obstacle, and being in soft material of the old estuary has long gentle slopes on the sides of the valley, rising gradually to a basaltic escarpment, which is sometimes over a mile from the main waterway. Below the escarpment the slopes are strewn with broken basalt from the plateau edge, undermined by the working away of the soft sands below, but unable to travel down the long gentle slopes. The head of the Parwan tributary near Ingliston station shows an earlier stage in the development of such a valley, full of angular blocks from the basalt, and with its sides for some distance an almost continuous series of land-slips. A similar explanation can be applied to Bacchus Marsh itself. At the Marsh the valley has been cut through the basalt to the underlying tertiaries. Down stream deepening is less rapid because the hard rocks extend to lower levels and are not yet penetrated. Hence the valley has been greatly widened in the soft rocks. When the Parwan has cut through the couple of miles of basalt in its course between its upper valley and the Marsh, it will be able to deepen its upper valley again at a more rapid rate and perhaps even to recapture what it has lost to make the Eastern Moorabool.

Professor Gregory has described the Grampians as ranges of the Pennine type. The area of Upper Palaeozoic rocks forms a great syncline with a few minor corrugations. The long gentle slopes towards the syncline are near the direction of the bedding, and the short steep slopes in their present form seem largely due to strong jointing. A well-developed jointing also occurs in a direction at right angles to the ranges contributing to the jagged character of their summits. Selwyn shows a section of the south end, and Krause[1] has given a section near the north end. The latter shows one of the minor folds. He also shows the granitic rocks as intrusive, though in his description he regards this point as doubtful. Two causes may have led to his favouring the idea that the granodiorite was intrusive. In the area afterwards worked for gold at Mt. William sandstone from the high hills close by is common. In its natural condition it would be difficult to see that this area was granodiorite covered with a thin layer of debris from the hills, and he seems to have mapped it as sandstone with dykes. Also there are undoubted dykes in the sandstone. Those with which I am acquainted at Hall's Gap are more probably allied to the Coleraine trachyte than to the granitic rocks.

The strike of the Grampians sandstone varies considerably, being distinctly west of north in the northern parts, but more meridional or east of north in the vicinity of Mr. William. The dips are usually low, but near Hall's Gap Krause records 77 deg.,

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1 Progress Report, Geol. Surv., Vic. I.

and I have observed 60 degrees, both on the outer range. A dip of 51 degrees is shown on Stony Creek by Krause.

The greatest elevation is at Mt. William, in the centre of the eastern ranges.

Neither of the earlier sections show any faulting, though the descriptions in both cases give estimates of thickness which are quite inadequate, apart from faulting. The main faults have not been observed, and I have no definite information to assign them a probable inclination. I have observed a nearly vertical strike fault in Stony Creek, near Hall's Gap. There is, however, little doubt that the great valleys here are determined primarily by faults allowing a succession of parallel ranges to be formed of the same beds, and it is probable also that many other parallel faults occur allowing repetition of beds in the long gentle slopes of the hill towards the syncline. The average inclination of these slopes is much more gentle than the dip, though in a hill south of the junction of Fyan's and Stony Creeks at Hall's Gap it is possible to walk a long distance down the bare rock following the bedding plains.

A feature of Fyan's Creek valley, which indicates late movement on this fault, is the form of some of the tributary valleys. At the Silver Band fall the stream comes out from a gap in the east face of the range and drops into the valley below.

We may ascribe the Grampians to the unequal elevation and tilting of a number of fault blocks, in which the principal faults were approximately meridional. The syncline was probably preexistent and sandstones already somewhat denuded, forming a part of the peneplain, so that they already were reduced in thickness on their eastern edge. Another fault may exist under the Mt. William Creek valley outside the ranges, and the whole series may be associated with similar faults determining the west end of the high lands as a whole. The faults need not necessarily be altogether of late date; all that is requisite is movement subsequent to the peneplain formation, it may be on old faults, and only on some of these.

We may extend this idea of block elevation to the rest of the highlands. A striking example is seen in a side view of the Pyrenees. Such a view is obtained from many points; that from Maiden Hill at Waubra is particularly good. At the south end the ranges drop suddenly to the lower country about Beaufort. There is no doubt that this southern end of the Mt. Cole Ranges is a fault scarp, and forms the south end of a great tilted block. It is also probably a fault line of early date on which movement has been renewed, as the granite is apparently absent from the peneplain below. The south end is deeply scarred with short steep valleys (not visible from this point), and the edge of the granite is in part buried under the talus fans. Northward the ranges present a long even slope. Buangor is 3247 feet above sea level; Ben Nevis, 2875; Avoca Hill, 2464; and Landsborough Hill, 1903. The Avoca River runs north down the east side of the highest ranges. Further north the Richardson and the Avon drain the north end of the block. The summits of the Pyrenees are to be regarded as the same peneplain as at Ballarat, but elevated more than 1000 feet higher. The parallel range of Ben Major and Ben More is on this side the Avoca River between it and the Bet Bet Creek. Possibly the Avoca follows down an east boundary fault, for the Ben Major range is much lower, and the levels fall still more to the east under the lava filled valleys.

There is one great interruption to the regular slope of the line of the Pyrenees summits. Behind Lexton we look into a great gap in the mass; in the gap is the pointed summit of the Sugarloaf, and beyond is the shoulder of Ben Nevis. We look down the valley of the Upper Wimmera. Two explanations are possible. There may have been an original slight hollow produced in the elevation of the block or a change of slope. The small difference in height between Ben Nevis and Avoca Hill seems to favour this as well as the extent of country whose drainage is diverted west and the fact that the diversion is not very new. As an alternative it may be simply a case of river capture, perhaps helped by an original steep fall at a fault on the west of the block. Some amount of capture from the Richardson and Avon has probably taken place, but an original inequality of elevation very likely started this course of the Wimmera.

The Pyrenees may be taken as representing a range, due to the same causes as ordinarily produce the Pennine type, but with a gentle or slightly undulating long slope and now much modified by denudation. It is evident that in such a series of elevations and tilting there may be more than one east and west crest produced. This would explain the character of the drainage system initiated in the Ballarat area, Mt. Doran, if previously formed, helping somewhat to constitute the southern crest. From the high land before mentioned running from east of Creswick to beyond Buninyong there seems to be a general fall to the west. Much of this may be due to the later denudation, but it is not unlikely that a fault exists under the Ascot Gap or at least a line of an original minimum elevation. A fault might have contributed to the preservation of the small patch of glacial rocks known to exist at the Midas Mines.

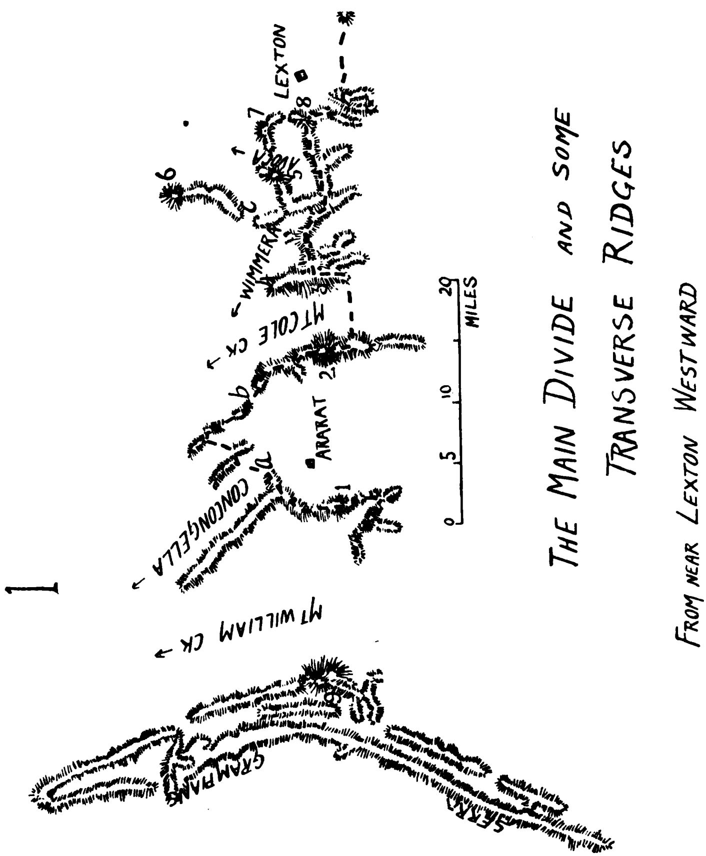
That east and west crests would be at first produced might be expected from the general trend of the Mesozoic trough, the tertiary trough and Bass Strait, all of which may be regarded as a series indicating a prominence of movements on east and west fractures since the time at which the active folding of the older rocks ceased.

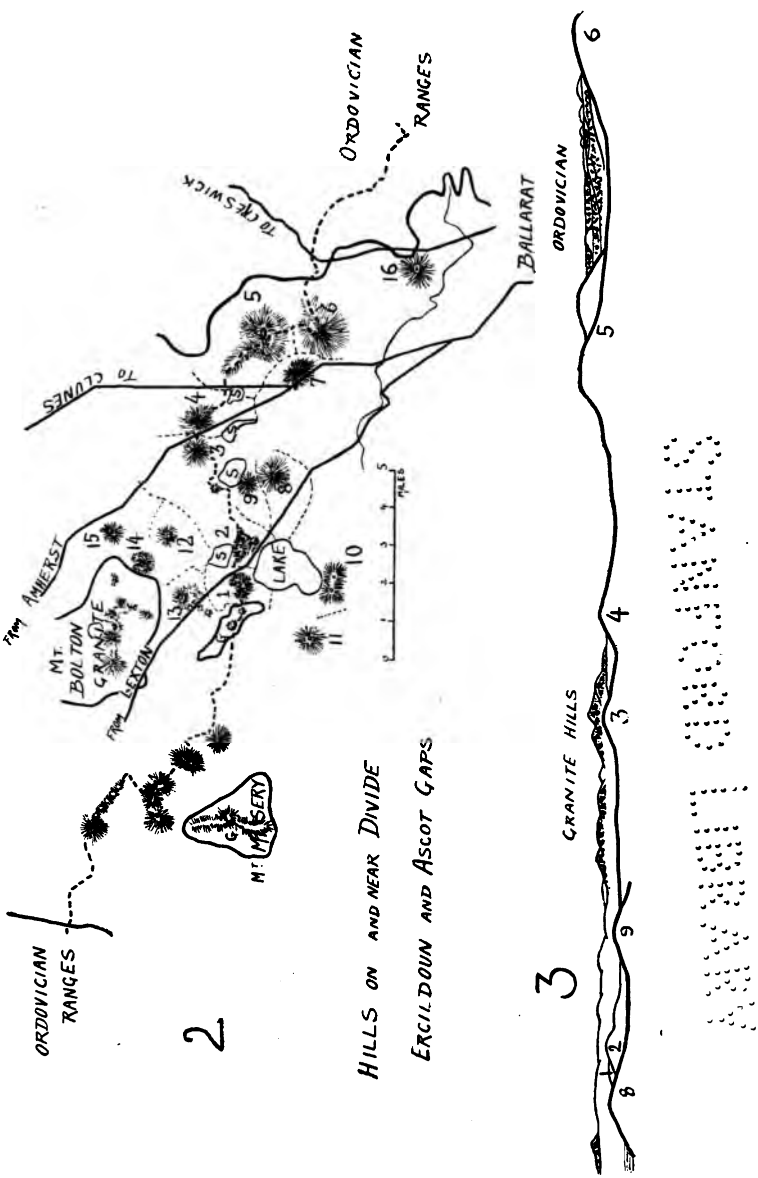
Some of the faults suggested may seem to have little to support them, but I think there is sufficient evidence to sum up the character of our western highland and Divide as due to unequal block elevations of a Mesozoic or early Tertiary peneplain, with subsequent extensive modification by denudation and volcanic activity.

DESCRIPTION OF PLATES XXII.-XXVI.

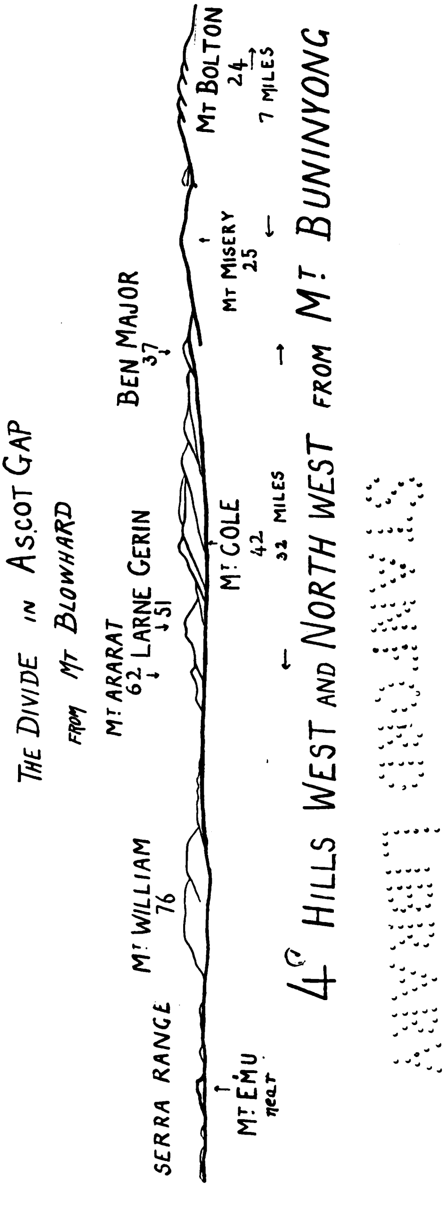
Fig. 1. The Main Divide and some of the transverse ridges, from near Lexton westwards, compiled from various sources. The names of the principal north flowing streams are shown. The south slope, except close to the Serra Range, drains eventually to the Hopkins. The numbers indicate hills as follows:—1, Mt. Ararat; 2, Larne Gerin; 3, Mt. Buangor; 4, Ben Nevis; 5, Sugarloaf; 6, Avoca Hill; 7, Ben More; 8, Ben Major; 9, Mt. William. *a* is the gap by which the railway goes from Ararat to Stawell; at *b* the Ararat-Avoca railway crosses the Divide; and at *c* passes from the Wimmera to the Avoca valley. The Main Divide is indicated by a broken line.

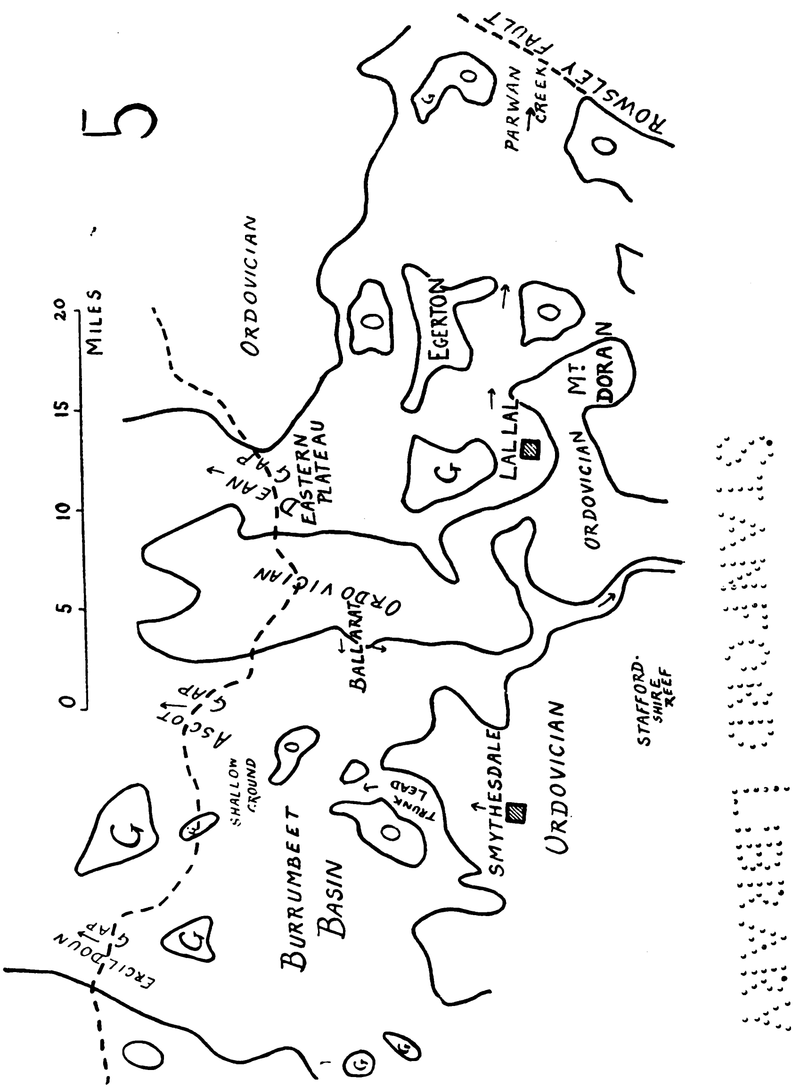
Fig. 2. Hills on and near the Divide at the Ercildoun and Ascot Gaps. O indicates Ordovician and G granitic areas. The full

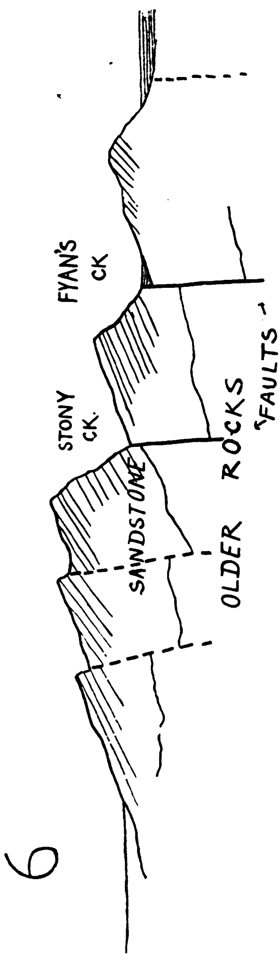

THE MAIN DIVIDE AND SOME TRANSVERSE RIDGES
FROM NEAR LEXTON WESTWARD
LEXTON
AVOCA
WIMMERA
MT COLE CK
ARARAT
CONCONGELLA
MT WILLIAM CK
GRAMPIANS
SIERRA
0 5 10 20
MILES



Hills on and near Divide
Ercildoun and Ascot Gaps

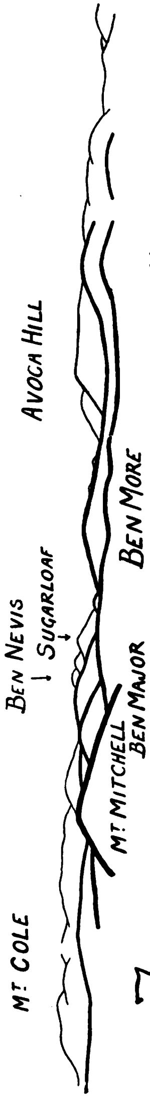

The Divide in Ascot Gap
from Mt Blowhard
Serra Range
Mt Emu
near
Mt William
76
Mt Ararat
62
Larne Gerin
51
Mt Cole
42
32 miles
Ben Major
37
Mt Misery
25
Mt Bolton
24
7 miles
4° Hills West and North West from Mt Buninyong


5
0
5
10
15
20
MILES
ORDOVICIAN
ROWSLEY FAULT
PARWAN CREEK
EGERTON
LAL LAL
MT DORAN
EASTERN PLATEAU
EAN GAP
ORDOVICIAN
BALLARAT
ASCOT GAP
SHALLOW GROUND
BURRUMBEET BASIN
TRUNK LEAD
SMYTHESDALE
ORDOVICIAN
STAFFORDSHIRE REEF
ERCILDOUN GAP



6

DIAGRAMMATIC SECTION OF THE GRAMPIANS SOUTH OF HALL'S GAP



7

PROFILE OF THE PYRENEES, FROM MAIDEN HILL

lines are the main roads across the Divide. The Divide itself is indicated by the heavy broken line, and the fainter broken lines mark the approximate limit of the slopes from each volcanic centre. A number of swamps are shown by the letter S. The volcanic hills are as follows:—On the Divide: 1, Brown's Hill; 2, Bankin's Hill; 3, Coghill's Hill, 1630 feet; 4, Mt. Cavern, 1588; 5, Mt. Hollowback, 1842; 6, Mt. Pisgah, 1771. South of the Divide: 7, Mt. Blowhard, 1664; 8, McLean's Hill; 9, Morton's Hill; 10, Saddleback Hill, 1548; 11, Weatherboard Hill, 1826; 16, Mt. Rowan. North of the Divide: 12, Tinkler's Hill; 13, Webster's Hill; 14, Vaughan's Hill, 1611; 15, One Mile Hill, 1443.

The information is largely from Mr. Norman Taylor's Geological Map of Learmonth.

Fig. 3. Profile of the Divide in Ascot Gap, Granite and Ordovician Ranges in the background shaded; the numbers have the same significance as in the preceding diagram. Sketched from Mt. Blowhard. The level topped Ordovician Ranges seen in the distance are partly west and partly east of the Dean Gap, a few volcanic Hills in this Gap are shown.

Fig. 4. Sketch of the Hills west and north-west from Mt. Buninyong. The distances of several of the hills are given under their names. Distances from point to point are also shown. The Serra Range is often visible as a more continuous line.

Fig. 5. Diagram to illustrate the possible courses of the leads south of the present Divide. O indicates areas of Ordovician rocks close to the surface; G of granitic rocks. The intervening areas are mainly volcanic or alluvial. The direction of the fall of some of the leads is shown by arrows.

Fig. 6. Diagrammatic cross section of the Grampians, south of Hall's Gap. The full lines show the probable position of the fault lines along two valleys, the dotted lines probable other faults whose number and position are uncertain. The depth to which the sandstone extends is also uncertain.

Fig. 7. Profile of the Pyrenees as seen from Maiden Hill near Waubra. Mt. Mitchell, in the foreground, is a volcanic hill. The increasing distances of the hills are shown by fainter lines.

ANNUAL REPORT OF THE COUNCIL

FOR THE YEAR 1906.

The Council herewith presents to Members of the Society the Annual Report and Details of Receipts and Expenditure for the year 1906.

The following meetings were held :—

March 8.—Annual Meeting and Election of Officers. Ordinary Meeting. Mr. J. A. Smith exhibited and described a new method of testing lenses during their figuring. Mr. A. E. Kitson exhibited some snakes from Western Australia which were stated to have killed themselves by self-inflicted bites. Also some dried plants which were reported to have grown several inches in length while in the Herbarium cases.

April 19.—Mr. J. A. Smith delivered a lecture on "The flow of fluids, illustrated by stream-line methods." The lecture was illustrated by experiments.

May 10.—Papers read: 1. "Some little-known Victorian Decapod Crustacea, with descriptions of new species, No. 3," by S. W. Fulton and F. E. Grant. 2. "Census of Victorian Decapod Crustacea, Part 1: Brachyura;" by S. W. Fulton and F. E. Grant. 3. "New Species of Victorian Marine Mollusca," by J. H. Gatliff.

June 14.—Paper read: "Micrometric measurements by a projected scale," by Dr. F. Clendinnen. Illustrated by experiments.

July 12.—Lecture by Prof. W. C. Kernot, M.A., M.C.E., on "Balloons and Airships." Illustrated by lantern slides.

Aug. 9.—Lecture by Kerr Grant, M.Sc., "The Vibrations of Jets." Illustrated by numerous experiments.

September 9.—Lecture by W. N. Kernot, B.C.E., "Some applications of the Electro-magnet." Illustrated by lantern slides and by numerous experiments.

October 11—Papers read: 1. "New or little-known Victorian Fossils in the National Museum; Part 8.—Some Palaeozoic Brittle

Stars of the Melbournian series," by F. Chapman, A.L.S. 2. "Note on Caligorgia flabellum from Port Phillip," by Prof. Sydney J. Hickson, D.Sc., F.R.S. 3. "New or rare Australian Plants," by Prof. A. J. Ewart, D.Sc., Ph.D.

November 8.—Lecture by Prof. E. W. Skeats, D.Sc., "The life history of a crystal." Illustrated by lantern slides.

December 13.—Papers read: 1. "Remarks on some Sub-fossil Bones from King Island," by Prof. W. Baldwin Spencer, C.M.G., F.R.S. 2. "Surface-tension as an aid in Canyon-formation," by J. A. Leach, M.Sc. 3. "Description of a new species of Cypridina from Hobson's Bay," by F. Chapman, A.L.S. 4. "Four new Echinoids from the Australian Tertiary," by T. S. Hall, M.A.

The series of lectures delivered during the year was a great success and large numbers of members and their friends attended.

During the year four Members and six Associates have been elected, two Associates have resigned, while one member and three Associates have died.

Mr. H. Moors, for many years member of Council, Treasurer, and more lately Auditor, of the Society, passed away at an advanced age, regretted by a large number of friends to whom his kindly nature had endeared him. The three Associates whose deaths we have to mourn are Messrs. F. J. Odling, C. Stewart, C.E., and G. J. Bolton, M.A.

The Proceedings of the Society, Vol. XVIII., Part 2, and Vol. XIX., Part 1, were published during the year, and owing to the low state of our finances in a most attenuated form.

Owing to the generosity of the Treasurer of the State our grant has been increased to £100, and we hope to increase our output of printed matter.

The Librarian reports 1454 additions during the year, which is the largest number yet recorded. The sum of £25 has been voted by the Committee for binding.

The Honorary Treasurer in Account with the Royal Society of Victoria.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance from 1905	£50	1	10	By Printing	£37	8	6
Government Grant	50	0	0	Postages and Petty Cash	9	0	10
Subscriptions—				Assistant-Secretary	20	16	2
Members	71	8	0	Hall Keeper	6	0	0
Country Members	4	4	0	Rates	1	13	4
Associates	34	13	0	Insurance	5	1	3
Arrears	30	9	0	Collector's Commission	11	15	11
Advance payments for 1907 ...	19	19	0	Sewerage	2	8	3
Rent of Rooms	7	10	0	Gas	2	14	0
Sale of Publications	1	1	3	Refreshments and Cleaning	5	1	3
				Bank Charges	0	10	0
				Periodicals	3	2	3
				Repairs	0	6	0
					£105	17	9
				Balance	163	8	4
	£269	6	1		£269	6	1

Compared with the Vouchers, Bank Pass-Book, and Cash-Book, and found correct,

(Signed) W. C. KERNOT, *Hon. Treasurer.*

(Signed) JAMES E. GILBERT, P. DE JERSEY GRUT, } *Auditors.*

7th March, 1907.

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1907.

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1907.

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His Excellency Sir Reginald Talbot, K.C.B. 1904

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Forrest, The Hon. Sir J., K.C.M.G., West Australia ... 1888

Hector, Sir James, K.C.M.G., M.D., F.R.S., Wellington, N.Z. 1888

Liversidge, Professor A., LL.D., F.R.S., University, Sydney, N.S.W. 1892

Neumayer, Prof. George, Ph.D., F.R.S., Neustadt a.d. Haardt, Germany 1857

Russell, H. C., B.A., F.R.S., F.R.A.S., Observatory, Sydney, N.S.W. 1888

Scott, Rev. W., M.A., Kurrajong Heights, N.S.W. 1855

Todd, Sir Charles, K.C.M.G., F.R.S., Adelaide, S.A. 1856

Verbeek, Dr. R. D. M., Buitenzorg, Batavia, Java 1886

Life Members.

Butters, J. S., F.R.G.S., Empire Buildings, Collins-street west 1860

Eaton, H. F. 1857

Fowler, Thos. W., M.C.E., Colonial Mutual Ch., 421 Collins-street, Melbourne 1879

Gibbons, Sydney, F.C.S., 31 Gipps-street, East Melbourne. 1854
Gilbert, J. E., "Melrose," Glenferrie-road, Kew 1872

Love, E. F. J., M.A., F.R.A.S., 213 Victoria Terrace, Royal Park 1888

Nicholas, William, F.G.S. 1864

Rusden, H. K., Glenhuntly-road, Elsternwick 1866

Selby, G. W., 99 Queen-street, Melbourne 1881

White, E. J., F.R.A.S., Observatory, Melbourne 1868

Ordinary Members.

Balfour, Lewis, B.A., M.B., B.S., Burwood-road, Hawthorn 1892
Baracchi, Pietro, F.R.A.S., Observatory, Melbourne 1887
Barnes, Benjamin, Queen's Terrace, South Melbourne ... 1866
Bavay, A. F. J. de, Foster Brewery, Collingwood 1905
Boese, C. H. E. 1895
Boys, R. D., B.A., Public Library, Melbourne 1903
Berry, Prof. R. J. A., M.D., F.R.S.E., University ... 1906

Cherry, T., M.D., M.S., Department of Agriculture, Melbourne 1893
Cohen, Joseph B., A.R.I.B.A., Public Works Department, Melbourne 1877

Dennant, John, F.G.S., F.C.S., Stanhope-grove, Camberwell 1886
Dunn, E. J., F.G.S., "Roseneath," Pakington-street, Kew 1893

Ellery, R. L. J., C.M.G., F.R.S., F.R.A.S., Observatory, Melbourne 1856
Ewart, Prof. A. J., D.Sc., F.L.S., University, Melbourne 1906

Fox, Dr. W. R., L.R.C.S., L.R.C.P., 90 Collins-street Melbourne 1899
Fryett, A. G., care Dr. F. Bird, Spring-street, Melbourne 1900

Gault, Dr. E. L., M.A., M.B., B.S., Collins-street, Melbourne 1899
Gillott, The Hon. Sir S., K.C.M.G., "Edensor," Brunswick-street, Fitzroy 1905
Grut, P. de Jersey, 125 Osborne-street, South Yarra ... 1901

Hake, C. N., F.C.S., Melbourne Club, Melbourne	1890
Hall, T. S., M.A., University, Melbourne	1890
Hartnell, W. A., "Irrewarra," Burke-road Camberwell ...	1900
Harvey, J. H., A.R.V.I.A., 128 Powlett-street, East Melbourne	1895
Heffernan, E. B., M.D., B.S., 10 Brunswick-street, Fitzroy	1879
Hooper, Dr. J. W. Dunbar, L.R.C.S., etc., Collins-street, Melbourne	1904
Jamieson, James, M.D., 96 Exhibition-street, Melbourne	1877
Kernot, Professor W. C., M.A., M.C.E., University, Melbourne	1870
Kernot, W. N., B.C.E., Working Men's College, Melbourne	1906
Kershaw, J. A., F.E.S., National Museum, Swanston-street	1900
Kitson, A. E., F.G S.	1894
Lyle, Prof. T. R., M.A., University, Melbourne	1889
Loughrey, B., M.A., M.D., Ch.B., M.C.E., 1 Elgin-street, Hawthorn	1880
Masson, Prof. Orme, M.A., D.Sc., University, Melbourne	1887
Michell, J. H., M.A , F.R.S., University, Melbourne	1900
Mills, A. L., University, Melbourne	1903
Nanson, Prof. E. T., M.A., University, Melbourne	1875
Oliver, C. E., M.C.E., Metropolitan Board of Works, Melbourne.	1878
Schlapp, H. H., 31 Queen-street, Melbourne	1906
Shephard, John, Clarke-street, South Melbourne	1894
Skeats, Prof. E. W., D.Sc., University, Melbourne	1905
Spencer, Prof. W. Baldwin, C.M.G., M.A., F.R.S., University, Melbourne	1887
Sugden, Rev. E. H., M.A., B.Sc., Queen's College, Carlton	1899
Sweet, George, F.G.S., Wilson-street, Brunswick	1887
Swinburne, The Hon. G., M.L.A., "Shenton," Kinkora-road, Hawthorn	1905
Tait, Thos., "Lanark," Queen's-road, South Melbourne ...	1905
Taylor, R., 31 Queen-street, Melbourne	1907
Walcott, R. H., F.G.S., Technological Museum, Swanston-street	1897
Ware, S., M.A., Education Department, Melbourne	1901
Wilkinson, W. Percy, Govt. Analyst, Melbourne	1894
Wisewould, F., 408 Collins-street, Melbourne	1902

Country Members.

Brittlebank, C. C., "Dunbar," Myrniong, Victoria 1898

Desmond, J., R.V.S., G.M.V.C., "Ellerslie," Hurtle-square Adelaide, S.A. 1901

Gregory, Prof. J. W., D.Sc., F.R.S., University, Glasgow 1900

Hart, T. S., M.A., B.C.E., School of Mines, Ballarat 1894
Heden, E. C. B., B.A., B.Sc., B.E. 1904
Hill, W. H. F., "Glenrowan," Dandenong-road, Windsor 1894
Hogg, H. R., M.A., 2 Vicarage Gate, Kensington, W. ... 1890
Howitt, A. W., F.G.S., D.Sc., "Clovelly," Metung 1877

Ingram, Alex., Hamilton, Victoria 1903

Maplestone, C. M., Eltham, Victoria 1898
Martell, F. J., School of Mines, Ballarat 1897
Mennell, F. P., Rhodesian Museum, Buluwayo, South Africa 1902
Murray, Stuart, C.E., "Morningside," Kyneton 1874

Oddie, James, Dana-street, Ballarat, Victoria 1882
Officer, C. G. W., B.Sc., "Kallara," Bourke, N.S.W. 1890

Corresponding Members.

Bailey, F. M., F.L.S., Government Botanist, Brisbane, Queensland 1880

Dendy, Professor Arthur, D.Sc., F.L.S., King's College, London 1888

Etheridge, Robert, Junr., Australian Museum, Sydney, N.S.W. 1877

Lucas, A. H. S., M.A., B.Sc., Sydney Grammar School, Sydney, N.S.W. 1895

Stirton, James, M.D., F.L.S., 15 Newton-street, Glasgow 1880

Associates.

Anderson, J., 225 Beaconsfield Parade, Middle Park 1903
Armitage, R. W., Continuation School, E. Melbourne 1907

Bage, Mrs. Edward, Fulton-street, St. Kilda	1906
Bage, Miss F., M.Sc., Fulton-street, St. Kilda	1906
Baker, Thomas, Bond-street, Abbotsford, Victoria	1889
Bale, W. M., F.R.M.S., Walpole-street, Hyde Park, Kew, Victoria	1887
Bennetts, W. R., c/o W. J. Clark, High-street, Kew ...	1894
Boyd, R. M., " Glynderbourne," Boundary-road, Toorak ...	1906
Booth, John, M.C.E., 25 Rathdown-street, Carlton	1872
Brook, R. H. T., 119 Errard-street, Ballarat	1906
Chapman, F., A.L.S., National Museum, Melbourne	1902
Cresswell, Rev. A. W., M.A., St. John's Parsonage, Camberwell, Victoria	1887
Clendinnen, Dr. F. J., Williams-road, Toorak	1906
Corbett, J., "Clifton," 39 Rushall-crescent, N. Fitzroy ...	1907
Danks, A. T., 391 Bourke-street West, Melbourne	1883
Ferguson, W. H., "Maryland Villa," Camberwell-road, Camberwell	1894
Finney, W. H., 40 Merton-street, Albert Park	1881
Fison, Rev. Lorimer, M.A., D.D., Essendon, Victoria ...	1889
Fulton, S. W., 369 Collins-street, Melbourne	1900
Gabriel, J., Victoria-street, Abbotsford, Victoria	1887
Gatliff, J. H., Commercial Bank of Australasia, Lygon-street, Carlton	1898
Grant, Kerr, M.Sc., Ormond College, Parkville	1905
Green, W. Heber, D.Sc., University, Melbourne	1896
Grayson, H. J., University, Melbourne	1902
Hall, Robt., F.L.S., C.M.Z.S., Elgar-road, Box Hill	1900
Hardy, A. D., F.L.S., Lands Department, Melbourne	1903
Henderson, A. A., B.Sc., School of Mines, Box 12, Bairnsdale	1905
Herman, Hyman, B.C.E., F.G.S., 60 Queen-st., Melbourne	1897
Holmes, W. A., Telegraph Engineer's Office, Railway Department, Melbourne	1879
Jobbins, G. G., Electric Lighting and Traction Co., Geelong	1902
Jutson, J. T., " Oakworth," Smith-street, Northcote	1902
Kenyon, A. S., Heidelberg	1901
Kernot, Frederick A., 57 Russell-street, Melbourne	1881

Lambert, Thomas, Bank of New South Wales, Collins-street, Melbourne 1890
Larking, R. J., "Woorigoleen," Clendon-road, Toorak ... 1905
Law, R., F.I.C., F.C.S., Royal Mint, Melbourne 1905
Le Souef, D., C.M.Z.S., Royal Park, Melbourne 1894
Luly, W. H., Department of Lands, Treasury, Melbourne 1896
Leach, J. A., M.Sc., Training College, Melbourne 1904

Muntz, T. B., C.E., Wattletree-road, Malvern 1873
Maclean, C. W., "Bronte," Strand, Williamstown 1879
Mahony, D. J., B.Sc., "Locksley," St. Kilda-rd., Melbourne 1904
Mattingley, A. H. E., 6 Alfred-street, N. Melbourne 1903
Mathew, Rev. John, M.A., B.D., Coburg 1890
McEwan, John, 317 Collins-street 1898
McKenzie, G., Lands Department, Melbourne... 1907

Nicholls, E. B., 164a Victoria-street, N. Melbourne 1904

O'Neill, W. J., Lands Department, Melbourne 1903

Pritchard, G. B., F.G.S., Mantell-street, Moonee Ponds ... 1892

Sayce, O A., Harcourt-street, Hawthorn 1898
Schafer, R., "Invercloy," Napier-street, Essendon 1883
Shaw, Alfred C., Bond-street, Abbotsford, Victoria 1896
Smith, F. Voss 1901
Smith, G. P., "Earlscourt," Glenferrie-road, Hawthorn ... 1901
Smith, J. A., 15 Collins-place, Melbourne 1905
Stephen, Rev. R., M.A. 1901
Summers, H., B.Sc., 67 Leopold-street, S. Yarra 1902
Sutherland, Ian M., "Novar," Dandenong 1905
Sweet, Miss G., D.Sc., Wilson-street, Brunswick 1906

Thorn, Wm., Lands Department, Melbourne 1907
Thiele, E. O., "Heimruh," Finlayson-street, Malvern ... 1898
Traill, J. C., B.A., B.C.E., "Osmington," Domain-road, South Yarra 1903

Wedeles, James, 231 Flinders-lane, Melbourne 1896
Woodward, J. H., Queen's Buildings, Rathdowne-street, Carlton 1903

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(The names of new species and genera are printed in italics.)

END OF VOLUME XX.

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