THE

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES

FOR THE YEAR

1914

Vol. XXXIX.

WITH NINETY-FOUR PLATES.

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CONTENTS OF PROCEEDINGS, 1914.

PART I. (No. 153).

(Issued 17th July, 1914.)

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(Issued 25th September, 1914).

PART III. (No. 155).

(Issued 24th November, 1914).

PART III. *(Continued).*

PART IV. (No. 156).

(Issued 26th February, 1915).

CORRIGENDA.

Page 47, line 7—for *H. foveatus*, read *H. foveata.*

Page 52, line 27—for *cyanipennis*, read *cyaneipennis.*

Page 97, line 5—*for* var. CYLINDRICA, *read* var. CYLINDRACEA.

Page 148, line 3—for var. *vialis*, read var. *sialis.*

Page 267, lines 22, 24, 26—for *Echinonema anchoratum*, read †*Echinonema anchoratum.*

Page 267, lines 35, 43—for *Thalassodendron*, read †*Thalassodendron.*

Page 267, line 45—for *Plectispa*, read †*Plectispa.*

Page 268, lines 1, 2—for *Plectispa*, read †*Plectispa.*

Page 284, line 26—for *T. ingalli*, read *D. ingalli.*

Page 334, line 25—after *Eumastia*, insert *Astromimus*(29), *Spongosorites.*

Page 360, line 16—*for* canals, which, *read* canals which.

Page 400, line 25—for *P. insidis*, read *P. isidis.*

Page 423, line 17—*for* conically, *read* conical.

Page 425, line 37—*for* spicules, (oxea), *read* spicules (oxea).

Page 434, line 12 (legend)—for *b*, read b, c.

Page 579, line 3—for *cyanipenne*, read *cyanipennis.*

Page 584, line 18—for *Helluosoma*, read *Ænigma.*

Page 651, line 26—*for* MALOCODERMIDÆ, *read* MALACODERMIDÆ.

Page 749, line 18—for *Purpurea grisea*, read *Purpura grisea.*

Plate xviii.—Fig.2 should be Fig.3, and *vice versâ.*

Plate xci. is incorrectly numbered cxi.

LIST OF NEW GENERIC NAMES PROPOSED IN THIS VOLUME (1914).

LIST OF PLATES.

PROCEEDINGS, 1914.

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES.

WEDNESDAY, MARCH 25TH, 1914.

The Thirty-ninth Annual General Meeting, and the Ordinary Monthly Meeting, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 25th, 1914.

ANNUAL GENERAL MEETING.

Mr. W. S. Dun, President, in the Chair.

The Minutes of the preceding Annual General Meeting (March 26th, 1913) were read and confirmed.

The President lelivered the Annual Address.

PRESIDENTIAL ADDRESS.

In one respect—the improved status of the Linnean Macleay Fellowships Endowment on 31st December, 1913, and the favourable correlated reaction on the Society's finances—the past year has been rather a notable one in the Society's history. The sum of £33,250 (being a bequest of £35,000 from the late Sir William Macleay for the endowment of four Fellowships, less £1,750 deducted for probate duty) was paid over to the Society in October, 1903; and invested at 4 per cent., the best investment offering at the time. As the income therefrom was insufficient to enable the Council to carry out the terms of the bequest—and would have been so, even if the Executors had not been called upon to deduct the amount of the probate duty—the question of the administration of the trust, under unexpected conditions, was referred to the Equity Court for guidance. In reply to the Society's petition for advice, His

Honor, the Chief Judge in Equity, on 26th August, 1904, directed, among other matters, that —(*a*) "The Council of the said Linnean Society of New South Wales will be justified in appointing three Fellows only with a salary of four hundred pounds per annum until the income from the fund in the said petition mentioned is sufficient to pay the four Fellows the full salary of four hundred pounds per annum." And (*b*): "The income from unawarded Fellowships should be accumulated until the said fund was sufficient to produce an income of one thousand six hundred pounds per annum."

The Council forthwith proceeded to carry out these directions. In October, 1904, and in the same month of every succeeding year up to 1912, the Council offered three Fellowships. The balance of the income, after providing for the salaries of the Fellows, except for small incidental expenses, has been capitalised annually. In this way, on 31st December, 1913, the original capital of £33,250 had been raised to £41,350, while, for the first time, the income for the year (£1,759 15s. 8d., as compared with £1,562 4s. 5d. for 1912) was sufficient to provide for the salaries of the maximum number of Fellows, and also to yield a surplus of £159 15s. 8d., which, at the discretion of the Council, may be taken for the "general use" of the Society: that is, in part, for defraying the cost of printing the papers of Fellows and of the Society's Bacteriologist, as well as the expense of the general administration of the Endowment Funds. Hitherto, this unexpected and unforeseen expenditure has been a charge on the Society's General Fund; and to meet it, and yet avoid a reduction in size of the annual volume of Proceedings (except in so far as the increased cost of printing has affected it), it has been necessary to exercise economy in other directions to a corresponding extent. The prospect of being relieved of this rather burdensome responsibility, and of seeing the realisation of Sir William Macleay's benevolent intentions as he wished them to be realised, is, therefore, very gratifying.

The arrears in the printing have been overtaken, and the Proceedings for the year have been completed. Twenty-six papers were read at the Monthly Meetings, but their average length was greater than usual; and, though one was withdrawn for some supplementary additions, the remaining twenty-five take up an additional space of about 40 pages, as compared with thirty-seven papers of the year before.

Mr. Hedley's important paper embodying the results of his patient examination of the types of Australian Mollusca in European and American Museums, illustrated with excellent figures of many of them, will be of great service to Australian conchologists. It is the kind of paper, of which Australian naturalists need many more, in other branches of knowledge.

When the suggestive papers of Mr. Andrews and Mr. Benson were read, it was proposed that detailed discussion thereon should be postponed until the papers were in print, and Mr. Benson had returned from England. We may look forward, therefore, to interesting discussions on the development of the *Myrtaceæ*, and on the geology and petrology of the Serpentine-Belt of New South Wales during the current Session, on dates to be announced.

The discussion on "The Study of Zoogeographical Distribution by means of Specific Contours," introduced by Mr. R. J. Tillyard at the Meeting in May, aroused much interest; but it seemed evident that the existing lack of a sufficiently detailed knowledge of the geographical distribution and range of many common groups, both of animals and plants, placed Members who are interested in these, at a disadvantage in applying Mr. Tillyard's views.

The names of nine new Members were added to the Roll during the year. Two Members resigned; two Ordinary Members, Mr. E. Betche, and Mr. T. Stephens, M.A., F.G.S., of Hobart, and one Honorary Member, Dr. Albert C. L. G. Günther, C.M.G., F.R.S., have been removed by death.

Mr. Ernst Betche, Senior Botanical Assistant at the Botanical Gardens, Sydney, who died on 29th June, was born at Potsdam, about sixty-one years ago. He was interested in horticulture in his early days, having first studied at the Horticultural College of his native city; subsequently gaining experience at the Municipal Gardens in Berlin, and at the horticultural establishment of Van Hoote. Afterwards, in the interest of his health, he went to Italy, but without satisfactory results; and he then decided to try the milder climate of the South Seas. He spent some time in collecting plants in Samoa, Tonga, and the Caroline Islands; and finally came to Sydney, in 1881, where he spent the rest of his days. His connection with the Sydney Botanic Gardens dates from the year mentioned. During the next fifteen years he collected extensively in New South Wales, for the Botanic Gardens; and subsequently became Botanical Assistant. Mr. Betche was naturally of a retiring disposition, and this characteristic was intensified by the fact that he was almost a life-long sufferer from a troublesome asthmatic complaint. But his interest in botany never flagged, and he accomplished, in his own unostentatious way, a considerable amount of useful and valuable work in connection with the Gardens and the State Herbarium, the importance of which is not to be estimated by what has been published. He collaborated with the late Mr. Charles Moore, in the production of a "Handbook of the Flora of New South Wales," published in 1893, now out of print, and much in demand; and with Mr. J. H. Maiden, in a long series of contributions, particularly "Notes from the Botanic Gardens, Sydney," in the Society's Proceedings covering the period from 1896-1913.

Mr. Thomas Stephens, the younger brother of the late Professor W. J. Stephens, was born in 1830, and died in Hobart in the latter part of last year. It would be difficult to find another case of two brothers who served, so eminently, and for so long a time concurrently, the cause of education and science, in slightly different ways, in two of the States of the Australian Commonwealth. After taking his degree at Oxford, Thomas Stephens came out to Victoria in 1855, but migrated to Tasmania in the following year, where he spent the remainder of his life. From 1857, he was identified with the Department of Education, first as Inspector of Schools, and finally as Director of Education. He joined the Royal Society of Tasmania in 1858, and from the time of his residence in Hobart, he was an office-bearer. He was no less keenly interested in the establishment of the University of Tasmania, and of its forerunner, Christ's College. His official duties provided opportunities for visiting all the settled parts of Tasmania, and led to the acquisition of a considerable knowledge of the geographical and geological features of the country, branches of knowledge in which his interest was of long-standing, and maintained to the last. Mr. Stephens joined this Society in 1904; and, in 1908, he contributed an important paper entitled "Notes on the Geology of the North-West Coast of Tasmania, from the River Tamar to Circular Head," which appeared in the Proceedings for the year mentioned. Other papers are to be found in the Papers and Proceedings of the Royal Society of Tasmania, or in the Report of the Meeting of the Australasian Association for the Advancement of Science held in Hobart in 1902.

Dr. Albert Günther was elected an Honorary Member of the Society in 1883, in appreciation of his valuable contributions to a knowledge of Australian Fishes, Amphibia, and Reptilia. His paper on *Ceratodus*, in the Philosophical Transactions of the Royal Society for 1871, is well known to students. His lengthy and honourable association with the British Museum, as Keeper of the Zoological Department, terminated on his retirement in 1895. He was the author of a monumental series of British Museum Catalogues, Monographs, and papers contributed to the Transactions of numerous Scientific Societies; also the founder and first editor of the Zoological Record. His services to science, both in connection with the British Museum, and in other ways, have been of the highest order; and his death in London, on February 1st, in his eighty-fourth year, closed a distinguished and fruitful career.

Dr. Greig-Smith, Macleay Bacteriologist to the Society, has continued his investigations into the reason for the beneficial action of heat and of the volatile disinfectants, such as chloroform and toluene, upon soils. It has been claimed by the Rothamsted investigators, that the enhanced fertility, that follows the treatment, is due to the destruction of the phagocytic protozoa. If this were so, it would be immaterial whether the one method were employed or the other, and in the case of a double treatment by both methods, whether heat were applied first or last. It has been found that, while the results are similar in field-soils, they are different in garden-soils. As one of the differences between the two classes of soils is the fatty material removable by disinfectants, it is not improbable that it plays a part in the restriction of the natural fertility. The presence of bacterio-toxins in soils has been denied by the Rothamsted investigators, but there are many reasons why their presence may have been overlooked. They are soluble in water, and are washed out of the soil by rain. They are unstable, and are slowly destroyed during dry weather. Although always present in varying amount, the nutrients may so overshadow them, that their presence may be unnoticed, until they are destroyed by some agent, such as heat, when an enhanced nutritive effect is obtained from the soil-extracts. Furthermore, an appropriate dilution, generally equal parts of soil and water, is requisite to show an optimum toxic effect. Toxic extracts can be obtained from soils by noting these conditions, and a soil, originally with a preponderating amount of nutritive substances, may be made to become toxic by simple incubation in the laboratory. While the soil-toxins are destroyed by heat, those of the subsoil are not. There are thus two classes of toxins in soils, a thermolabile in the soil, and a thermostable in the subsoil. One would imagine that the saturation of an organic manure, such as dried blood, with paraffin or vaseline, would reduce the rate of decay. Laboratory-tests have not borne this out, and the matter is under investigation. The action of naphthalene upon soils was also examined. This substance has recently been recommended for increasing the fertility of horticultural soils. It was found that while it increased the growth of bacteria, they were of a kind which did not bring about the formation of ammonia from dried blood.

Dr. J. M. Petrie, Linnean Macleay Fellow in Biochemistry, contributed two papers during the year, "Hydrocyanic Acid in Plants. Part ii. Its Occurrence in the Grasses of New South Wales," and "Note on the Occurrence of Strychnicine," which will be found in the last Part of the Proceedings. In the first of these, it is shown that a considerable number of our grasses contain cyanogenetic compounds, but that very few contain free hydrocyanic acid. There are indications that only the latter is a poisoning factor in these grasses. The investigation is, accordingly, being continued in the direction of ascertaining what substances are capable of decomposing the glucoside, and what conditions are necessary to bring about poisonous results. The examination of the alkaloids of certain solanaceous and other plants is being carried on.

Mr. E. F. Hallmann, B.Sc., Linnean Macleay Fellow in Zoology, has almost completed his first paper entitled "Revision of the Monaxonid Species described as new in Lendenfeld's Catalogue of the Sponges in the Australian Museum," which will be read at the Meeting in May. Mr. Hallmann's progress in the study of the Monaxonida has been greatly retarded not only by the inherent difficulties in the way of a satisfactory classification of this group, a subject which one of the most experienced workers at sponges has characterised as "actually repulsive from its difficulties"; but he has been greatly hampered by the grossly inaccurate and misleading character of many of the descriptions given in the Catalogue; and also because the specimens of types, in two different Collections, do not agree either with each other, or with the descriptions; while each of them includes cases of similarly labelled specimens belonging to dissimilar species.

In consequence of the increased income from the Fellowships Fund for last year, for the first time the Council was able to offer four Fellowships. Three applications were received in response. I have now the pleasure of making the first public announcement of the re-appointment of Dr. J. M. Petrie and Mr. E. F. Hallman, to Linnean Macleay Fellowships in Biochemistry and Zoology, and of the appointment of Mr. W. Noël Benson, B.A., B.Sc., to a Fellowship in Geology, for one year, from 1st proximo.

Mr. Benson, in joining the research-staff of the Society, comes with the highest qualifications. He completed the course for the B.Sc. degree in the University of Sydney, in 1907, with First Class Honours in Geology and Mineralogy. For some time he was

Demonstrator in Geology; subsequently Acting Lecturer in Mineralogy and Petrology at the University of Adelaide during the absence of Dr. Mawson with the British Antarctic Expedition under Lieutenant Shackleton; and, afterwards, again Demonstrator in Geology in the University of Sydney, up to the time of his appointment, in 1911, to a Science Scholarship of the Royal Commissioners for the Exhibition of 1851, tenable for two years, but later on extended for a third year. In this way, Mr. Benson was enabled to proceed to Cambridge, and hold a Research Studentship at Emmanuel College. On the acceptance of his thesis on "The Geology and Petrology of the Great Serpentine-Belt of New South Wales," Mr. Benson was admitted to the degree of B.A., last year. Three portions of his thesis have been published in our Proceedings for 1913, and the rest of it will form the subject of future communications. Mr. Benson has now had some considerable experience in research work under very favourable conditions. He has contributed a number of Papers to the Proceedings of this Society, to the Journals of the Royal Society of New South Wales and South Australia, or to other publications. While at Cambridge, he took the complete course of study given to senior students; and he comes to us with high credentials, from his Australian teachers as well as from Professor Bonney and Mr. Harker, of Cambridge. This instructional work has been supplemented by visits to the laboratories of Universities in Germany and Switzerland. Mr. Benson has also had special opportunities of seeing for himself, and learning as much as possible of the geology of certain areas in England, Scotland, and the Hartz Mountains, under very advantageous circumstances, a knowledge of which has an important bearing on the work he has done in connection with the Serpentine Belt, or proposes to continue, on his return to the State. On taking up the work of his Fellowship next month, Mr. Benson will continue the line of work upon which he has made a beginning, so as to complete, in detail, a study of the geology of the country from Tamworth to Warialda, with a general account of the physiography, special attention being given to the Attunga and Moonbi districts, where the intrusion of the granite has produced some remarkable contact-effects on the tuffs, lavas, and other members of the Devonian Series, analogous to those of the Hartz Mountains. The Serpentine Belt also needs further investigation southward from Nundle towards the Myall Lakes, through an area at present little known geologically.

At the Meeting of the Society in September, Mr. R. H. Cambage called attention to a laudable legislative effort then about to be made in England, to check the destruction of bird-life in distant countries; and, on his motion, it was resolved—That the Linnean Society of New South Wales considers it to be highly desirable that the Importation of Plumage (Prohibition) Bill, now before the British Parliament, should become law, and desires that a letter be written to the Premier of this State for transmission to the Secretary of State for the Colonies, urging the passing of the Bill. By the courtesy of the Premier, the terms of the Resolution were carried out; and on February 7th a letter was received from the Under-Secretary, Chief Secretary's Office, Sydney, notifying "that a Despatch has been received from the Secretary of State for the Colonies by the Prime Minister of the Commonwealth, requesting that your Society be informed that the Bill was introduced into Parliament by His Majesty's Government, and will be re-introduced next Session." From the newspapers, we have since learned that the second reading of the Bill was moved in the House of Commons by the Postmaster-General, Mr. C. E. Hobhouse, on 9th March, and agreed to by 284 votes to 27. The mover expressed the hope that an international conference on the subject would be held without delay, for, as he said, "Britain was really acting towards the Colonies as the receiver of stolen goods." Naturally, we should like to know how the Bill is viewed by naturalists and scientific bodies in Europe; but at this distance, it is difficult to find out and follow the trend of scientific opinion. A lengthy criticism of the Bill, by Sir Harry Johnston, will be found in "Nature" for December 11th, 1913 (p. 428). This writer contends that the Bill "is a very mildly worded measure, which will not satisfy root-and-branch reformers, for it exempts from supervision personal clothing worn or imported by individuals entering this country from abroad." But he adds, further, that any legislation rather than none, as the thin end of the wedge, is to be welcomed. In reply to Sir Harry, Mr. H. O. Forbes, as a British ornithologist interested in the Royal Society for the Protection of Birds, agrees that the Bill does not go far enough, but he considers that the weakness in the Bill pointed out by Sir Harry, can be eliminated by making the wearing of wild birds' feathers in England by British subjects, as illegal as the importation of feathers ("Nature," December 25th, p. 476). Mr. Forbes continues: "The real object desired by the Royal Society for the Protection of Birds is the prevention of the great cruelty for which the plumage trade is responsible, of the extermination, and of the reduction, towards that point, of the beautiful and beneficient fauna of the world." The international attitude towards the principle of the Bill is thus referred to in "Nature" for January 29th, 1914 (p. 617): "The United States Government has made the importation of birds' plumage penal, as well as prohibited the wearing of feathers. Austria and Germany are in accord with England as to the necessity of putting a stop to this nefarious traffic by similar laws. France and Belgium stand on the other side, for the plumassiers are so influential that it is hopeless for the Government of either of these countries even to propose such a protective Bill." Lastly, in "Nature" for February 5th (p.639) will be found a very gratifying message, cabled to the Zoological Society of London, by the Zoological Society of New York, on the occasion of the Annual Meeting. The hope is expressed that unanimous support will be given to the Hobhouse Bill, which is designed to reinforce the protective measures passed by Congress. The message continues—"The effect of the American Bill has been instantaneous and widespread, and is now receiving unanimous support all over the United States. The very passage and enforcement of the Bill has created a sentiment for wild-life protection in many quarters where it did not exist before. The millinery trade has adapted itself to the new conditions, and the law is acknowledged to be most beneficial in its results." In conclusion, we have still to remember that the Hobhouse Bill provides for only one phase of the complex problem of the preservation of the world's bird-life, namely, the checking of the destruction of birds for trade purposes. Another phase needing consideration, which is not in evidence in Europe or the United States, but which manifests itself in Australia in connection with the destruction of rabbits by poison, is the preservation of useful birds, many of them not having ornamental plumage of value to the trade, whose welfare is not provided for by the Hobhouse Bill.

I have pleasure in making known to Members, that the Society is in receipt of a very cordial invitation from Mr. J. A. Barr, Manager of the Panama-Pacific Exposition, to be held in San Francisco from February to December, 1915, supported by Mr. J. P. Bray, American Consul-General in Sydney, to hold a Meeting during the Exposition. In thanking these gentlemen for their kindness and courtesy, they have been informed that the invitation would be communicated to the Members at the Annual Meeting; and that, thereafter, if a sufficient number are able to visit the Exposition, the Council will inquire as to the possibility of arranging for the acceptance of the invitation. It may be presumed that the object of holding such a Meeting will be to provide an opportunity of discussing the Australian aspect of problems of general interest; or matters arising out of scientific exhibits or the assembling of scientific men from all parts of the world in connection with the Exposition. Members who contemplate visiting the Exposition are requested to give in their names to the Secretary in good time. Perhaps if the number of representatives of any one Society is not very large, it might be possible to arrange for a joint Meeting of visitors from Australia.

An event entitled to notice is the return of the second contingent of the Australasian Antarctic Expedition, which left our shores in 1912, under the leadership of Dr. Douglas Mawson. It is not intended to touch on the tragic losses, nor the fortitude of the leader—which have already been fully brought to the attention of members and the public. But the actual, and potential scientific results are such, that they are well worthy of the attention of those interested in Australian science. The outstanding feature of the work carried out by this Expedition, is that investigations in all the leading lines, occupying the attention of previous ventures, have been prosecuted in an entirely new region, or practically new, for Dumont D'Urville did not land on the mainland, and brought back no information concerning it, except the main fact, that there was land. Wilkes had taken a few soundings. Sixty of the 90° of the Australian Quadrant were new ground, and it was there, that operations were carried out in relation to physiography, meteorology, and other branches of science. The result is that the coast has been mapped through 33° of longitude, and the extension of the continent has been shown for the remainder by means of soundings indicating continental slopes or a shelf.

Large areas of the land were sledged over, and rough topographical maps prepared. A study of the great Ice Sheet, both on the plateau, and along its coastal face, has been illuminating, and adds new data for the study of glaciation. Marginal shelf-ice on a large scale, floating glacier-tongues, a booming glacier, and an avalanche-cascade were special features studied. The occurrence of extraordinarily large bergs, up to 40 miles in length by 20 miles broad, and observations upon their annual rate of travel, form a matter of interest.

The territory of Adelie Land was extended to reach the area of the Main Base. King George Land is considerably to the east of the Main Hut, Queen Mary Land at our western base, Wilkes' Land is south of Dumont D'Urville's Clare Land, which was proved to be non-existent.

From these terse facts it will be seen that though all the details of the geography of the Australian Quadrant are not yet known, it is assured that the salient features are covered.

Important dredging work was carried out; unfortunately, owing to weather conditions, it was only on the last cruise that really satisfactory results were obtained, and on this venture every dredge was successful. Dredgings at all depths between 50 fathoms and two miles were made along the region of the Antarctic Circle (in the Australian Quadrant). These dredgings are in the charge of Mr. Hunter, and it is understood that the distribution is to be carried out by the Australian Museum and the University. The results of the detailed examination are bound to be of the highest importance. The earlier cruises were accompanied by Mr. Waite and Professor Flynn, of the University of Tasmania, but weather conditions militated against successful results.

A very large number of soundings have been taken,including two lines of soundings between Australia and the Antarctic Continent—one from Tasmania to Adelie Land, the other from Queen Mary Land to Adelaide. A well-marked submarine elevation was discovered to the south of Tasmania, another to the north of Queen Mary Land—the relics of old land-connections. A very large series of oozes was obtained during the dredgings.

In Antarctic waters, besides the usual cherts, gneisses, red sandstones, etc., wood and coaly matter were dredged up on several occasions, and once scoriaceous lava, this to the north of where North's Highland appears on Wilkes' maps. Dr. Mawson is of the opinion that this comes from a local volcanic centre.

The severe weather conditions at both bases, especially at Adelie Land, where almost unimaginable and frequent blizzards were found to prevail, are most astonishing. It is now known that the average wind velocity, on the Antarctic Continent, is greater as one decreases the distances to the Geographical Pole; localities on the same latitude may, however, vary through wide limits, the two extremes being Amundsen's base and Mawson's.

The snowfall is phenomenal in the northern portion of the continent—probably up to 2 or 3 feet in the day. Magnetic observations were regularly taken, and when published, hourly values will be given for the whole period.

Observations on the Aurora were continued in connection with the state of the æther, and as to its capacity of transmitting wireless waves. It is of interest to note that an accurate longitude was established in Adelie Land, by the use of the wireless installation. Antarctic bacteriology was studied by Dr. McLean, and cultures were prepared.

Another station was Macquarie Island, which has been mapped and contoured by Mr. H. Blake; the sea-elephants and the abundant life were studied by Mr. Hamilton; the meteorology by Mr. Ainsworth; and the geology by Mr. Blake. All the older rocks are igneous, gabbros predominating; glacial tills and glacial lakes occur.

The results of the examination of the collections, and the study of the observations are now being taken in hand, and I feel sure that, when published, they will be such as not only to confer credit on the work, but to prove of the greatest interest to the scientific world.

In a few months we shall be taking part in the most important scientific gathering ever held in Australia, for, in August next, the representatives of the British Association for the Advancement of Science will assemble in the various capitals. These will comprise about 400 members, although a greater number applied for inclusion. Amongst those who are coming, are many of the leading men of science of the world, for besides the main British party, invitations issued to many leaders in science of foreign countries have also been accepted. Sir Oliver Lodge and Sir Edward Schäfer, the last two past-Presidents, are included.

It has been decided that an advance section, consisting of about 70 members will call at Western Australia, while the main party will visit Adelaide, Melbourne, and Sydney, and arrangements have been made for some of the members to visit Brisbane and New Zealand, while the question of some going to Tasmania is now under consideration.

Sectional Presidential addresses will be delivered at Adelaide, Melbourne, Sydney, and Brisbane; and papers in the various sections will be read at Melbourne, Sydney, and Brisbane.

The President of the Association will deliver the first half of his address in Melbourne, and the remainder in Sydney.

The popularity of the visit will be increased by the discourses and lectures of prominent members. Two discourses will be delivered to members, and two citizens' lectures to the public. and of these, the latter will be largely under the control of the Workers' Educational Association. For the discourses in Sydney, two eminent lecturers, Sir James Rutherford and Professor Grafton Elliott

Smith, have been selected; while several have offered their services for the citizens' lectures, but a final choice has not yet been made.

From a scientific standpoint, the gathering will be the most brilliant ever assembled in Australia; and, as many of our visitors will be engaged in lecturing on their return, it will be seen that the assistance, which has been granted to this Association by the various Australian Governments, must meet with ample reward.

The remainder of the Address was devoted to a consideration of the relations of the Permo-Carboniferous fauna of Australia to those of other parts of the world; and will appear later in separate form.

Mr. G. A. Waterhouse, on behalf of Mr. J. H. Campbell, Hon. Treasurer, who was indisposed, presented the balance sheet for the year 1913, duly signed by the Auditor, Mr. F. H. Rayment, F.C.P.A., Incorporated Accountant; and he moved that it be received and adopted, which was carried unanimously. *Abstract:* GENERAL ACCOUNT, Balance from 1913, £207 11s. 4d.; income, £1,111 16s. 7d.; expenditure, £1,039 18s. 11d.; transfer to Bookbinding account, £11 11s. 0d.; balance to 1914, £279 9s. 0d. BACTERIOLOGY ACCOUNT, Balance from 1912, £39 5s. 9d.; income, £543 7s. 10d.; expenditure, £588 5s. 6d.; Dr. balance to 1914, £5 11s. 11d. LINNEAN MACLEAY FELLOWSHIPS ACCOUNT, Income, £1,759 15s. 8d.; expenditure, £868 8s. 4d.; transfer to Capital account, £891 7s. 4d.

No nominations of other Candidates having been received, the President declared the following elections for the Current Session to be duly made :—

PRESIDENT : Mr. W. S. Dun.

MEMBERS OF COUNCIL (to fill six vacancies) : Professor David, C.M.G., D.Sc., F.R.S., Messrs. W. S. Dun, J. R. Garland, M.A., Professor W. A. Haswell, M.A., D.Sc., F.R.S., A. H. Lucas, M.A., B.Sc., J. H. Maiden, F.L.S., &c.

AUDITOR : Mr. F. H. Rayment, F.C.P.A.

A very cordial vote of thanks was accorded, by acclamation, to the President, on the motion of Dr. Kesteven, seconded by Mr. A. F. B. Hull.

The Linnean Society of New South Wales.

GENERAL ACCOUNT.

Balance Sheet at 31st December, 1913.

Liabilities.

	£	s	d
Capital: Amount received from Sir William Macleay during his lifetime	14,000	0	0
Further Sum bequeathed by his Will, £6,000, less Probate Duty, £300	5,700	0	0
	£19,700	0	0
Bookbinding A/c	69	6	0
Income A/c, at 31st December, 1913	279	9	0
	£20,048	15	0

Assets.

	£	s	d	£	s	d
Society's Freehold				1,600	0	0
Investments: Loans on Mortgage...				18,100	0	0
Cash:						
Commercial Banking Co. of Sydney, Ltd. (Current A/c)	307	6	5			
Government Savings Bank	41	8	7			
				348	15	0
				£20,048	15	0

Examined and found correct. Securities produced.

F. H. Rayment, F.C.P.A., Auditor.

J. H. Campbell, Hon. Treasurer.

Sydney, 12th February, 1914.

INCOME ACCOUNT, year ended 31st December, 1913.

Dr.

	£	s	d	£	s	d
To Salaries and Wages... ...				452	0	0
,, Printing (Publications)	378	8	0			
,, Illustrations...	101	17	6			
				480	5	6
,, Rates	23	9	2			
,, Insurance...	7	13	8			
...				31	2	10
,, Postage, Telegrams, Advertising and Petties...	43	18	0			
,, Printing (sundries), Stationery, etc	11	1	0			
,, Maintenance Fee, Sir Wm. Macleay's Grave	1	10	0			
,, Audit Fee (proportion of)	1	15	0			
,, Telephone...	4	9	7			
,, Repairs...	1	10	0			
,, Bank Charges	0	16	0			
				64	19	7
,, Bookbinding A/c				11	11	0
,, Balance to 1914				279	9	0
				£1,319	7	11

Cr.

	£	s	d	£	s	d
By Balance from 1912				207	11	4
,, Subscriptions—						
1913...	162	13	0			
Arrears	19	19	0			
In advance	4	4	0			
				186	16	0
,, Entrance Fees				11	11	0
,, Interest on Investments				838	10	5
,, Sales				58	19	2
,, Rent (Bacteriology A/c)				16	0	0
				£1,319	7	11

BACTERIOLOGY ACCOUNT

Balance Sheet at 31st December, 1913.

Liabilities.	£	s	d
Capital: Amount bequeathed by Sir William Macleay, £12,000, less Probate Duty, £600	11,400	0	0
Accumulated Interest ordered by Council to be added to Capital	1,600	0	0
Interest invested	900	0	0
	13,900	0	0
Commercial Banking Co....	5	11	11
	£13,905	11	11

Assets.	£	s	d	£	s	d
Investments:						
New South Wales Inscribed $3\frac{3}{4}\%$ Stock				13,900	0	0
Income A/c at 31st Dec., 1913 ...				5	11	11
				£13,905	11	11

Dr. INCOME ACCOUNT, year ended 31st December, 1913. Cr.

	£	s	d
To Salary and Wages	442	5	10
,, Rent	16	0	0
,, Rates	7	16	9
,, Insurance	1	5	4
,, Gas	7	2	6
,, Apparatus and Chemicals	16	0	0
,, Audit Fee (proportion of)	1	15	0
,, Petty Cash	12	0	0
,, Journals (1906-13) and Printing ...	83	10	1
,, Bank Expenses	0	10	0
	£588	5	6

	£	s	d	£	s	d
By Balance from 1912				39	5	9
,, Interest on Investments				523	7	10
,, Tuition Fees	60	0	0			
,, Less Bacteriologist's proportion	40	0	0			
				20	0	0
,, Balance to 1914				5	11	11
				£588	5	6

Examined and found correct. Securities produced
Sydney, 12th February, 1914.
F. H. Rayment, F.C.P.A., Auditor.

J. H. Campbell, Hon. Treasurer.

LINNEAN MACLEAY FELLOWSHIPS' ACCOUNT.

Balance Sheet at 31st December, 1913.

Liabilities.

				£	s	d
Capital: Amount bequeathed by Sir William Macleay, £35,000, less Probate Duty, £1,750				33,250	0	0
Balance of Income Account capitalised in terms of bequest or available for such purpose—						
To 31st Dec., 1912	7,369	2	5			
At 31st Dec., 1913	891	7	4			
				8,260	9	9
				£41,510	9	9

Assets.

				£	s	d
Investments: Loans on Mortgage	31,950	0	0			
New South Wales Inscribed 3¾% Stock...	7,715	0	0			
Fixed Deposit, Comml. Banking Co.	1,500	0	0			
				41,165	0	0
Cash:						
Commercial Banking Co.	166	15	7			
Savings Bank of N.S.W.	178	14	2			
				345	9	9
				£41,510	9	9

INCOME ACCOUNT, year ended 31st December, 1913.

Dr.

	£	s	d
To Salaries of Linnean Macleay Fellows	866	13	4
,, Audit Fee (proportion of)...	1	15	0
,, Amount transferred to Capital A/c	891	7	4
	£1,759	15	8

Cr.

	£	s	d
By Interest on Investments	1,759	15	8
	£1,759	15	8

Examined and found correct. Securities produced.
F. H. Rayment, F.C.P.A., Auditor.
Sydney, 12*th February*, 1914.

J. H. Campbell, *Hon. Treasurer.*
22*nd January*, 1914.

ORDINARY MONTHLY MEETING.

March 25th, 1914.

Mr. W. S. Dun, President, in the Chair

The Donations and Exchanges received since the previous Monthly Meeting (26th November, 1913), amounting to 49 Vols., 258 Parts or Nos., 48 Bulletins, 11 Reports, and 11 Pamphlets, received from 107 Societies, etc., and three individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. David G. Stead exhibited a number of very large nematode worms from the ovaries of a Jewfish, *Sciæna antarctica* Castelnau. On the 3rd December, 1913, two sets of ovaries of Jewfish were being examined in connection with an investigation into the spawning period of the species. One of these was quite normal, but the other was seen to be infested with a peculiar nematode worm, previously found under similar conditions. Upon opening these ovaries, a great number of the round worms were found. One of the worms proved to be no less than 84 inches in length, while others were nearly as long. They were of a wonderful translucent ruby colour, and from about 2 mm. to 2·5 mm. in diameter. Another nematode worm (an immature Ascaris), but of small size, was also present on the outside of the ovaries; but this is seen in nearly all cases. The long nematodes were tied up into many knots, individually, and with each other, and may have grown so. Nine of them, that were isolated from one another, measured respectively 30, 36, 60, 60, 72, 72, 78, 78, and 84 inches; while there were seven other sections aggregating 97 inches, and two complete worms hopelessly tied in knots with each other—altogether about 65 feet of this large nematode worm in one ovary alone. The Jewfish, from which the parasitised ovaries were taken, was from Port Kembla. It measured 42 inches, and weighed 29 lbs.

Mr. E. Cheel showed a small Skink Lizard with an anomalous tail.

ON THE STUDY OF ZOOGEOGRAPHICAL REGIONS BY MEANS OF SPECIFIC CONTOURS.

With an application to the *Odonata* of Australia.

By R. J. Tillyard, M.A., F.E.S.
(New South Wales Government Research Student in Biology at the University of Sydney.)

(Plate i., and Transparencies 1-3.)

It can scarcely be denied that the science of Zoogeography is in a somewhat unsatisfactory condition, and that great difficulties exist both in the following out of lines of research and in the drawing of general conclusions. This is not to be wondered at, when we realize that the present distribution of the fauna and flora of the earth has been brought about by the acting together of so many conflicting conditions, continually changing throughout immensely long geological periods; and that the task of re-picturing or re-constructing these conditions is in itself a most baffling one, owing to the very fragmentary evidence still preserved to us.

Under these circumstances, any method which may promise to yield good results, and to give us a clearer view of the problem in hand, is worthy of a trial. The author, therefore, offers the method explained in this paper, with the intention neither of ousting any of the already approved methods of study, nor of proclaiming the discovery of a panacea for the difficulties known to exist; but rather with the purpose of presenting the subject in a new light, in which, it is hoped, certain facts may be made to stand out in bolder relief than they have hitherto done.

It is now generally admitted that the six main zoogeographical regions, as originally proposed by Sclater, and modified by Wallace, are valid subdivisions of the land-surface of the earth, as far as its fauna and flora are concerned. But though these regions may be marked off very definitely in the case of certain groups—as, for instance, in the case of the Mammalia and the Passerine Birds, for which they were originally instituted—yet in other cases the boundaries between them may be more or less transgressed, or may even be non-existent for certain groups. This is, of course, due to the fact that the barriers which mark off the different regions may not always have been barriers in time past, nor may they be complete barriers in time present. It can be easily seen, for instance, that Wallace's line need not prove a bar to the migration of strong-flying insects, nor need the arid tract that somewhat vaguely separates the Nearctic from the Neotropical Region be any bar to the progress of eremian forms of animals or plants.

It is no wonder, therefore, that much less agreement should be found amongst the opinions of students when we come to consider the question of *subregions*. Many schemes have been proposed for the subdivision of the six main regions into subregions of approximately co-ordinate value. Possibly the desire for uniformity and symmetry has been one of the underlying forces in some of these attempts. One scheme, with a good deal to recommend it,* divides each main region into four subregions. Such divisions cannot, however, be regarded as of co-ordinate value. To take an example, the Australian region is subdivided into the Australian proper (Australia and Tasmania), the Papuan, the Polynesian, and New Zealand (with its allied islands). Of these, New Zealand stands in a higher rank than the others, and is claimed by many scientists to form actually a separate region. On the other hand, the division does not recognise the claims of the South-Western corner of Australia, which, to botanists at any rate, will appear to be as distinct a subregion as could possibly be found; while, on the other hand, the so-called Polynesian subregion is founded purely on negative characters, and is only doubtfully to be included in the Australian region at all.

The present paper is an attempt to approach the subject from a different view-point. The desire to draw hard-and-fast divisions exaggerates the actual boundaries reared by Nature at

* Text-Book of Zoogeography, F. E. Beddard.

various times and in various manners, and we are apt to lose sight of the great fact of the underlying unity of descent connecting together the various groups of animals or plants upon the earth. In the method proposed, no attempt will be made to indicate *land-area* divisions or subdivisions; but the attempt at subdivision or classification will be devoted to the *actual contours of groups.* The construction of these contours is, however, a matter of great difficulty. As the author is convinced of the futility of attempting such a task, except under the guidance of very strict and definite rules, the following scheme is here presented as an explanation of the method, for which the name "*Method of Specific Contours*" is proposed :—

i. Selection of the Land-Area.

Any land-area, either continuous or discontinuous, may be selected *which may be considered to have claims to be regarded as a zoogeographical unit.* Without doubt the best results will be obtained by the drawing of contours over the complete area of one of the six main zoogeographical regions. For the study of circumpolar or circumtropic distributions, it would be advisable to take the total land area of the earth into discussion. Parts of a region (such as Madagascar, New Zealand, or Australia with Tasmania), may be studied separately with good results, provided the unity of the prevailing flora or fauna of a region is not destroyed by the selection of an area that has no claims to be considered as a unit.

ii. Selection of the Group.

The group of animals or plants selected for study by contours, whether it be a single genus, group of genera, subfamily, or division of higher order, *must be a natural group clearly marked off from its nearest allies.* Genera or other groupings merely based on taxonomic expediency cannot be used. For if we fail to take into account any portion of a complete natural group, we cannot expect to obtain a completely natural result. In particular, *known* convergences of type must be carefully avoided; but, on the other hand, when convergence is not yet proved, the resulting contour may give valuable evidence as to its existence.

iii. Collection of Records.

It is essential that the records used be *fairly complete.* Probably in very few cases can the complete records of distribution of even a single species be obtainable. But this is not necessary, because the object of the method is not to produce contours of impeccable accuracy (such, indeed, are practically an impossibility), but to study the *type* of contour produced. The alteration of a contour line a few miles (or even perhaps a few hundred miles) usually will not affect our ability to recognise it as belonging to a particular type. As an example of the kind of contour aimed at, one may offer any of the well-known meteorological contour maps drawn over a large area. In these, the *general* distribution of isobars, isohyets, or isothermals, is very clearly shown; but these lines are drawn as free curves, and ignore many small local variations. To give a good example, the average annual rainfall map of Australia (Plate i.) is produced from about *seven hundred* records. Doubtless, if we could have access to *seven thousand* records, a much closer approximation to the truth could be obtained. Yet nobody would seriously maintain that the contour as now produced is not accurate enough for all practical purposes, *especially for study as a complete whole*, in which too much attention to detailed curvings of contour-lines would mar the clear effect now obtained.

Under this heading, it is hoped that the method of Specific Contours will, if adopted, lead to a closer recognition of the *value of every single record* that can be obtained *of every single species, however common it may be.*

iv. The validity of Species.

No attempt can here be made to answer the question "What is a species?" To each student who desires to use the method, sufficient common sense may be attributed not to mar the result by an insistence on the recognition, as species, of units of lower than specific value. In this connection, it should, however, be clearly noted that, on the whole, both "splitter" and "lumper" will produce approximately the same contours for a given group. For, if a recognised species, A, be subdivided into any number of species, A_1, A_2, A_n, the contour will not be affected *unless two or more of the forms occur in a single locality.* But as nearly all the argument between "splitters" and "lumpers" occurs about "geographical races," it follows that in such cases no alteration of the contour is effected by a change of opinion, since the species in question *can only score "one"* in each locality in which it occurs.

Local varieties, known to be produced as the offspring of a definite species, should on no account be included as "species."

v. Application of the Method.

On the map of the area to be studied, each locality from which records are obtainable should be marked down. Against each, the *number* of species (of the group in question) occurring in that locality should be written. Contour lines are then to be drawn as *free curves enclosing in turn all those localities possessing the same number of species.* In the simplest cases (where no lacunæ or breaks occur), the result will be as follows:—

Between the outermost contour-line (1) and the next (2) will lie all those localities in which only *one* species occurs. (N.B.—It is important to notice that this is not necessarily the *same* species for all these localities).

Between contour-lines 2 and 3 will lie all those localities possessing *two* species (again, not necessarily the *same* two species). And so on. Finally, the nth or highest contour-line will be either a closed oval, or possibly a series of closed ovals, of comparatively small extent, enclosing those few localities in which the highest total of n species occurs (again, be it noted, not necessarily the *same* n species in every locality within an oval).

Where the records are not sufficient, continuity or discontinuity may be assumed provisionally according to the evidence available. To give an example:—A species may be recorded from Sydney, Newcastle, Richmond River, Tweed Heads, Brisbane, Rockhampton. In such a case, it may reasonably be assumed that it occurs along the whole coast-line from Sydney to Rockhampton, because the conditions known to exist between these points naturally suggest its occurrence throughout. But, suppose a species is recorded from Perth, Bunbury, Busselton, Albany, Adelaide, Port Elliott, Murray River. In this case, we might be justified in refusing to include the very barren coastal region along the Great Bight within the contour, until we had definite evidence of the occurrence there of the species in question.

Suppose, then, that the contour of the group, planned on the lines laid down, has been obtained. Of what value is it to us?

i. It is a *density*-contour for the group, but not an actual *species*-contour. It takes account only of the *number* of species occurring at a given point, not of the *actual* species comprising that number.

ii. It is not accurate in detail, but only *in broad outline.*

If these two facts be continually borne in mind, the contour may be used with very real value. The objects to be aimed at in using such a contour are as follows:—

1. To obtain on a single map a fairly accurate *graphical representation* of the present distribution of a group.

The author claims that the single "contour-map" will give to the mind *a clear and sufficiently accurate* representation of the distribution of the group, which *cannot be attained* by the perusal of many separate maps, on each of which the area of distribution of a single species of the group is mapped separately.

2. By comparison of the Specific Contours of many groups over the same region, these groups may be arranged into separate sets, each set possessing a contour *referable to a single type*, but not, of course, similar in details.

3. By a study of the different types obtained, the sum total of the fauna or flora of the region may be clearly visualised, and its different components clearly distinguished.

4. In many cases, valuable phylogenetic evidence may be deducible from a study of the contour.

Before dealing more fully with these points, it is necessary to consider (*a*) the general structure of a contour, (*b*) the general theory of contour-types.

A. *The general structure of a contour.*

It is evident that, *in general*, the lowest contour-lines will enclose the largest areas, while, as the number-value of the contour-line increases, the area it encloses will become smaller and smaller. Finally, the *n*th, or highest, contour-line will enclose a small area or series of areas surrounded by all the other contour-lines. Such an area, representing a "summit" of the contours, may be spoken of as a *Zoocentre*; it being clearly understood that in using this term no definite claim is put forward that the area is also *a centre of origin* for the group. The *Zoocentre* may be defined as the *centre of present greatest density* for the group. It may be also a centre of origin, but in most cases it is possible that such a claim cannot be maintained for it. Sometimes the area of the zoocentre is elongated very much in comparison with its breadth; it may then be termed the *Zoocentric Axis* of the group. In the case where the contour exhibits more than one separate zoocentre, that which contains the highest number of species may be called the *primary* zoocentre, while those of lower value may be called *secondary* zoocentres.

It sometimes happens that the order of the contours is reversed, so that the higher contours enclose the lower, until in the middle may be found a small area in which perhaps only 2, 1, or even *no* species occur. (Such a case, for example, is furnished by the failure of a subtropical group to ascend a central mountain range, though it may be spread abundantly all round it. As one reaches a higher elevation, the number of species found will diminish; until, perhaps, above a certain level no species of the group will occur). In such a case, the area of lowest contour may be called a *Lacuna*. The mapping of lacunæ may be of the very greatest importance in the study of a group.

In constructing a contour, it is very important to leave out of account *purely local discontinuity*. To give an exaggerated example:—Certain species of rush occur throughout Central Australia, *wherever there is a waterhole.* The waterholes may be fifty or a hundred miles apart. Nevertheless, the correct contour needed for general study of this group of rushes should be drawn completely around the whole region in which they occur, and not as a number of small circles around the various waterholes. So, also, in mapping contours for groups of *Odonata*, we do not draw our contours along the boundaries of rivers and lakes, though the species are *actually* confined to them; rather, we include the whole area in which, *given the necessary water*, the particular species can be shown to occur.

B. *The general theory of Specific Contours.*

Let us select for study a region, Z, separated by a definite barrier from another region, Y. A group of species occurring in Z may either have originated in Z, or they may have immigrated into it from some other region. Suppose a group of species, A, to have been inhabitants of the region Y at some past time before the barrier between Y and Z was effective, and let A be a dominant or increasing group. As it extends its boundaries, first one and then another species may reach Z and penetrate further and further into the new region. As these new arrivals encounter new conditions of life, such as altered temperature, rainfall, geological or vegetational conditions, their progress may be gradually stopped. Some forms may penetrate further than others, or may take different paths. As long as the barrier between Y and Z is not a *complete* one, so long will this immigration stream flourish and be clearly recognisable as such.

The contour of such an immigration group over the area Z is easily recognisable (Transparency 1) by the fact that its *zoocentre* either lies entirely outside or only partly inside the region Z, while the lower contour-lines extend farther and farther into the region.

For such a contour, the name *Ectogenic Contour* is proposed.

Suppose, next, that the barrier between Y and Z becomes complete, so that the immigrant-stream is cut off from the parent group. If it does not die out, it will gradually assimilate itself to the new conditions, *forming new zoocentres in those areas where conditions are most favourable to it.* After a sufficient interval of time, it will have evolved a group very distinct from the parent group in Y, and the differences may be accentuated by the evolution of the two groups along divergent lines. Thus the group in Z gradually takes on a distinct or regional form, and becomes part of the native or autochthonous fauna of the region. We thus obtain a group *whose group-characters, as now recognised, were actually evolved within the region Z. Such groups form the characteristic fauna or flora of a given region,* and it is on the evidence of such groups that regional distinctions are based. Their contours are recognisable by the fact that their zoocentres lie *within* the region, while the lower contour-lines spread out farther and farther around, and may even overlap into surrounding regions (Transparency 2).

For a contour of this type, the name *Entogenic Contour* is proposed.

We can now go one stage further, and assume that a particular *entogenic* group in Z is faced with newer and stronger invasions of ectogenic groups from other regions, due, perhaps, to the removal of old barriers. In the struggle for existence, the older group will go under, and, if it is preserved at all, will appear as a remnant in one or more areas of the region Z. These areas *may* be the original zoocentres of its former entogenic contour; for it is reasonable to suppose that the group would be able to hold out longest in those areas where its density is greatest. They may, however, be simply "refuge" areas into which the remnants have been driven, and, in such cases, will not afford any evidence of the position of the original entogenic zoocentres. The contour of the group will now appear as a series of discontinuous ovals with no contour-lines of high value.

Such a contour may be termed a *Palæogenic Contour*. These are the contours of archaic groups. They may be sufficiently numerous to furnish part of the distinctive character of the fauna or flora of the region, but are usually of less importance, though not necessarily of less interest, than the entogenic and ectogenic groups of the region. Owing to the great changes in land distribution throughout long geological epochs, true palæogenic contours may very often be, and indeed usually are, *discontinuous over more than one region.* Hence their contours should be mapped out on a complete map of the world, and then studied in relation to all the regions in which they occur. In those cases in which they occur in only one region, they may be very similar to entogenic contours, but will exhibit less density and extent.

We may now define the three main types of contour as follows :—

i. *Ectogenic Contours.*—The contours exhibited by groups which evolved their present group-centres *outside* the region Z, but have since invaded Z and form a definite part of its fauna and flora. The zoocentres will be either completely outside Z, or only slightly projecting into it, while the lower contour-lines will extend farther and farther into Z.

Generally, it will be found that the *species* forming the immigrant group are quite distinct from the main body of the group still located in Y. Very often they are also generically distinct, but the closer connection between the parent genus and its offshoots will still be evident, and will necessitate the two being taken together as a natural group, according to the rule already laid down.

ii. *Entogenic Contours.*—The contours exhibited by groups which evolved their present group-characters *within* the region Z. The zoocentres will lie entirely within Z, while the lines of lower contour will spread out more and more over the region, and one or more of them may possibly pass outside the region (forming the beginning of a new *ectogenic* contour for some other region).

Groups with entogenic contours are essentially those that give the distinctive character to a region, and on them the main zoogeographical regions of the earth are based.

iii. *Palæogenic Contours.*—The contours exhibited by groups which are remnants of what were once far more widely spread groups. Such contours may consist of one or more isolated areas of low value, and usually exhibit discontinuity over more than one region. These isolated areas may be regarded as the "sunken peaks" (probably the zoocentres) of a once large and continuous contour (just as an archipelago shows only the sunken peaks of what once formed a continuous land-mass).

It should be clearly recognised that these three types of contour are definitely connected, and that intermediate forms may occur; for instance, an *ectogenic* group may have spread nearly all over a region, forming one or more secondary zoocentres in it, and still exhibit connection with the parent group, *entogenic* in a neighbouring region. As soon as that connection is definitely broken, and the offshoot assumes its own distinguishing characteristics, it becomes entogenic in the region of which it has taken possession. Again, an entogenic group may gradually die out, and so reach a stage at which it exhibits a contour intermediate between an entogenic and a palæogenic one. Such a contour would not, perhaps, show any discontinuity, but the paucity of contour-lines would indicate how very little more reduction was needed to produce a typical palæogenic contour.

It may be seen, also, how every group, in the course of time, from its rise to its final extinction, may go through the three stages of ectogenic, entogenic, and finally palæogenic contour in any given region,

Contours may exhibit flatness (in the case of groups with few species) or steepness (in the case of groups with many species in a small area). Several contour-lines may lie together in one single line, as, for example, along the coast-line of a region, or, in the case of several plant-feeding species which extend all together to the utmost boundary of distribution of a single food-plant. In such cases, it is probably best to exhibit the contours as a set of close parallel curves arranged in the order in which they would naturally come if the species did not end off quite coterminously. In the case of a coast-line, these parallel lines may be drawn on the map, actually over that part representing the sea, following the coast-line in general direction, but not its irregularities. (See the ectogenic contour in Transparency 1). Where the same species occurs in a number of islands, a single contour-line may be drawn round all the islands.

When the contours of different groups have to be studied in relation to the rainfall, temperature, or geological conditions of the region, they should be drawn on transparent paper, so that they can be placed over a map of the isohyets, isothermals, or geology of the region, as the case may be. This has been done in the Plate given with this paper, the printed map showing isohyets.

Application of the Method to a Selected Region.

Let us now take the Australian region and apply the method of specific contours to it, as far as our records will allow us. Probably no region has been so little worked; so that, if we are able to obtain satisfactory results from somewhat meagre records, we should be encouraged to expect even better results in regions where the records are more complete.

The groups will be selected from the *Odonata*, in which the author has collected fairly complete records during the past nine years. Our objects will be (1) to recognise which groups of *Odonata* present ectogenic, entogenic, or palæogenic contours respectively; (2) to try to discover whether distinct subtypes exist within any of these three types.

By reference to the map in the Plate, it will be seen that some of the Papuan portion, and much of the Polynesian portion, has been omitted from the Australian region. The records of the Papuan portion are not complete enough, while the contours exhibited do not in any case extend into that part of the Polynesian subregion omitted. Owing to the small size of the map, the inland continental limits of the various contour-lines have been somewhat extended, otherwise they would appear too closely crowded along the coast-line to be distinguishable on so small a scale.

A. *Ectogenic Contours.*—Transparency 1 exhibits the approximate specific contour of the genus *Rhyothemis*. This is a genus of dragonflies with coloured wings, belonging to the subfamily *Libellulinæ*, and very distinct from its nearest allies. It is entogenic in the Oriental region, but has spread eastwards across Wallace's line, appearing as a strong immigration stream into the Papuan subregion and along the northern and north-eastern coasts of Australia. One species (*R. graphiptera*) has spread as far south as the Clarence River, in New South Wales, and reaches also inland up to the 3,000 feet level in North Queensland. Another (*R. phyllis chloë*) reaches just into New South Wales at Murwillumbah, and does not extend as far inland as *R. graphiptera*. A third (*R. chalcoptilon*) has not been recorded south of Gayndah. Two other species (*R. resplendens* and *R. braganza*) are only found very much further north, the former extending from Papua to Cairns, the latter from Cape York to Townsville. The resulting contour exhibits a typical *ectogenic* arrangement, the zoocentre containing five species and lying so as just to intrude into the northern part of Australia.

Other genera of *Odonata* exhibiting a contour similar to this in general form (not, of course, similar in actual detail or density) are :—

Agrionoptera, *Macromia*, *Ictinus*, *Anax*, *Gynacantha*, the group comprising the closely allied Australian genera of the legion *Protoneura*, *Pseudagrion*, *Argiocnemis*, *Agriocnemis*. *Austrolestes*, as an offshoot of the cosmopolitan *Lestes*, still very little differentiated from the parent stock, exhibits, in Australia, a very interesting contour intermediate between typical ectogenic and entogenic form. It is, in fact, just in process of being "budded" or separated off from the parent stock.

A certain amount of evidence goes to show that small invasions from the Oriental region have reached Australia by way of Timor. My records are not, however, complete enough to present a contour of this type for any group of *Odonata*, though I have little doubt that such could be established as a result of careful collecting in the North-West.

We see, therefore, the probability of two distinct kinds of ectogenic contour in Australia. For these I propose the names *Torresian* and *Timorean* respectively, indicating the respective paths by which the stream of immigration reached Australia.

B. *Entogenic Contours.*—Transparency 2 exhibits the contour of the group *Synthemina*, comprising the closely allied genera *Synthemis*, *Metathemis*, and *Choristhemis*. This group belongs to the subfamily *Corduliinae*, and has no near allies. The contour shown is typical of the greater portion of the essentially Australian fauna. It consists of two separate portions in which the species are more or less differentiated from one another. A large area is occupied on the east, extending from New Guinea to Tasmania, while on the west the genus reappears in the south-western corner of Australia. The separation of the two areas has clearly been brought about by the destruction of the group in the dry area of country along and north of the Great Bight—the Desert Barrier between East and West Australia. The species of *Synthemina* found in Western Australia are all specifically distinct from those in the East, except *S. macrostigma*, which is only differentiated into the two closely allied subspecific forms *occidentalis* and *orientalis*. This species also occurs, somewhat remarkably, in Fiji.

The primary zoocentre of this contour is along the highlands of South-eastern Australia, while a secondary zoocentre is developed around Cape Leeuwin.

In many genera of animals not so dependent on the rainfall as are the *Odonata*, this same form of contour is exhibited, but the lower contour-lines of the eastern portion will lie *very much farther inland* to the west, and in many cases one or more species may occur across the Desert Barrier, thus linking up the two portions of the contour into one complete whole.

Other genera of *Odonata* exhibiting this contour are:—*Austrogomphus*, *Austroæschna*, *Hemicordulia* (in which the western species also occur in the east, and may be linked up with them when sufficient records are available).

To a contour of this type I propose to give the name *Holonotian*, further distinguishing the two portions as the *Eonotian* on the east, and the *Hesperonotian* on the west. The genus *Diphlebia* exhibits an *Eonotian* contour only, being completely absent from the South-West. Many genera in other groups of animals can be shown to exhibit Eonotian contours; but, so far, the only purely *Hesperonotian* contours known are exhibited by certain genera of plants peculiar to the South-West.

The commonest form of Holonotian contour is one in which the primary zoocentre tends to be located most strongly in the south-east of the continent, though it may run northwards for a considerable distance as a narrow *zoocentric axis*. Sometimes two distinct zoocentres may occur, one in the south-east, and one near the border-line between New South Wales and Queensland. In nearly all those cases where the zoocentre tends to be in the south-east, one or more of the contour-lines will extend over

Tasmania; but it is rather the exception than the rule for any of these contour-lines to reach into New Guinea. In the *Odonata*, the group *Synthemina* is the only one known to me whose contour embraces both Tasmania and New Guinea.

Another variation of the Holonotian contour has a zoocentre tending to be located more northwards, usually in Northern New South Wales, or in South Queensland. In such cases, (e.g., *Diphlebia*) the contour may reach to New Guinea, but not into Tasmania, and generally does not exhibit any Hesperonotian portion.

Besides the Holonotian contour, representative of so many Australian groups, we find other types of entogenic contours. Unfortunately, the records available are not sufficient for the actual construction of these contours, but only sufficient to indicate broadly their existence. One of these may be termed the *Papuan* contour, and has its primary zoocentre located in Papua. The lower contour-lines spread out over the surrounding islands, and also down into Queensland, that portion of the contour appearing very similar to the ectogenic *Torresian* contour already defined—in fact, a group with Papuan contour may rightly be considered as entogenic in Papua, but ectogenic in Queensland, if it is desired to contrast the fauna of Papua with that of Australia proper. Again, in the case of strong-flying insects, one or more of the outermost contour-lines may reach beyond Wallace's line into the Oriental Region proper, and especially into Celebes, which appears to be a kind of link between the two regions, receiving both Oriental and Australian forms.

In the *Odonata*, the genus *Argiolestes* has a Papuan contour. There are a large number of species in Papua, and probably many more to be discovered. One species, at least, reaches to the Celebes. This group has, however, extended down into Australia itself far more vigorously than would be usually expected in the case of a tropical group, and is actually in process of budding off a distinct Holonotian contour, having a secondary zoocentre in Northern New South Wales with five species; and also a single species occurring in Western Australia.

A more typical Papuan contour is exhibited by the well-known *Ornithoptera*-group of the *Papilionidæ*. The species of this group spread out from Papua as a centre, and a comparatively small branch extends into Australia itself, one species reaching as far south as the Richmond River in New South Wales.

Another form of entogenic contour, not, so far, found amongst the *Odonata*, appears to be shown by the distribution of the Australian fresh-water Crayfish, in which zoocentres of low numerical value occur in the North, South-East, and South-West of the continent respectively. With sufficient records, it seems that this contour would appear as the clear result of *radial* distribution in three separate directions from the large central lake known to have existed in Australia in Cretaceous time. It might, therefore, be suitably called a *Radial Contour.*

The study of entogenic Australian groups occurring in Tasmania, and the careful contouring of their separate distributions, may be expected to throw some light on the question of Antarctic connections. The evidence afforded by the *Odonata*, so far, is not very strong, but the very close alliance between the species of the isolated group *Petalini*, found only in Chili and on the Blue Mountains, will be regarded by some students as one link in the chain of evidence for a former connection between Australia and America *viâ* Antarctica. If the Blue Mountain species exists also in Tasmania, the argument will be much strengthened. The fact that it has not yet been recorded is of little value, when we consider how many years it has taken to secure only four specimens in a well collected locality close to Sydney.

C. *Palæogenic Contours.*—Transparency 3 exhibits part of the contour of the subfamily *Petalurinæ*, a small group of *Odonata* with no near allies. In the Australian region, it is represented by the genus *Petalura* in Australia, and by *Uropetala* in New Zealand. *Petalura gigantea* occurs in the Blue Mountains and their southern spurs, and also on Stradbroke Island, South Queensland. *P. ingentissima* is confined to Kuranda and Herberton, North Queensland, while *P. pulcherrima* extends from Kuranda to Cooktown. *Uropetala carovei* is common in the

North Island of New Zealand. In Chili, the group is represented by *Phenes raptor*, and in North America by *Tachopteryx thoreyi* in the State of New York, and by *T. hageni* in Nebraska.

This contour, therefore, is seen to be discontinuous over three separate regions, the Australian, Neotropical, and Nearctic. Such a contour, as is well known, can only be exhibited by archaic groups, and is only explicable on the supposition that it represents the remains of a once much more complete and widespread contour over several regions. One of the best known examples is that of the *Dipnoi*.

In *Odonata*, a further example of a palæogenic contour is exhibited by the group *Petalini* of the *Æschninæ*, mentioned above, with one species on the Blue Mountains, and six in Chili.

Contours exhibiting the passage from the entogenic type to the discontinuous palæogenic type are not infrequent. Such, for instance, amongst the *Odonata*, are probably those of the genera *Nannophya* and *Nannophlebia*; while the *Monotremata* furnish an excellent example that will be more clearly appreciated.

We may now exhibit the various types of contour for the Australian region as follows, bracketing those that are not fully established.

Type.	Subtype.	Examples.
A. ECTOGENIC...	A_1 TORRESIAN	*Rhyothemis*, *Agrionoptera*, *Gynacantha*, &c.
	[A_2 TIMOREAN]	
(Transference from A to B :—*Austrolestes.*)		
B. ENTOGENIC..	B_1 HOLONOTIAN......	*Synthemina*, *Austroæschna*, &c.
	{ b_1 Eonotian	*Diphlebia.*
	{ b_2 Hesperonotian	
	B_2 PAPUAN	*Argiolestes.*
	[B_3 RADIAL]	
(Transference from B to C :—*Nannophya*, *Nannophlebia.*)		
C. PALÆOGENIC		*Petalurinæ*, *Petalini.*

The composition of a Regional Fauna.

One of the great advantages of the method of Specific Contours is that it clearly separates out the different types or "layers," as it were, which make up the fauna of any given region. The attempts to subdivide regions into definite subregions do not give sufficient prominence to this, but tend rather to give an idea of essential differences between the divisions, separated by hard and fast lines. The method of Specific Contours may be called a *three-colour process*, in which the true "colour" or appearance of any given fauna is obtained by the superposition of separate plates on which the three different distributions, ectogenic, entogenic, and palæogenic, are drawn. Only by such an analytical process can we obtain a clear idea of the changes in the faunal character of different parts of a region.

To take a good example of this:—The North Queensland coastline does not strike the visitor as typically Australian in either its fauna or flora. Yet if these be analysed, the very strong entogenic element very soon becomes apparent, and the overlying ectogenic element which marks it can be differentiated out as of Oriental origin. As soon as one gets inland, the effect of the ectogenic element becomes much less marked, and the entogenic fauna and flora show up very distinctly. As one travels southwards, the effect of the ectogenic element diminishes.

Again, on the Blue Mountains, there is at once apparent a very strongly marked entogenic fauna and flora. Almost lost in this, but still present—and, by its presence, adding to the variety and interest of the fauna—we distinguish the remains of palæogenic groups whose value to the phylogenist can scarcely be overestimated.

The factors of zoogeographical distribution.

Different students of zoogeography have given prominence to various factors which have brought about the present distribution of the fauna and flora of the earth. It is necessary, however, to distinguish clearly between the two classes of factors which contribute to the result. They may be classed as follows:

i. *Primary Factors.*—Those which determine the presence or absence of groups in the fauna or flora of a region. These factors are :—(*a*) the position and extent of the region with reference to the centres of origin of the various groups; (*b*) barriers.

ii. *Secondary Factors.*—Those which determine the form of contour exhibited in a region by a group whose presence has been brought about by the action of i. These are :—(*a*) climate (rainfall, temperature); (*b*) the geology of the region; (*c*) the strength of the tendency to vary or mutate exhibited by the group in question; (*d*) further alteration in the position of barriers, after the arrival of the group within the region.

In determining the distribution of the Australian *Odonata*, the primary causes have been—(*a*) The proximity of the Australian region to the Oriental. (*b*) The inefficiency of Wallace's line as a barrier to strong-flying species. (*c*) The "bridges" across Torres Straits and Timor, allowing of definite streams of immigration. (*d*) Possible lost connections with Antarctica and thence with South America.

The secondary causes, which have restricted the spread of the group within the Australian continent, have been—(*a*) The restriction of the rainfall mainly to the coastal districts. (*b*) The Desert Barrier between South-East and South-West Australia. (*c*) The Bassian Barrier between Tasmania and the mainland. (*d*) The changes in mean temperature as we pass from north to south.

Of these, the distribution of the rainfall is, no doubt, the controlling factor in determining the narrow form of the Holonotian contours exhibited by Australian *Odonate*-groups. Entogenic groups of insects of other orders, less dependent upon the rainfall, exhibit Holonotian contours of very much greater width.

The subdivision of Holonotian contours into Eonotian and Hesperonotian portions has been brought about by the Desert Barrier.

The absence of certain forms from Tasmania which occur commonly on the mainland at the points nearest to the island, can only be explained by the supposition that these forms arrived at their south-eastern limit after the Bassian Isthmus had sunk beneath the sea. This affords valuable evidence of the relative archaism of (*a*) *Austrothemis* and *Nannophya* (present in Tasmania) as compared with *Diplacodes* (absent). (*b*) *Procordulia* (present) compared with *Hemicordulia* (absent except for new colonisation by *H. tau*, a species with strong migratory tendencies). (*c*) *Æschna* (present) compared with *Anax* (absent).

The lowering of the mean temperature as we pass southwards down the eastern coast-line is the chief factor in restricting the ectogenic invasion of groups of Oriental origin. As far as the northern rivers of New South Wales, the mean temperatures are very high, the influence of Antarctic depressions and southerly winds being very little felt. To this limit many essentially tropical groups, such as *Rhyothemis*, have penetrated. Some few reach to Sydney and beyond: but, as we go south, the number diminishes very rapidly, and the ectogenic element soon disappears. A similar process, no doubt, affects the composition of the *Odonate* fauna of the western coast-line, about which very little is known. Around Perth, only *Tramea* and *Pantala* have been noticed as of ectogenic origin.

In the Plate, the isohyets or lines of equal rainfall are given as supplied by the Federal Meteorological Bureau. In the northern portion of the continent, this rainfall is almost wholly of monsoonal origin, and falls mainly during summer (December to March). In the South-West and South-East, and in Tasmania, the rainfall is mostly of Antarctic origin, and falls mainly in the winter (May to September). In New South Wales, both monsoonal and Antarctic influences are at work, with the result that both summer and winter may be dry or wet according to the intensities of the two operating factors. It will readily be seen from the map and transparencies that—(*a*) Ectogenic groups exhibit contours broadly similar to the contours of the monsoonal isohyets. (*b*) Entogenic groups (Holonotian) exhibit contours more dependent upon the distribution of Antarctic rainfall.

This correlation between specific contour and rainfall is in no way a complete one. Above a certain amount, rainfall may tend to retard the spread of a group. The west coast of Tasmania, with a rainfall up to 100 inches a year, appears to be very poor in *Odonata*; doubtless owing to its sunless and cold summer.

The excessively wet portion of tropical coast-line centred around Innisfail, North Queensland, with a rainfall up to 130 inches a year (nearly all summer rain) is not so rich in species as the surrounding districts with from 50 to 70 inches.

Other Applications of the Method.

The Method of Specific Contours may be profitably used in studying the density distribution of Zonal Groups—*i.e.*, groups which are not confined to one zoogeographical region, but are distributed along a zone of the earth's surface. On the map of the world (Mercator's projection) contours may be shown of Boreal, Holarctic, Bipolar, or Circumtropical groups which will present at a glance the salient features of distribution in a graphic manner. The author has worked out on these lines the contour of the holarctic genus *Sematochlora* with a very satisfactory result, though the number of detailed records available was scarcely sufficient to give a very accurate contour. Leaving out of account three species usually included in the genus (two from New Zealand and one from Chili) about whose inclusion in the genus there is ground for doubt, we obtain a contour of the zonal type ranging round the northern temperate zone. It is interrupted by the Atlantic—as might be expected—but not by the Pacific, since two species, at least, occur on both sides of Behring's Straits, and extend far westwards into Siberia and eastwards into Canada. The primary zoocentre seemed to be located in the vicinity of the State of Maine, U.S.A., with a density of six species, while a secondary zoocentre of large extent but of less density (three) runs across the northern part of Europe and Asia. The boundary line of the contour southward throws out two well-defined projections into lower latitudes, one down along the eastern coast of U.S.A. as far as Florida, another into Japan, while a somewhat indefinite bulging takes place to include records of a single species extending into Arizona.

This contour is not published here, because the inequality of the records available scarcely admits of its consideration in anything but the broadest of aspects. More collecting has been done in the one State of Maine than in the whole of Siberia.

The apparent zoocentre in Maine may be, therefore, only due to the completeness of the local records, and the genus may possibly attain as great, or even greater, density in some part of Siberia. Generally speaking, the number of records necessary for drawing an approximate contour in the case of a zonal group will be much higher than in the case of a regional group, since the former will extend into at least two regions.

Other examples of zonal distribution in *Odonata* whose distribution might be advantageously studied by this method are:—

Holarctic—*Libellula*, *Sympetrum*, *Leucorrhinia*, *Gomphus*, *Boyeria*, *Calopteryx*.

Circumtropic—*Macromia*, *Tramea*, *Gynacantha*, *Teinobasis*.

In the study of zonal groups, the contour itself will decide in what region or regions a given zonal group may be considered to be entogenic; viz., those regions in which that group can be seen to have established definite zoocentres. For example, the genus *Somatochlora* may be rightly considered entogenic in the Nearctic Region, and also (though apparently not so definitely) in the Palæarctic Region. Other zonal groups are quite clearly entogenic in one region but ectogenic in another. *Tramea*, for instance, appears to be entogenic in the Neotropic Region, with an ectogenic outgrowth into the Nearctic Region and another into the Australian Region.

Cosmopolitan groups, such as *Anax*, *Æschna*, *Lestes*, may also be studied by this method; but, of course, the number of records necessary for the complete contouring of such a group will be even greater than in the case of a zonal group.

The method may also be applied to the study of a *barrier*, in the following manner:—A map should be taken showing the barrier, with parts of the surrounding regions, and over this map the partial contours of various groups, drawn on transparencies, may be placed in turn. The efficacy of the barrier may be gauged by considering the percentage of contours showing *total discontinuity* across the barrier. In so far as group contours are completely delimited or cut off by the barrier (*i.e.*, the group is prevented from passing across the barrier at all), the barrier may be considered a *Primary Barrier*; but, in so far as group contours are only *severed* by it, (*i.e.*, the group is divided into two distinct portions) the barrier is only a *Secondary Barrier*. It is clear that a barrier can only be a Primary Barrier to those groups whose arrival in its neighbourhood is of later date than the uprising of the barrier; while, even to such groups, if they possess special facilities for passing the barrier, it may only play the part of a Secondary Barrier, or even be no barrier at all. On the other hand, if the date of the uprising of the barrier be later than that of the arrival of the group, it cannot rank higher than as a Secondary Barrier. A recognised barrier, such as Wallace's line, might be carefully treated in this manner for a large number of groups with very valuable results.

A further suggestion as to a valuable use of this contour method is offered by the author for the case of migrating groups of birds. With sufficient records, two separate contour maps might be drawn up for, say, one of the genera of the *Fringillidæ*, showing (*a*) the contour of the group during the nesting season; (*b*) its contour during the winter. These two contours, drawn on large maps and exhibited side by side, would bring home to us, more clearly than pages of records, the movements of the group during the changing seasons of the year. Probably the records available in Europe and America for such a contour will be found to be quite sufficient.

In conclusion, the author contends that the study of zoogeographical distribution will be advanced by the method outlined in this paper, and that contours of groups are a more natural unit for study than theoretical subdivisions of regions into separate portions.

REVISION OF THE SUBFAMILY *TENEBRIONINÆ*, FAMILY *TENEBRIONIDÆ*.

(Australian Species: with Descriptions of new Species of *Tenebrioninæ* and *Cyphaleinæ*).

By H. J. Carter, B.A., F.E.S.

(With six text-figures.)

Revision of the Subfamily *Tenebrioninæ*.

This subfamily is in more need of revision than any of the *Tenebrionidæ*, through the extraordinary complications that have arisen through the imperfect descriptions of early writers, notably of Boisduval; and this has been aggravated by the diversity of determinations made by later authors. As these complications apply to some of the commonest of Australian insects, it is hoped that the author's attempt at reaching a stage nearer finality will assist other entomologists by clearing our catalogues of names that are either synonyms, or belong to lost types, and are valueless. This task has been facilitated by the aid of Mr. K. G Blair, of the British Museum, who has sent me a collection of specimens, some of which have been compared with the types of Pascoe and Hope, while others have some historic value from their labels.

The subfamily is now held to include the Cœlometopides, Tenebrionides vrais, and Toxicides of Lacordaire.

Distribution.—In the new Catalogue of Junk, in which the *Tenebrionidæ* are so ably edited by Gebien, there are 97 genera of the subfamily, excluding *Microphyes*, *Chileone*, and *Ephidonius*, and including *Teremenes* (vide infra). Of these, only 16 are represented in Australia, of which 10 are exclusively so (endemic). These 10 are distributed as follows:—

Exclusively Australian.

Brises—Central Australia (including Northern Territory).

Asphalus—New South Wales, Queensland (coastal districts).

Hypaulax—All States; widely distributed.

Hydissus—New South Wales, Queensland, Lord Howe Island.

Oectosis—Victoria, South Australia.

Meneristes—New South Wales, Victoria, Tasmania, Queensland, South Australia.

Teremenes—New South Wales, Victoria, Tasmania, Queensland, South Australia.

Synercticus—New South Wales, Queensland.

Tanylypa—Tasmania.

Paratoxicum—Tasmania, and Victorian Alps.

Not exclusively Australian.

The remaining six genera are distributed as follows:—

Pediris—Cape York, Austro-Malay Islands.

Encyalesthus India, E. Asia and Japan, Austro-Malay Islds., E. Australia.

Promethis—Sikkim, Lord Howe Island, Australia (all States).

Menephilus—Europe, Asia, Africa, Australia (all States).

Tenebrio—Cosmopolitan; two species universally distributed as flour- and grain-pests; other species world-wide.

Toxicum—Africa, America, Asia, Australia (all States).

Brises and Ephidonius.

In Junk's Catalogue, Herr Gebien places *Brises* with the *Tenebrioninæ*, and *Ephidonius* with the *Cyphaleinæ*; but whatever classification be adopted, it seems quite undesirable to separate them. In the trapeziform shape of the head, with the eyes widely separated, both are much nearer the *Tenebrioninæ*, as further indicated in the continuous epipleuræ; while in the form of the antennæ, the more widened emargination of the thorax, and especially in the carinate prosternum, they show a strong relationship with the *Cyphaleinæ*. Both, however, have marked characters in which they differ very much from each of these groups. (1) In the palpi, where the last joint of the maxillary palpi is at most rather narrowly triangular; in *B. trachynotoides* Pasc., this joint is so narrow as to be considered subulate; whereas in both *Tenebrioninæ* and *Cyphaleinæ* it is strongly securiform. (2) The posterior intercoxal process in both is narrow, triangular, or very little rounded at apex; whereas in *Tenebrioninæ* and *Cyphaleinæ*, this process is generally widely rounded. (3) The legs and tarsi form the greatest barrier to the inclusion of these genera in either group—widely differing from the *Tenebrioninæ* in their more elongate form, clothed as to their tibiæ and tarsi with long hairs; while equally distinguished from the *Cyphaleinæ* by their unusually long tibial spurs and tarsal claws. The author suggests (1) that *Brises* = *Ephidonius*; (2) that *Brises*, at present, be considered as a single subgroup of the *Tenebrioninæ*.

I cannot find any satisfactory character, beyond sculpture, to separate the two genera; and in the case of the new species, *B. Blairi*, the sculpture is intermediate between that of *B. trachynotoides* Pasc., and *E. Duboulayi* Bates. The name *Ephidonius* should, therefore, be sunk, and the species may be tabulated as follows, all of them being before me.

BRISES Pasc. (Ann. Mag. Nat. Hist., 1869).

Ephidonius Pasc. (*loc. cit.*).

1(3) Elytra bicostate.
2. Upper surface nitid .... *Blairi*, n.sp.
3. Upper surface opaque .... *trachynotoides* Pasc.
4(6) Elytra bicostate, upper surface nitid.
5. Costæ subobsolete .... *acuticornis* Pasc.
6. Costæ strongly raised .... *Duboulayi* Bates.
7. Elytra with 5 slightly raised costæ, surface opaque.... *parvicollis* Blackb.

The two following genera, *Asphalus* and *Hypaulax*, may be grouped as *Cœlometopinæ*, only distinguished from "Tenebrionides vrais" of Lacordaire, by their short metasternum and apterous body.

ASPHALUS Pasc.

1. Elytral surface shallow, surface very nitid........................ *ebeninus* Pasc.
2. Elytral striæ deep, surface less nitid........................ *striatus* Cart.

HYPAULAX Bates.

Chileone Bates.

Chileone is not (as Blackburn also suggested) sufficiently differentiated from *Hypaulax* to deserve generic distinction. The only marked distinctions given by the author (Trans. Ent. Soc. Lond., 1868, p.264) are the bisinuate thorax, with the angles prominent, and the alveolate sculpture of the elytra; the other distinctions are either slight or elusive. Of the marked distinctions, the first two are certainly found in *H. insularis* Hope (= *H. iridescens* Blackb.), and the last (the alveolate elytra) is closely approached in the species described below (*H. foveatus*). I believe I have seen specimens of all the described species. If I have identified *H. interioris* Blackb., correctly, in a specimen from N.W. Australia, it is further distinguished by its strongly punctate abdomen—a character shared to a less, and very variable, degree by that widely distributed and most variable species, *H. orcus* Pasc. Bates evidently did not sufficiently consider the great variability in size, sculpture, shape of prothorax, and convexity of form, that is to be noticed in examining long series; so that, as he himself admitted in the synonymy of *H. ovalis* and *H. oblonga*, varieties have been described as species; while Macleay described two species in a few lines, without having seen the descriptions of Bates' *H. sinuaticollis** and *H. tarda* (Trans. Ent. Soc. New South Wales, p.285).

The following are almost certainly synonyms :—

H. gayndahensis Macl. = *H. oblonga* Bates = *H. ovalis* Bates = (? *Upis crenata* Boisd.).

H. opacicollis Macl. = *H. sinuaticollis* Bates = *H. marginata* Bates.

H. iridescens Blackb. = *H.* (*Platynotus*) *insularis* Hope.

The last has already been suggested by Champion.

The descriptions of three new species will be found below.

Table of *Hypaulax*.

1(3) Elytra sulcate, its lateral intervals sharply elevated.
2. Pronotum opaque, lateral border little raised or thickened.................. *insularis* Hope; *iridescens* Blackb.
3. Pronotum nitid, lateral border strongly raised and thickened.................. *Spenceri*, n.sp.
4(6) Elytra striate, intervals convex.
5 First two striæ deep, punctures obvious.... ..*ovalis* Bates; *oblonga* Bates; *gayndahensis* Macl.; (?)*crenata* Boisd.

6. First two striæ shallow, punctures very small or obsolete...................
...........*tenuistriata* Bates.
7(11) Elytra more or less striate, intervals flat.
8. Pronotum and elytral intervals clearly punctate.. . ....*puncticollis*, n.sp.
9(11) Pronotum and elytral intervals scarcely visibly punctate.
10. Prothorax arcuate in front, anterior angles advanced. .... *orcus* Pasc.
11. Prothorax truncate in front, anterior angles not advanced... ....
...........*ampliata* Bates.
12(22) Elytra seriate-punctate.
13(15) Elytral punctures alveolate.
14. Apex of prothorax bisinuate, lateral borders thick and crenulate.........
...........*Deyrollei* Bates.
15. Apex of prothorax truncate, lateral borders less thick and scarcely crenulate . ...*foveata*, n.sp.
16(22) Elytral punctures much smaller.
17(19) Size large (17-23 mm. long).
18. Colour subopaque black, seriate punctures smaller.....*interioris* Blackb.
19. Colour nitid-black, seriate punctures larger.. .. ..*marginata* Bates; *sinuaticollis* Bates; *opacicollis* Macl.
20(22) Size small (12-15 mm. long).
21. Prothorax with lateral channel......................................*tarda* Bates.
22. Prothorax without lateral channel .... *opacula* Bates.

Nyctobates and *Setenis* are not represented in the Australian fauna, the former being limited to America. It is possible that *Promethis* (*Nyctobates*) *sterrha* Oll., from Lord Howe Island, is a *Setenis*, but I am not able to state this definitely, through lack of knowledge of the genus. Under *Setenis*, Herr Gebien has included two of Boisduval's mysteries, *Upis crenata* Boisd., and *U. Lottinii* Boisd. These will be discussed below. Having examined the types of *Meneristes curtulus* Oll., and *M. vulgaris* Oll., from Lord Howe Island, I should unhesitatingly place them under *Hydissus*, the larger species (*M. vulgaris*) being extremely close to *H. feronioides* Pasc. The species may be distinguished as follows :—

Hydissus Pasc.

1. Pronotum smooth, elytral intervals strongly convex, seriate punctures evident........ ....*feronioides* Pasc.
2. Pronotum finely punctate, elytral intervals little raised, seriate punctures very small, almost hidden in striæ .. . .*vulgaris* Oll.
3. Pronotum more strongly punctate, elytral intervals flat, seriate punctures larger than in 2 (also shorter and wider)................*curtulus* Oll.

Under *Encyalesthus*, two species have been described, to which a third is now added. These may be tabulated as follows:—

Encyalesthus Motsch.

1(3)Colour black.
2.Subnitid, hind tibiæ of ♂ with margins entire ....*punctipennis* Pasc.
3.Very nitid, hind tibiæ of ♂ with excised margin...........*excisipes*, n.sp.
*4.Elytra green or bronze, posterior tibiæ of ♂ angulate...*atro-viridis* Macl.

Promethis.

Before attempting to tabulate the species of this genus, it is necessary to clear the ground by a discussion of Boisduval's species, the inadequate descriptions of which contain neither dimensions nor figures (with one exception), and the types are mostly lost. To take these in turn, *Pediris* (*Upis*) *sulcigera* is the one member of the Subfamily figured in the "Voyage de l'Astrolabe," and is well known in European museums. Originally described from Amboyna, I have specimens from New Guinea and Cape York, the latter taken by Mr. H. Hacker, as recorded by me (These Proceedings, 1909, p 125).

Upis Lottinii Boisd., placed by Gebien under *Setenis*.—There is a specimen in the British Museum consignment, labelled New South Wales (F. Bates' Coll.), with a second label bearing the name "*Upis Lottinii* Boisd., Schaufuss." This specimen is undoubtedly a *Promethis*, and is probably a small *P. nigra* Bless. A second specimen, bearing similar labels, has been further labelled by Mr. Blair as *P. lethalis* Pasc. This specimen, I should consider as the typical *P. nigra* Bless. The original habitat of *U. Lottinii* was stated to be New Guinea. Having little doubt as to the synonymy of *P. lethalis* Pasc., with *P. nigra* Bless., (from specimens of the former sent by Mr. Blair, compared with

* Macleay omitted any reference to sex in his description, or to the fact that the elytra are often a brilliant brassy-bronze colour; the females have the posterior tibiæ without this angular swelling. I have examined many specimens.

Oectosis.—The single species, *O. cylindrica* Pasc., is not common in collections. I have a specimen from the Mallee district of Victoria.

the excellent description and figure by Blessig) I should place *U. Lottinii* Boisd., as a probable synonym; this doubt rendering it undesirable to preserve the name.

Upis crenata Boisd.—There has again been much disagreement as to the insect described under this name. The Macleay Museum has, under this name, what is undoubtedly *P. nigra* Bless., probably so identified by Macleay. The British Museum has a specimen of *Hypaulax oblonga* Bates, labelled as *U. crenata* Boisd.; while another specimen bearing this name. in the British Museum, is certainly *Hypaulax tenuistriata*; and Herr Gebien writes that he has an *Hypaulax* under Boisduval's name. The ten words of Boisduval's description, without dimensions, apply more aptly to *Hypaulax* than to *Promethis*, especially "thorace lævigato, subconvexo, lateribus rotundato," since the species of *Promethis*, in no case, have a lævigate thorax, nor are the sides notably rounded. Although the name has reappeared in Junk's Catalogue under *Setenis*, it should be consigned to oblivion, as a probable synonym of the common *Hypaulax oblonga* Bates. It is scarcely possible that Boisduval should have failed to collect this in the Sydney district.

Baryscelis laticollis Boisd. - It would be tedious and useless to follow up the various attempts to determine this species. In 1869, Pascoe described *Meneristes laticollis*, which is possibly the same thing, though Champion expresses a contrary opinion (Trans. Ent. Soc. 1894, p.392), without giving any reason. There seems little cause to doubt that Pascoe's species is the same as that described by Blessig as *Tenebrio australis*, by Motschulsky as *Asiris angulicollis*, and by Blanchard as *T. nigerrimus*. Mr. Blair writes that in the Bates Coll., he has "one series over *laticollis* Pasc., and another over *australis* Macl.; but I cannot distinguish between them." The Rev. T. Blackburn proposed, as his solution of the tangle, the identity of *T. australis* Boisd., and *B. laticollis* Boisd., but even Boisduval could scarcely describe the same insect under two genera in two successive pages. Moreover, the words "antice emarginato" applied to *B. laticollis*, are not contained in the ten words that describe *T. australis*; and this being a marked character in Pascoe's species, it is likely enough that Pascoe's suggestion is the true one.

Baryscelis politus Boisd., seems to have been left unnoticed by writers, so that not even a conjecture, so far, has been made as to its identity; nor have I seen any insect so identified. From the short note by Boisduval, "Il est un tiers plus petit que le précédent, et le corselet est moins retréci postérieurement," it would seem to be identical with *M. intermedius* Pasc., a smaller (and female) variety of *M. laticollis* Pasc. It seems possible to me that *T. australis* Boisd., is identical with *Promethis quadricollis* Pasc.; and that *T. nigerrimus* Boisd., = *M. servulus* Pasc., which, again, is certainly (from compared types) identical with *Menephilus convexiusculus* Hope.

Having examined a very large number of *Promethis*, both from our museums and from numerous collections, the following synonymy is almost certain :—

P. lethalis Pasc., = *P.* (*Iphthimus*) *nigra* Bless.

P. Pascoei Macl., = *P. quadricollis* Pasc.

P. lethalis Pasc., at furthest, can only be considered as a variety of *P. nigra*. The Queensland specimens show a great deal of variation, *inter se*; a long series taken by Mr. Lea, at Cairns, have the hinder part of the prothorax more sinuate, with the elytral punctures more hidden, than is the case with the typical *P. nigra* of the Southern States. Moreover, specimens that have been for some time in spirits, show a much clearer and coarser puncturation that is apt to mislead. A similar variation is to be noticed in *P. quadricollis* Pasc., but having examined the type of *P. Pascoei* Macl., and compared it with specimens sent by Mr. Blair as *P. quadricollis* Pasc., I have no doubt of their identity. Most probably, Pascoe's locality, Swan River, for his species, is a mistake. I have seen only *P. angulata* Erichs., from West Australia; while hundreds of specimens of the other species have been examined from the Eastern States. The known species of Australian *Promethis* may be tabulated as follows, three new species being added and described below, *P. Harmandi* Oll., from Sikkim, being omitted, as unknown to me.

Promethis Pasc.

1(9)Posterior angles of prothorax scarcely, or not, produced.
2.Elytra very convex, much widened behind, intervals little raised........ .... *sterrha* Oll.
3(8)Elytra moderately convex, intervals strongly ridged.
4(6)Size large (22-29 mm. long), prothorax widest in front, elytra obovate
5.Seriate punctures partly hidden in striæ, abdomen moderately punctate ... .*nigra* Bless.
(Prothorax more sinuately narrowed behind)....var. *lethalis* Pasc.
6.Seriate punctures larger than in 5, not at all concealed, abdomen very coarsely punctate....................... .... *major*, n.sp.
7.Size smaller (15-20 mm. long), form flatter and more parallel, prothorax little or not widened in front, sides nearly straight.................... ....*quadricollis* Pasc.; *Pascoei* Macl.
8.Elytra parallel, sides of prothorax angulately crenate...*angulata* Erichs.
9.14 mm. long, subcylindric, sides of prothorax rounded, its angles wide and declinate, elytral intervals moderately convex ....*minor*, n.sp.
10.Posterior angles of prothorax lobate in ♂, elytral intervals costate...... .... *lobicollis*, n.sp.

Augolesthus australasiæ Motsch.—From the description, it would appear that this is identical with *Chariotheca* (*Thesilea*) *planicollis* Fairm., = *C. cupripennis* Pasc. This genus should, therefore, be omitted from the subfamily *Tenebrioninæ*

Menephilus Muls.

1(3)Upper surface blue.
2.Sides of prothorax sinuate, hind angles acute............*corvinus* Erichs.; *cyanipennis* Hope.
3.Sides of prothorax not sinuate, hind angles obtuse ....*lætus*, n.sp.
4.Pronotum black, anterior angles round, elytra obscure blue, legs and antennæ black .... *cærulescens* Haag-Rut.
5 Head ferruginous, pronotum piceous, elytra violaceous, æneous or blue, legs and antennæ red...................... ....*ruficornis* Champ.; var. *æneus* Carter; var. *azuripennis*, n.var.
6.Head and pronotum purple-bronze or blue, elytra variegated, legs red. .. ..*brevis*, n.sp.
7(10)Upper surface black or piecous, subnitid, pronotum strongly punctate.
8.Length 12 mm., prosternum fulvo-pubescent, its episterna punctate...... ....*humilis* Erichs.
9.Length 8-9 mm., prosternum glabrous, its episterna pustulose............ ....*colydioides* Erichs.

10. Length 6-7 mm., form flatter than 9, anterior angles more produced, elytral intervals less raised, seriate punctures smaller............ ....*parvulus* Macl.
11(13)Upper surface nitid black, pronotum finely punctate, anterior angles strongly produced.
12. Posterior angles produced backwards...... .... *Sydneyanus* Blkb.
13. Posterior angles not produced... .... *rectibasis*, n.sp.

M. corvinus occurs in Tasmania, South Australia, and New South Wales.

M. cœrulescens Haag, is widely distributed in New South Wales and Queensland.

M. ruficornis Champ., occurs from Tasmania to North Queensland. *M. æneus* is only a small bronze variety of it. Mr. Lea has taken several specimens at Cairns, with the elytra dark blue, which seem worthy of a name, for which I propose *M. azuripennis.*

M. humilis Erichs.—The only specimen of this I have seen, is one in the British Museum consignment; larger, wider, the front angles less advanced; with the differences of underside noted above, it can be easily distinguished from the more common *M. colydioides* Erichs.

It is open to question whether *M. parvulus* Macl., is only a variety of *M. colydioides* Erichs. I have specimens of the former, compared with type, from New South Wales and Queensland; and of the latter, from Tasmania, and New South Wales. Specimens of both are from the Blue Mountains, but the distinctions given above, seem to warrant their separation at present.

M. Sydneyanus Blkb., is very common in New South Wales and Queensland. I have specimens from Eden to Tambourine Mountain.

Meneristes Pasc.

1. Moderately nitid black, tibiæ of ♂ unarmed, elytra subparallel............ *laticollis* Pasc., *angulicollis* Motsch., (?) *laticollis* Boisd., *T. australis* Bless., *T. nigerrimus* Blanch., var. *intermedius* Pasc., (?)*politus* Boisd.
2(5)Polished ebony-black.
3. Tibiæ of ♂ unarmed, angles of prothorax more strongly produced than 1. Elytra ovate, little wider than prothorax at base ....*latior*, n.sp.

4-Hind tibiæ of ♂ with triangular tooth, its apex greatly enlarged and curved . ...*tibialis*, n.sp.
var. Hind tibiæ without this tooth .... *proximus*, n.var.
5. All tibiæ of ♂ bidentate, form subcylindric.......... .. .. *dentipes*, n.sp.

There is little doubt that *M. intermedius* Pasc., is only a smaller form of the common *M. laticollis.* Mr. Blair has sent me specimens compared with types, and has expressed his own agreement with this. The type of *M. intermedius* Pasc., is a female, and is of the form very common in New South Wales, the larger form being more often found in Tasmania and Victoria. *Meneristes* is a variable and difficult genus to separate into definite species, and probably more species will be found. The new species, described below, are all very distinct, two of them from their male tibial characters as shown by the outlines figured below – traced with a camera. Mr. Lea has taken a number of *Meneristes* at Cairns and Atherton, which are very nitid, and have larger elytral punctures than the typical *M. laticollis* Pasc. For the present I can only treat this species as a variety.

M. servulus Pasc., = *Menephilus convexiusculus* Hope, = (?)*M. nigerrimus* Boisd.—Mr. Blair sends specimens compared with Pascoe's and Hope's types, which show this. I had already noted it on my visit to the Hope Museum in 1907. There is also a specimen in the British Museum box identical with *M. servulus* labelled *M. nigerrimus* Laf., but the doubt that must always exist in Boisduval's species renders it undesirable to retain the name. At any rate this species requires another generic title, differing markedly from *Meneristes* in (1) the structure of the prothorax, with the rounded unproduced front angles; (2) the very short apical spines of the tibiæ; (3) the quite different onychium. As regards (3), Herr Gebien has been kind enough to point out to me the very unusual onychium of *M. laticollis* Pasc., with its several spines besides the two usual setæ, and he further adds, "I do not know another genus, except *Phrenapetes* of South America, in which that onychium occurs." I therefore propose the name *Teremenes* for *M. convexiusculus* Hope, and *M. longipennis* Hope, the latter of which has also been clearly identified by specimens sent from the British Museum, and which is probably only an elongate and larger variety of *M. convexiusculus* Hope, but which, for the present, I would retain as separable from that species. To these I would add a third species from North Queensland, received from various collectors; and tabulate them as follows :—

TEREMENES, n.gen.

1. 17-18 mm. long, pronotum and elytral intervals finely punctate...... . ...*longipennis* Hope.
2. 13-15 mm. long, pronotum, elytral intervals, and underside smooth or only microscopically punctate . .. .*convexiusculus* Hope, *serrulus* Pasc., (?)*nigerrimus* Boisd.
3. 13-15 mm. long, pronotum, elytral intervals, and underside strongly punctate....... ....*socius*, n.sp.

T. longipennis Hope, is recorded from Tasmania and South Australia. I have specimens also from Victoria and New South Wales.

T. convexiusculus Hope, is widely distributed in all the Southern States.

T. socius, n.sp., seems to be confined to North Queensland. Its distinction of sculpture is very marked, while it also has sharper hind angles to the prothorax, and a narrower lateral border, with the front angles less depressed and more evident.

Microphyes rufipes Macl.—I have examined the type of this, and identified it in my own Coll., from Queensland and West Australia (H. Brown). It should be transferred to another subfamily, the *Ulominæ*, I think, but it is certainly out of place in the *Tenebrioninæ*.

Synercticus piceus Pasc., = *S. heteromerus* Newm. – A most variable insect in size. My specimens vary from 8 to 13 mm. in length.

Synercticus and *Tanylipa* are aberrant members of the *Tenebrioninæ* in having their anterior coxal cavities open behind. For the present, they must be held as anomalous forms of the subfamily, with a doubtful relationship.

Toxicum Latr.

Eight names have been published as belonging to the Australian species of this genus. In my opinion, these should be reduced to three, with a synonymy as follows :—

(1) *T. curvicorne* Blkb., = *T. spretum* Blkb., = *T. parvicorne* Macl., = *T. brevicorne* Pasc.

(2) *T. addendum* Blkb., = *T. distinctum* Macl., = *T. punctipenne* Pasc.

(3) *T. gracile* Pasc.

Of these, I have examined the types of *T. spretum*, *T. parvicorne*, and *T. distinctum*; and specimens compared with types by Mr. Blair of *T. curvicorne*, *T. punctipenne*, and *T. gracile*; while *T. brevicorne* is the commonest species in Victoria and New South Wales, and is, no doubt, correctly named in the Macleay Museum. Mr. Blair, moreover, writes that he has placed *T. curvicorne* in the British Museum Collection as a synonym of *T. brevicorne*, an opinion with which I concur, after seeing the specimens sent by him.

All the species I have seen in a fresh condition, except *T. gracile*, have an opaque velvety indumentum which can be removed by friction. The type of *T. spretum* Blkb., in the South Australian Museum, is, I consider, an abraded specimen of *T. brevicorne* Pasc., the elytral intervals and punctures being a little more clearly defined and its surface more nitid than in the fresh specimens. In a long series, the male presents variations in the length of the horns, as shown in other horned insects (e.g., *Onthophagus*, *Bolboceras*, etc.); thus the type of *T. parvicorne* Macl., is, I consider, a specimen of *T. brevicorne* Pasc., with unusually stunted horns. Mr. Champion has published the synonymy of *T. addendum* Blkb., with *T. punctipenne* Pasc.; while *T. distinctum* Macl., is undoubtedly the same species. As pointed out by Champion, Blackburn (and I would add Pascoe and Macleay) failed to notice the angular enlargement – or blunt tooth – on the inside edge of the anterior femora of the male; a pronounced character in *T. punctipenne* Pasc. In *T. brevicorne* Pasc., this tooth is smaller but evident, while in *T. gracile* Pasc., it is even less obvious, though present.

With regard to the antennæ, Blackburn overlooked the contradiction contained in Pascoe's description of *T. brevicorne* (Journ. of Ent. 1866, p.454). In the Latin part, this reads "antennarum clava triarticulata," while in the longer English notes below, he writes "club of the antennæ four-jointed." From my examination of the five species tabulated below, I find the club to be as follows:—

T. punctipenne Pasc.—Club of 3 joints, easily differentiated from the preceding joints.

T. brevicorne Pasc.—Club of 4 joints, the 8th transverse, but more triangular than the 9th joint.

T. gracile Pasc.—The slender club may be considered as having three or four joints, the 8th being intermediate in size between the 7th and 9th, but so much smaller than 9, and in shape like 7, that I should consider the club as rather 3-jointed than four.

T. insigne, n.sp.—Club of 4 joints, easily differentiated from the preceding joints.

T. quinque-cornutum, n.sp.—Club of 4 joints, easily differentiated.

The five species can be readily tabulated by the character of the horns of the male as follows:—

(1.) *Clypeal horns* separate, starting from near the corners of the clypeus, and nearly vertical.
Frontal horns gently incurved, pointing upwards, with semicircular fringe of red hair from near the apex on the outside to about $\frac{1}{3}$ way down the inside.................................*punctipenne* Pasc.

(2.) *Clypeal horns* shorter than in (1), separated, but not starting from opposite corners of the clypeus, and diverging.
Frontal horns semicircularly incurved, pointing inwards, with smaller fringe of red hair round the apex, above and below...................
...........*brevicorne* Pasc.

(3.) *Clypeal horns* connected at base, starting from the middle of the clypeus, forming the letter Y, with the common base wide.
Frontal horns moderately incurved, pointing upwards, nearly as in (1), with fringe of yellow hair starting from near the apex on the outside and continued half way or more on the inside..............
...........*gracile* Pasc.

(4.) *Clypeal horns* abbreviated into wide conical tubercles at the corners of the clypeus.

Frontal horns strongly incurved at base, the extreme apex again incurved, widened, and deflexed, with a wide apical surface nearly meeting, with a fringe of red hair on the outside only, extending, but narrowly, to half way down. ....*insigne*, n.sp.

(5.)*Clypeal horns* three, the middle one largest and widely triangular, the two lateral ones short, also triangular, forming the extension of the canthi.

Frontal horns flattened, widest seen laterally, sharply incurved at base, twisted backwards at apex, with very small tuft of yellow tomentum on outside of apex...... ....*quinque-cornutum*, n.sp.

Paratoxicum iridescens Champ.—I have taken a specimen of this at Mt. Buffalo, Victoria.

Brises Blairi, n.sp.

Ovate, depressed, glabrous, nitid-black, oral organs, joints 1-2, and 8-11 of antennæ, and tarsi, red.

Head closely and distinctly punctate, mandibles bifid at apex, labrum emarginate and rounded, epistoma arcuate in front, rounded at sides, making an obtuse angle with the canthus, the latter raised and angulate (subcornute) and lightly impinging on the eyes, epistomal suture sulcate and arcuate, the forehead on a higher plane than the epistoma, eyes large, transverse, widely separated and free of the prothorax, last joint of maxillary palpi triangular; antennæ not reaching the base of prothorax, rather slender at base, moderately enlarged at apex, joint 3 about as long as 4-5 combined, 4-7 obconic, 8-11 rather shortly ovate. *Prothorax* 3·5 × 6 mm., widest at middle and base, arcuate at apex, the anterior angles round and little advanced, sides strongly widened to the middle, then widely sinuate to the acutely produced and dentate posterior angles, without any defined border, lateral margins widely explanate and reflexed, concave anteriorly, convex posteriorly, separated from disc by a groove; disc with medial line faintly indicated, and two basal foveate depressions; minutely punctate. *Scutellum* transversely triangular. *Elytra* wider than prothorax at base and nearly thrice as long, ovate and rather flat, shoulders rather square, epipleural fold slightly reflexed, horizontal margins wide on basal half, narrowing towards apex, with a separating sulcus containing an irregular row of punctures becoming obsolete behind, with two raised costæ on each elytron, the first originating abruptly at some distance from the base, and obsolescent about half-way, the second starting considerably behind the first and continued a little further backward, the intervals with indistinct rows of shallow punctures, the apical declivity a little rugose and finely pustulose, also a row of indistinct pustules on each side of suture on apical half. *Prosternum* punctate, its flanks ridged on the inside, its process narrowly carinate and produced, mesosternal cavity wide, with raised margins, posterior intercoxal process rounded, abdomen minutely punctate, epipleuræ smooth, tibiæ pustulose, the front tibiæ slightly bent, tibial spurs and tarsal claws very long, the tarsi clothed with long red hair. *Dimensions*, 16 x 8 mm.

Hab. Killalpanima, 100 miles east of Lake Eyre (H. J. Hillier).

A single specimen (♂?) sent by Mr. K. G. Blair for examination, and in whose honour I name it, is easily distinguished from the only other bicostate *Brises* by its nitid surface, wider form, and very different sculpture.

In the structure of the head, with the epistoma on a lower plane than the forehead, and the eyes quite free of the prothorax, it is more like *B. Duboulayi* Bates, and is interesting as showing a connecting link between two aberrant forms. Type in the British Museum.

A second specimen has been lately sent for determination from the National Museum, Melbourne, labelled "Finke R.; N. Australia," taken by Professor Baldwin Spencer.

Hypaulax foveata, n.sp.

Elongate-ovate, nitid black; antennæ, tibiæ, and tarsi dark castaneous, inside of tibiæ and tarsi beneath clothed with pale golden pubescence.

Head very wide, truncate in front, narrowed behind the eyes, smooth on forehead, finely punctate on epistoma and labrum, the last prominent and ciliate, suture semicircular, mandibles slightly notched at apex, antennæ stout, joint 3 scarcely longer than 4, 7-11 enlarged, 8-10 subquadrate, 11 longer than 10. *Prothorax* wider than long (about 6 × 7 mm.), truncate at apex, the angle feebly advanced, wider at apex than at base, anterior angles rather squarely rounded, lateral rounding very slight on the anterior part, a little sinuate posteriorly, its angle prominent and acute, pointing obliquely outwards, margins fairly wide in front, narrowly channelled within, margin and channel narrowed (sometimes with a slight crenulation) before the sinuation; base slightly bisinuate and thickly margined; disc with faint median line, and, under a strong lens, seen to be finely punctate. *Scutellum* transverse. *Elytra* slightly wider than prothorax at base, gradually widening to beyond the middle, sinuately and strongly narrowed at apex, with moderate declivity; thickly margined at base, humeral angle very obtuse but prominent, lateral margin and channel narrow; substriate, with nine lines of large foveæ, the last on margin, sometimes confluent but smaller and punctiform on the first row and near apex; an extra scutellary row consisting of about three elongate punctures. Abdomen faintly striolate, intercoxal process widely rounded, its margin interrupted at apex: prosternum with three wide carinæ, the two outside irregularly thickened and crenulate within, the deep sulci between the carinæ produced in front of coxæ, prosternal process rounded behind; front tibiæ strongly curved at apex. *Dimensions*, 22-25 × 7½-9 mm.

Hab.—Dalveen (H. J. Carter), Stanthorpe (H. Cox) Queensland; Tenterfield, New South Wales (Dr. Clark).

Six specimens examined, the males generally larger, wider, and less convex than the females. The species differs from all described species by the large foveate punctures of the elytra, very little smaller than in *H.* (*Chileone*) *Deyrollei* Bates, from which it differs in its narrower, longer, and less depressed form, the much less produced and wider anterior angles of prothorax, with its less thick and crenulate border. (In only one specimen of *H. foveata* is this crenulation marked). Though not strictly striate, the intervals are raised, and, viewed from behind, the rows appear to be in linear depressions. It is noteworthy that *H. Deyrollei* Bates, occurs within the same geographical area, and has been captured by the author at Guyra and Tenterfield, while four specimens of *H. foveata* were taken at Dalveen. Types in the author's Coll.

HYPAULAX PUNCTICOLLIS, n.sp.

Elongate-obovate, dull black above, nitid beneath, antennæ reddish, tarsi with golden tomentum.

Head: mandibles bifid, epistoma truncate at apex, oblique at sides and continuous with the canthus, limiting suture arcuate and fine, forehead evenly convex, the whole closely and not very finely punctate. *Prothorax* 4 × 5½ mm., subtruncate at apex and base, anterior angles obtuse and scarcely advanced, sides feebly arcuate, abruptly incurving behind, posterior angles obtuse, deflexed and not at all produced or dentate, base and sides with narrow, raised margin, that of the latter with a subangular twist at the point of incurving; disc without foveæ or central line, densely and regularly punctate, like the head. *Scutellum* very small. *Elytra*: basal border thickened and raised, shoulders obtuse, sides scarcely sinuate at apex; striate-punctate, the striæ shallow and unevenly defined, the seriate punctures small, fairly even in size and position (much smaller and closer than in *H. orcus* or *H. ampliatus* Bates; about three punctures would go to the width of an interval), interstices almost flat throughout, and distinctly punctured. Abdomen striolate and finely punctate, prosternum coarsely punctate, its process sulcate at the sides, the sulci produced behind the pro-coxæ, its apex rounded. Protibiæ rather strongly bent and incurved at apex. *Dimensions*, 18 × 7 mm.

Hab.—Onslow, West Australia.

A single specimen in the Melbourne Museum differs from *H. interioris* Blkb., in (1) its distinctly punctate head and thorax (a character Blackburn could scarcely have left unnoticed had it existed in his species); (2) the unproduced obtuse posterior angles of prothorax, which with *H. interioris* are "parvis acutis extrorsum retrorsumque inclinatis." Moreover, if I have identified *H. interioris* correctly in a much larger species from La Grange Bay, the abdomen is coarsely and deeply punctate, while the prosternum is finely punctate—the reverse being the case with *H. puncticollis.* The species differs widely from the other two western forms in the very different elytral sculpture. The three apical joints of antennæ are wanting. Type in the National Museum, Melbourne.

A second specimen, labelled W.A., measuring $21\frac{1}{2} \times 9$ mm., is in the consignment of insects sent by Mr. Blair from the British Museum; both are, I think, males.

Hypaulax Spenceri, n.sp.

Oblong-ovate, nitid black above and beneath, antennæ piceous (reddish towards apex), tarsi clothed beneath with red hair.

Head distinctly punctate, epistoma and canthus coarctate, the canthus shorter and more knobbed than in *H. insularis* Hope, forehead very convex, ridged at the sides, with a horseshoe-impression; antennæ moderately enlarged at apex. *Prothorax* $5 \times 6{\cdot}5$ mm., slightly wider behind than in front, apex subtruncate, the widely rounded anterior angles scarcely advanced, widest behind middle, sides widely diverging to the widest part, then rather abruptly but not angularly converging (subsinuately) to the obtuse undentate posterior angles; base truncate; lateral border rounded, thick, raised and nitid, forming a sulcate channel within, its extreme outline faintly crenulated, basal border thin and accentuated by a transverse sulcus meeting the lateral sulcus at the angles; disc more convex than in *H. insularis*, with a faintly impressed medial line, a fovea on each side of this, and a larger depression between the foveæ and the sides at their widest; minutely and closely punctate. *Scutellum* very transverse and thin. *Elytra* slightly wider than the prothorax at base, obovate, with nine rows of large, elongate foveæ placed in deep sulci, the ninth on the lateral sulcus only distinctly punctate anteriorly, the intervals narrower and more convex than in *H. insularis*; minutely punctate; *submentum* finely transversely rugose, gular furrow well marked; prosternum coarsely rugose-punctate anteriorly, its process very convex, and not raised at apex; mesosternum and abdomen coarsely punctate and longitudinally rugose; mandibles bifid at apex. *Dimensions*, 16×7 mm.

Hab.—Flora River, Northern Territory (Professor Baldwin Spencer).

A single male specimen, sent by the Melbourne Museum, taken by Professor Spencer, in whose honour I name it, is a close ally of *H. insularis* Hope(=*iridescens* Blkb.), from which it may be distinguished by (1) its entirely nitid upper surface; (2) the much thicker margin of prothorax, with wider anterior and unproduced posterior angles; (3) the longer and more deeply placed foveæ of the elytra; and (4) the coarsely rugose-punctate undersurface, (the same in *H. insularis* being finely and sparsely punctate) besides other minor differences. Type in the National Museum, Melbourne.

Encyalesthus excisipes, n.sp.

Elongate, convex, nitid black, oral organs, antennæ, and tarsi red.

Head closely and clearly punctate, epistomal suture distinct and straight, continued obliquely outwards to the margins, canthus little raised, space between eyes flat and not much wider than the width of one eye, very convex behind; antennæ extending a little beyond the base of prothorax, joint 3 longer than 1-2 combined, 7-11 considerably and successively widened. *Prothorax* 3·5 × 4 mm., convex, truncate at apex, anterior angles widely rounded, depressed, not emarginate, widest about the middle, sides slightly rounded, not at all sinuate, posterior angles obtuse, not at all produced, base biarcuate, subangulate in the middle, lateral and basal border narrow (as in *E. punctipennis* Pasc.), disc closely and evidently punctate, without foveæ or middle line. *Scutellum* triangular. *Elytra* considerably wider than prothorax at base, twice and two-thirds as long, very convex and slightly widened behind the middle, lightly striate-punctate, with eight rows of punctures, besides a lateral and a short scutellary row placed in irregular striæ, these more deeply impressed at sides and apex, the punctures of about the same size but generally more closely placed than in *E. punctipennis* Pasc., the intervals minutely but evidently punctate; underside finely punctate, the abdomen longitudinally rugose; femora swollen towards apex, tibiæ without apical spines, the male with front tibiæ slightly bent at apex, the posterior tibiæ hollowed on the inside, giving an appearance of an excision. *Dimensions*, 11·5-13·5 × 4·5-5·5 mm.

Hab.—Kuranda, North Queensland (F. Dodd and A. M. Lea).

Four specimens, two of each sex, examined, one sent to me some time ago by Mr. Dodd, the other three, taken by Mr. Lea, evidently differ from the well-known *E. punctipennis* Pasc., in the following characters: (1) form wider and more robust, (2) colour more nitid, (3) antennæ stouter, and especially more enlarged apically, (4) elytral striæ more distinct, seriate punctures closer, (5) stouter femora, and the posterior tibial excision of the male. Type in the author's Coll.

PROMETHIS MAJOR, n.sp.

Elongate-obovate, nitid black, antennæ piceous, tarsi and apex of tibiæ clothed with red tomentum.

Head as in *P. nigra* Bless., but with stronger punctuation, the antennæ also stouter and more evidently punctured. *Prothorax* 6 × 7·2 m.m., subquadrate, widest in front, the apex nearly straight, anterior angles widely rounded, reflexed and projecting outwards, lateral border thickened in front, narrowed and slightly sinuate behind, without any twist or crenulation, base bisinuate, posterior angles obtuse, but less so and more prominent than in *P. nigra;* disc closely punctate, the medial line deeply sulcate, but not quite extending to apical border. *Scutellum* punctate, curvilinear-triangular. *Elytra* obovate, much wider than and more than three times as long as the prothorax, striate-punctate, each elytron with nine rows (besides a short scutellary row) of large round punctures, the punctures close but not contiguous, nor at all hidden in the striæ; the first two rows continuous to apex, the third and fourth connected, the fifth and sixth connected in front of the former, the seventh and eighth connected behind the preceding, the ninth on the sides containing less defined punctures; the intervals rather sharply convex and very minutely punctate. *Abdomen* closely but irregularly covered with large round punctures, these larger, deeper and more numerous than in *P. nigra* Bless., meso- and metasternum rugose, their sides only punctate, prosternum transversely rugose.

♂. With front tibiæ strongly bent inward at apex, and clothed with a tuft of tomentum.

♀. With front tibiæ slightly arcuate, but not bent inwards.

Dimensious : ♂, 29 × 11 mm.; ♀, 25 × 10 mm.

Hab.—Gympie, Queensland (R. Illidge).

I have seen three specimens of this, amongst the large number of *Promethis* examined, two from the British Museum, one much damaged and ancient; the other, the female type, labelled "Australia." The male type was taken by Mr. Illidge at Gympie, and given to me, with many other generous gifts. The species evidently differs from the many varieties of *P. nigra* Bless., in (1) the unusually widened apex of prothorax, the angles of which, in the ♀ type, form distinct lobes; (2) the much coarser punctures of the elytral series, not at all concealed in the striæ; (3) the even more markedly coarser punctuation of the abdomen; (4) the much more sharply convex intervals of the elytra. While a few examples of *P. nigra* Bless., approach *P. major* in size, the latter is larger and wider than the general average size of *P. nigra* Bless.

Promethis lobicollis, n.sp.

Elongate, parallel, subnitid-black, antennæ piceous-red, tarsi (and apex of tibiæ in ♂) clothed with red hairs.

Head densely and strongly punctate, the mentum of ♂ not bearded; mandibles bifid at apex, last joint of palpi securiform, mentum subcordate, carinate in the middle, submentum coarsely rugose-punctate, gula transversely wrinkled; labrum emarginate, straight and ciliate; epistoma straight in front, obliquely rounded at sides, meeting the canthus at a sinuate angle, limited behind by a straight depression becoming more defined and sulcate at the sides; antennæ with joint 3 not longer than 1-2 combined, and similar to that in *P. angulata* Erichs. Prothorax 4·5 × 5 mm., subquadrate, a little advanced and raised in the middle at apex, base truncate, except at the angles; anterior angles depressed and rounded, not advanced, sides feebly arcuate (in one example slightly wider in front, and straight in the middle two-thirds), abruptly incurved near base, the posterior angles, in ♂, produced behind into a small, swollen, lobate process (somewhat as in *Cardiothorax egerius* Pasc.); in the ♀ specimen, the lobe is reduced to a small subrectangular tooth, pointing outwards rather than behind; lateral and basal border entire, except for a single crenulation near the base in ♂, narrowly reflexed, sulcate within; this border narrowed and terminated on the apex; disc closely and definitely punctate, with a faint suggestion of a smooth middle line. *Scutellum* triangular with rounded sides, clearly punctate. *Elytra* wider than prothorax at base and thrice as long, sides nearly parallel throughout, shoulders rather squarely rounded, disc with eight fine crenulate costæ, the crenulation formed by rows of large punctures on the outside of each, the punctures rather smaller than the seriate punctures in *P. angulata* Erichs., the second and third, fourth and fifth, sixth and seventh meeting in pairs near apex; a short scutellary and an extreme lateral row of punctures, the latter continuous to apex, the intervals between costæ wrinkled and closely punctate. Abdomen and mesosternum densely and very definitely punctate, prosternum less deeply so. Femora coarsely punctate, ♂ with a small tooth on inner margin of fore and middle femora near the base, tibiæ finely punctate, grooved and carinate; strongly curved and elongate in ♂. *Dimensions*: ♂, 20 × 6·5 mm.; ♀, 16 × 5·6 mm.

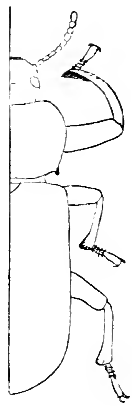

Fig. 1.
P. lobicollis ♂.

Hab.—Kalgoorlie and Kookynie (Messrs. Duboulay, senior, and E. Duboulay).

Three specimens, two ♂, one ♀, are the only specimens I have ever seen, and are quite distinct from the described species in the shape of the prothorax, and the stronger surface-punctures. One specimen, ♂, shows much more puncturation than the others, possibly due to immersion in spirits. The elytral sculpture is unlike that of any other Tenebrionid known to me, and may deserve generic position, but as it possesses all the salient

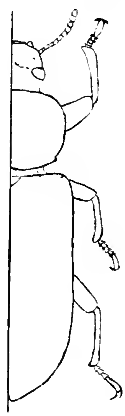

Fig. 2.
P. lobicollis ♀.

characters of *Promethis*, as briefly given by Pascoe, I prefer not to multiply genera in its favour. Types in the Author's Coll.

PROMETHIS MINOR, n.sp.

Elongate, parallel, piceous-black, subnitid, underside piceous-brown, more nitid, antennæ and tarsi red.

Head much more coarsely punctate than in *P. quadricollis* Pasc., the antennæ shorter, and a paler red. *Prothorax* 3 × 4mm., widest at middle, subtruncate at apex, the middle slightly raised and more nitid than the rest, anterior angles rounded, obtuse, and declinate, sides rather widely rounded, lateral border narrow, even and entire, turned downwards, rather abruptly narrowed, but scarcely sinuate behind; posterior angles widely obtuse, base bordered and sulcate, apex without border, disc distinctly and evenly punctate, the punctures deeper and more distant than in *P. quadricollis* Pasc., medial channel distinctly impressed but not quite continuous to apex. *Scutellum* triangular. *Elytra* wider than prothorax at base, and thrice as long, shoulders rather squarely rounded, sub-cylindric, narrowly marginal throughout, striate-punctate, seriate punctures smaller and more distant than in *P. quadricollis* Pasc., becoming larger towards sides, intervals convex and finely punctate; abdomen sparsely and finely punctate, slightly wrinkled at the edges of segments, metasternum finely rugose, prosternum nearly smooth. Front tibiæ of ♂ slightly curved, and finely tomentose at apex (straight in ♀). *Dimensions*, 14 × 5 mm.

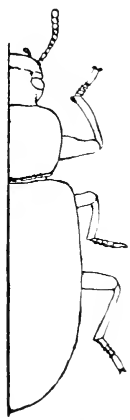

Fig.3.
P. minor.

Hab.—Rockhampton, Queensland.

Three specimens, 1 ♂, 2 ♀, in the British Museum consignment, sent to me by Mr. Blair, are evidently distinct from the common *P. quadricollis* in (1) smaller size and cylindric form; (2) less nitid, browner-black colour; (3) prothorax with sides and angles more turned downwards, the wider angles, and the much more rounded sides without any sign of crenulation at margin; (4) more evident punctures of elytral intervals, and finer punctures of the underside. Types in the British Museum.

TEREMENES SOCIUS, n.sp.

Elongate, parallel, nitid-black; oral organs, clothing of tarsi, and (in some examples) the underside of legs pitchy-red.

Head densely and strongly punctate, clypeal suture arched and well impressed, eyes large and rather prominent, antennæ not reaching the base of prothorax, the apical joints moderately enlarged. *Prothorax* about as wide as long (3·5 m.m.), widest in front of middle, subtruncate at base and apex; anterior angles rather widely rounded and depressed, scarcely advanced, sides gently converging backwards in a feeble curve, slightly sinuate behind; posterior angles narrowly dentate and extended, sides and base sulcate within the border, disc slightly gibbous in the middle of the anterior portion, densely and clearly punctate, generally with two foveæ near the basal border, and without any medial line. Scutellum curvilinearly triangular. *Elytra* wider than prothorax at base, twice and one-half as long, sides subparallel, or slightly widened behind in the female; striate-punctate, the punctures in the striæ smaller and closer than in *T. convexiusculus* Hope; the intervals distinctly punctate, and, towards the apex, a little convex. Underside-structure as in *T. convexiusculus,* but much more strongly punctured, especially on the abdomen. The male is distinguished as in *T. convexiusculus* by the longer and strongly curved front tibiæ, with their tuft of golden hair at the apex, which is absent from the female. *Dimensions*, 10-14 x 4-4·4 mm.

Hab.—North Queensland: Coen (Hacker), Cairns (Lea), Cooktown, Ayr.

Several specimens examined, differ from the widely dispersed *T. convexiusculus* Hope in the more strongly sculptured surface, both above and beneath, in marked contrast to the almost impunctate pronotum and abdomen of Hope's species. The lateral border is also narrower, the front angles less depressed and more evident, the hind angles sharper than in *T. convexiusculus* Hope (*servulus* Pasc.). Types in the Author's Coll.

MENEPHILUS LÆTUS, n.sp.

Near *M. corvinus* Erichs., (= *M. cyaneipennis* Hope), the whole upper surface bright blue (sometimes purplish), underside black, antennæ and legs castaneous.

Head very finely punctate, epistomal suture straight, prothorax subquadrate, truncate at base and apex, twice as wide as long, moderately arcuate and not all sinuate at sides; lateral margin and channel narrow, basal margin thicker; disc without foveæ or middle line, minutely punctate (only apparent under a strong lens); anterior angles rather squarely rounded, posterior angles obtuse but defined. Elytra parallel, cylindric; striate-punctate, the striæ narrow, the punctures small and regular, intervals flat on disc, slightly convex towards the sides and minutely punctate. *Dimensions*, $10\text{-}12\frac{1}{2} \times 4\text{-}4\frac{1}{2}$ mm.

Hab.—Kuranda, North Queensland (F. Dodd and A. M. Lea).

I have identified *H. corvinus* Erichs., from specimens taken at Dorrigo, New South Wales, and compared with specimens sent from the British Museum. The above differs from it in its shorter and more convex form, nonsinuate sides of prothorax, the anterior angle squarer, posterior obtuse (acute in *M. corvinus*), much finer punctures, while the elytra are more glossy, and *not* as in Erichson's species "subtiliter transversim rugulosis" but are minutely punctate. Types in the Author's Coll. (eight specimens examined, four sent me by Mr. Dodd, and four taken by Mr. Lea in the same district.)

MENEPHILUS BREVIS, n.sp.

Short, parallel, convex, head and pronotum purple-bronze or blue, elytra variegated, in general green with metallic reflections, the suture purple, all appendages and underside castaneous.

Head short and wide, epistoma rounded and tumid, its suture straight, eyes just free of prothorax, antennæ attenuated at base, 7-10 enlarged and subtriangular, 11th spherical; whole surface and that of the pronotum densely, and by no means finely punctate. *Prothorax* subquadrate, but arcuately narrowed in front, its acute anterior angles rather strongly produced; rather depressed and slightly explanate; sides (except for the slight narrowing in front) nearly straight, base faintly bisinuate, posterior angles subrectangular. *Scutellum* very small, punctate. *Elytra* of the same width as prothorax at base, shortly cylindric, and bluntly rounded behind; striate-punctate, with eight striæ containing fine, close punctures, the intervals flat (slightly convex at the sides) and minutely punctate; legs smooth, abdomen and epipleuræ rather closely and strongly, prosternum and gula coarsely punctate; prosternal process with raised crenulate margins, the first segment of the abdomen with a fovea betwen the coxæ. *Dimensions*, $4\frac{1}{2}$-5 × 2-$2\frac{1}{4}$ mm.

Hab.—Brisbane (R. Illidge), Kuranda (G. E. Bryant); Acacia Creek, N.S.W. (The Author).

Five specimens of this pretty little insect differ only in colour, the Acacia Creek specimen being the most brilliant, the head and pronotum being blue-green, the elytra purple at suture, then blue, green, gold, purple, blue, and gold (on sides), succeeding one another. Types in the Author's Coll.

MENEPHILUS RECTIBASIS, n.sp.

Elongate, parallel, nitid-black above and beneath, tarsi and antennæ red (tibiæ sometimes reddish).

Head minutely punctate on epistoma, more coarsely so on forehead, the former surface extended backward more than usual, and defined by arcuate depression, eye-sockets more deeply hollowed than in *M. Sydneyanus* Blkb., the antennæ shorter and less enlarged apically than in that species. *Prothorax* 2·5 × 3 mm., apex bisinuate, advanced in the middle, the anterior angles acute and strongly advanced, sides feebly arcuate, narrowed apically, almost straight on posterior two-thirds, base truncate, posterior angles sharply rectangular, lateral margins raised, distinctly sulcate within, basal border narrow but clearly defined, disc densely and finely punctate, without central line, and with two small and inconspicuous basal foveæ. *Scutellum* transversely oval. *Elytra* scarcely, or very slightly, wider than prothorax at base and more than twice as long, shoulders rather sharply rectangular, sides parallel, less convex than *M. Sydneyanas* Blkb., striate-punctate, the seriate punctures small and closely placed in deep striæ, intervals convex, and finely punctate (the punctures becoming larger and intervals sharper towards sides). *Abdomen* densely and delicately punctate, prosternum finely striolate, tibiæ straight, or nearly so, the anterior tibiæ strongly and angularly dilated at apex, especially in ♂. *Dimensions* 9-10 × 3 mm.

Hab.—Dorrigo (H. Cox, W. Heron), Richmond River (British Museum).

Ten specimens under examination, of which two, in the consignment from the British Museum, are intermediate between *M. Sydneyanus* Blkb., and *M. colydioides* Erichs. Possibly it has often been overlooked by collectors in mistake for the common *M. Sydneyanus* Blkb., which I have from the same district. It can be readily distinguished from Blackburn's species by (1) prothorax with unproduced hind angles and truncate base, the distinctly sulcate sides, and the absence of the basal transverse depression; (2) elytra of flatter form, more deeply striate and more convex intervals; (3) much more distinctly punctate thorax and underside; (4) the straight tibiæ of ♂, with their angulately dilated apex (the same being strongly bent downwards, and rounded at apex in *M. Sydneyanus*). From *M. colydioides* it can be distinguished by its wider form, more nitid-black colour, prothorax with more produced anterior angles with wider lateral border and sulcation within. (N.B.—*M. Sydneyanus* Blkb., ranges from Victoria to South Queensland, while I have specimens of *M. colydioides* Erichs., from Tasmania, Victoria, and New South Wales). Types in the Author's Coll.

MENERISTES DENTIPES, n.sp.

♂ Elongate, subcylindric, polished nitid-black; antennæ, palpi, and tarsi dark red; apex of front tibiæ with large tuft of red tomentum, tarsi scantily clad with a few reddish hairs.

Head minutely punctured on forehead, more closely on epistoma, and finely rugose-punctate on the neck; epistoma truncate in front, with a deep, straight sulcus behind, arcuately continued in front of canthus, with two straight longitudinal sulci produced backward in front of the eyes; antennæ short, scarcely reaching beyond the front third of prothorax, considerably widened outwards, joint 3 scarcely longer than 4, 8-10 subquadrate, 11 nearly round. *Prothorax* 5 × 5·6 mm., more convex than in *M. laticollis* Pasc., widest near middle, apex slightly bisinuate, the middle a little advanced, anterior angles widely rounded, scarcely advanced, sides gently rounded, sinuate behind when viewed sideways (due to subangulate depression of border at this point), base nearly straight, posterior angles rather bluntly acute and produced; sides, base, and the greater part of apex with raised border, the lateral border not so evident from above as in *M. laticollis* Pasc., due to its greater convexity; a narrow sulcus within border throughout, except at the middle of apex, border thickened at the posterior angles; disc quite smooth, highly polished, with four foveate depressions, one near each angle within the apical and basal border respectively, and a faint beginning of a central depression at base and apex. *Scutellum* triangular. *Elytra* wider than prothorax at base, and nearly twice and one-half as long, more convex and parallel than *M. laticollis* Pasc., shoulders advanced and rather squarely rounded, striate-punctate, with nine rows, besides a short scutellary row of large round punctures, no wise concealed by the striæ, the terminal puncture at base especially large and deep; intervals convex and smooth. Gula finely, transversely rugose, prosternum finely punctate, metasternum and abdomen nearly smooth, except for a row of punctures at front edge of second and third segments, and some minute strioles; femora smooth, front tibiæ unusually bent downwards and inwards, deeply excavated, carinate on the inside, with two teeth, one wider near base, the second conical on the upper third; middle and hind tibiæ straight on the outer edge, the middle tibiæ with two teeth, the one near the apex far more acute, posterior tibiæ also bidentate, with a large conical tooth near the middle, the other wide and round, emerging into the unusually widened apex. *Dimensions*, 19-20 × 7 mm.

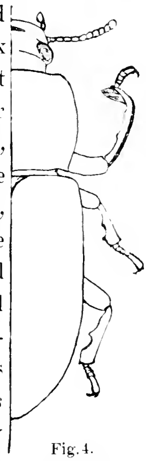

Fig. 4.
M. dentipes.

♀. Wanting.

Hab.—Coen River, Cape York (H. Hacker), Queensland (British Museum).

Two male specimens examined, one taken by Mr. Hacker, in 1906; a second, labelled Queensland 77-27, in the British Museum consignment to me. The tibial characters are remarkable, and are shown in my outline figure; while its highly polished surface, cylindric form, large seriate punctures, and less produced angles of thorax, easily distinguish it from the common *M. laticollis* Pasc. Type in the Author's Coll.

Meneristes tibialis, n.sp.

♂. Elongate, parallel, polished ebony-black; antennæ, palpi and tarsi castaneous, front tibiæ with a few red hairs at apex.

Head rather coarsely punctate on forehead and labrum, with a smooth arched space connecting the eyes, more densely and finely punctate on epistoma, the latter straight in front, limited behind by arched sulcus, canthus oblique and raised, antennæ extending to two-thirds of prothorax, joint 3 as long as 1-2 combined, longer than 4, joints 8-10 transverse but somewhat quadrate, 11th elongate-ovate. *Prothorax* 5 × 6 mm., widest at middle and base, one-third narrower at apex, feebly bisinuate at apex (a little drawn back in middle); anterior angles obtuse, scarcely rounded and well advanced, sides gently arcuate widening to middle, feebly sinuate behind; posterior angles acutely produced, pointing directly backwards and downwards, with narrow reflexed border at sides, terminated and thickened at the posterior angles, attenuated but continuous throughout at apex, base without raised border, sides with narrow sulcus within border, widened into a horizontal lamina towards the anterior angle, base bisinuate; disc minutely not closely punctate, with two large and deep basal foveæ, comma-shaped, occupying half the space between the angles and the middle, a faint indication of depressed middle line (not shown in one example). *Scutellum* triangular, minutely punctate.

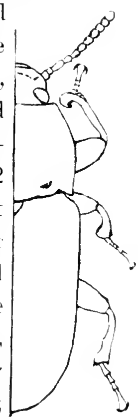

Fig. 5. *M. tibialis.*

Elytra wider than prothorax at base, and twice and one-third as long, shoulders rather squarely rounded, sides narrowly margined, striate-punctate, with nine rows, besides a short scutellary row of rather small punctures, closely placed in deep striæ, intervals strongly convex and distinctly punctate (more evidently so than in *M. laticollis* Pasc.), gula densely and coarsely punctate, prosternum finely rugose-punctate, metasternum, abdomen, middle and hind femora very finely rugose and minutely punctate; front femora more densely and coarsely punctate, front tibiæ swollen in middle, strongly widened and curved near apex only, this wide curved lobe coarsely punctate; carinate on outside edge, this carina widened into a rounded tooth or emargination at apex, with two short blunt spurs; middle tibiæ strongly curved and similarly but less widened at apex, hind tibiæ slightly curved with an angulate emargination or triangular tooth on inside edge below the middle, apex less enlarged than in the other tibiæ, the four hind tibiæ with long apical spurs.

♀. With all tibiæ straight, much less enlarged at apex, hind tibiæ without the emargination.

Dimensions of type ♂, 20 × 8 mm., other specimens from 18 × 7 mm.; of ♀, 19-23 × 7-9 mm.

Hab.—Victorian Alps (The Author), *Queensland*(?), and New South Wales.

Three male specimens examined, two from the Victorian Alps taken by myself, with four corresponding females; the third male, with a female, is labelled N. Queensland, but I have no record of their capture; a very large female was taken by my son, at Gynken, Blue Mountains.

The species is easily separated from its allies, in male specimens by the single tooth on the hind tibiæ. It has the polished surface of *M. dentipes*, with much more anteriorly narrowed prothorax and sharper angles. Even female specimens may be distinguished from *M. laticollis* by the more polished black colour, the more produced and sharper angles, and widened margins near the front angles of prothorax. Types in the Author's Coll.

Var. *proximus*, n. var.

A provokingly closely allied species, of which both sexes, from Dorrigo and Acacia Creek, and Tambourine Mountain, is without the emargination on the hind tibiæ of the ♂; the only other differences to be noted are (1) larger seriate punctures of elytra; (2) sides of prothorax less arcuately widened but more sinuate behind; (3) posterior angles of prothorax directed a little outwards; and (4) tibiæ less curved and enlarged at apex in ♂.

MENERISTES LATIOR, n.sp.

♂. Widely ovate, polished ebony-black: antennæ, palpi, and tarsi castaneous, front tibiæ with a fringe of red tomentum at apex.

Head: labrum emarginate and coarsely punctate, forehead coarsely, epistoma densely and more finely punctate, the latter straight in front, rectangular at sides, meeting the canthus at a wide angle, limited behind by a defined semicircular sulcus; antennæ extending to two-thirds of prothorax, considerably widened at apex, joint 3 as long as 1-2 combined, 8-10 transversely oval, 11th nearly twice as long as 10, ovate. *Prothorax* 5·5 x 7 mm., widest in front of middle, much less narrowed in front than in *M. laticollis* Pasc., or *M. tibialis*, and nearly as convex as in *M. dentipes*; apex bisinuate, middle portion advanced, anterior angles widely rounded but advanced, sides moderately arcuate, sinuate behind, posterior angles acutely produced backwards and a little outwards, base strongly bisinuate, extreme border narrow on sides, thickened towards and at the posterior angles, very narrow but uninterrupted at apex, obsolete at base, sides with a wider marginal channel than usual, less widened in front than in *M. tibialis*, but more marked than in *M. laticollis* Pasc., disc microscopically punctate, highly polished, with two deep foveate excavations at base near angles, and only the faintest suspicion in one example of a medial depression. *Scutellum* widely triangular. *Elytra* very little wider than prothorax at base, ovate, twice and one-third as long, shoulders rather widely rounded but prominent;

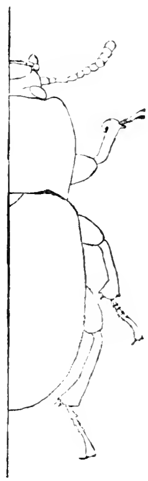

Fig.6.
M. latior.

striate-punctate, intervals sharply ridged, seriate punctures larger than in *M. tibialis*, more closely placed than in *M. laticollis* Pasc., intervals apparently quite impunctate; underside very finely striolate, prosternum finely transversely rugose, femora smooth, tibiæ coarsely punctate on under surface, (on upper surface at apex only). Front tibiæ moderately curved and enlarged at apex, external carina triangularly enlarged at apex, middle and hind tibiæ less curved and enlarged, apical spurs long. *Dimensions* of type ♂, 21 × 8·5 mm.; other specimens from 17 × 6·2 mm.

Hab. – Dorrigo, N.S.W.(R. J. Tillyard).

Five specimens examined, all males. I can find no females to match them. The species is separated from its allies by the great width of the prothorax, very little less than that of elytra at base, also the great width of elytra compared with length. Thus in *M. laticollis* Pasc., the elytra are nearly exactly twice as long as wide. In *M. latior*, the length is only once and two-thirds the width. Type in author's Coll.

TOXICUM INSIGNE, n.sp.

Elongate, parallel, dull brownish-black above, without the usual indumentum; oral organs, antennæ, legs, and underside piceous.

♂. *Head* concave, punctate, the clypeal horns degraded into conical tubercles situated at the corners of the clypeus, frontal horns strongly incurved at base and apex, the apices slightly widened and deflexed, nearly meeting, with a fringe of golden hair on the outside only, extending but narrowing almost to the extreme base; antennæ with a distinct 4-jointed club, the 8th joint clearly differentiated in size and shape from the 7th. *Prothorax* bisinuate at base and apex, widest in front, about as wide as long (4 mm.), anterior angles rather squarely rounded, sides nearly straight and gently converging to base, posterior angles obtuse, not produced; disc densely and uniformly punctate, sometimes with a faint depression to denote a medial line. *Scutellum* curvilinearly triangular. *Elytra* wider than prothorax at base, and twice and one-half as long, shoulders rather square, sides nearly parallel till near apex; striate-punctate, the intervals convex, the punctures smaller and closer than in *T. punctipenne* Pasc., the basal part of elytra with irregular, confused punctures of the same size as those in the series. Sternum, especially the prosternum, very coarsely punctate, abdomen less coarsely punctate. Front femora enlarged but not dentate, tibiæ widely dilated at the apical two-thirds.

♀. Without the (clypeal) tubercles, the frontal horns replaced by two wide conical tubercles, the antennal club smaller, the tibiæ only slightly dilated at apex.

Dimensions, 16 × 5(vix) mm.

Hab.—Lynndoch, S.A. (Tepper); Young, N.S.W. (Sloane): Teralga, **N.S.W**, and South Australia (British Museum).

Eight specimens (5 ♂, 3 ♀) examined; three from the South Australian Museum, two from the British Museum, three from the Melbourne Museum, labelled from the above localities. It is easily distinguished by its greater size, the form of the male horns, its different elytral puncturation, and the curiously widened tibiæ of the male. Types in the South Australian Museum.

TOXICUM QUINQUE-CORNUTUM, n.sp.

Elongate, parallel, opaque-black above, nitid-black beneath; antennæ and tarsi piceous, the apical joints of the former red.

Head densely and strongly punctate, clypeus three-horned, the middle one largest and widely triangular, obliquely pointing upwards, its base occupying the whole front of clypeus, with two shorter triangular elevations forming a dentate extension, forwards and upwards, of the canthi; the frontal horns flattened, widest when seen laterally, sharply curved inwards at base, twisted backwards at apex, with a very small tuft of yellow tomentum on the outside of apex; club of antennæ moderately wide and four-jointed, joints 9 and 10 largest, and rounded. *Prothorax* 3 × 2·6 mm., bisinuate at apex and feebly so at base, slightly widest at apex, anterior angles rather squarely rounded and depressed, sides nearly straight and slightly narrowed to base, posterior angles obtuse; disc very finely and densely punctate, with a faint indication of a smooth middle line. *Scutellum* triangular. *Elytra* wider than prothorax at base, and twice and one-half as long; striate-punctate, the punctures in the striæ regular; of the same size, but more distant than in *T. brevicorne* Pasc. Underside sparsely punctate, the punctures on prosternum largest. Femora unarmed, tibiæ slender. *Dimensions*, 10 × 3·5 mm.

♀. Wanting.

Hab.—New South Wales (Bellingen ?).

A single ♂ specimen, kindly given to me by Mr. W. Duboulay, probably from Bellingen, is easily distinguished by its remarkable clypeal and frontal appendages. Type in the Author's Coll.

In my revision of the *Cyphaleinae*, I have unfortunately used generic titles that are preoccupied. Thus *Mitrephorus* has been used by Schönherr, (Col., 1837; Scudder, Nom. Zool.), and *Toreuma*, by Haeckel (Index Zool., 1902). Moreover, it appears that *Ctimene* Bates, was also used by Boisduval in Lepidoptera; and *Chariotheca* Pasc., is preoccupied by Dejean (Col. 1833; Scudder, Nom. Zool.). I, therefore, propose the following changes: For *Mitrephorus* Cart., substitute *Mitrothorax*, n.gen.: for *Toreuma* Cart., substitute *Eutoreuma*, n.gen.; for *Ctimene* Bates, substitute *Timeneca*, n.gen.; for *Chariotheca* Pascoe, substitute *Charithes*, n.gen.

Errata.—On. p. 105, These Proceedings, 1903, In the Explanation of Plates, for *Chlorophanes*, read *Trisilus;* and on p. 65, for *Lygestria* read *Lygestira;* and for *Mithippa* read *Mithippia.*

Platyphanes vittatus Westw.—Mr. Blair lately informed me that he had written to Geneva, and that Dr. Weber had kindly sent him the type of *P. vittatus* Westn. It is Pascoe's *Opigenia iridescens*, which, accordingly, must be now known as *Opigenia vittata* Westw. As regards *P. aculeatus* Westw., and *P. striato-punctatus* Westw., Dr. Weber states that neither of them is at Geneva, though both types are stated to be in the Melly Coll. This is most unfortunate, as leaving the identity of *P. aculeatus* Westw., with *Mœrodes Westwoodi* Macl., unsettled. The following new species have been received since the publication of my revision.

Subfamily CYPHALEINÆ.

PLATYPHANES DENTICOLLIS, n.sp.

Elongate, parallel, black; head and thorax opaque, elytra and underside subnitid, tarsi and antennæ piceous, the former clothed with red hair.

Head: labrum squarely emarginate, rufo-ciliate in front, epistoma truncate, its sides rounded, making nearly a right angle with the flat, elongate, and parallel canthus, the suture arcuate and subobsolete in the middle; front depressed, the whole coarsely and deeply punctate, space between the eyes as wide as the transverse diameter of one; antennæ short, extending to one-half the length of prothorax, greatly enlarged apically, joint 3 longer than 4, 4-7 obconic, 8-10 transverse, successively wider and more ovate, 11 as wide as 10, oval. *Prothorax* 5 × 8·5 mm., widest in middle, wider at base than at apex, the latter nearly straight except at the angles, these slightly reflexed, produced obliquely outwards and forwards into a sharp triangular tooth, base bisinuate, sides slightly rounded in the middle, sinuate in front and (less strongly) behind; the posterior angles subrectangular, not produced; lateral border moderate, scarcely raised, not channelled within, apical border evident throughout. Disc with irregularly scattered round punctures, more crowded at the sides, with some smooth spaces near the middle. *Scutellum* curvilinearly triangular, punctate. *Elytra* wider than prothorax at base and four times as long, widely rounded at, and slightly gibbous near, the humeral region, sides parallel, apex rather wide and horizontal, gradually narrowed in front, obsolete at shoulders, narrowly bordered, the margin separated from the disc by a fine sulcus, showing a few close punctures on basal half; disc scarcely striate-punctate, with ten defined rows of large punctures besides a short scutellary row, and an abbreviated row of smaller punctures on the fourth interval; intervals somewhat tumid, and convex at the sides, minutely punctate; the seriate punctures round, and placed so that the distance between two is about the width of an interval, with slight variations of size and distance apart. *Submentum* closely pustulose, prosternum transversely rugose, its process coarsely punctate, bisulcate and widely rounded behind, compressed and nodulose in front, mesosternal cavity widely triangular, its edges swollen, sides of metasternum and epimera with large round punctures, basal segments of abdomen strigose and finely punctate, femora coarsely punctate, posterior tarsi with apical and clawjoint of equal length. *Dimensions*, 28 × 12 mm.

Hab.—Warra, Queensland (Mrs. Hobler).

A single (♂?) specimen, kindly given to me by Mrs. Hobler, is the largest described species, and differs from its nearest ally, *P. creber* Blkb., in its black elytra, its dentate anterior angles of prothorax, the absence of defined striæ, of which *P. creber* is said to have about 14. From *P. striato-punctatus* Westw., it differs still more, not only in the form of the prothorax, but in its wider, more parallel, and not at all cylindrical shape, with a quite different elytral sculpture. Type in the Author's Coll.

Platyphanes rugosulus, n.sp.

Narrowly elliptic, very convex; head and pronotum nitid coppery-black, elytra dull coppery-brown, antennæ and tarsi fuscous, underside and legs black.

Head distinctly but not very closely punctate, epistoma straight in front, arcuately impressed behind, this impression joined by two shallow longitudinal impressions extending backwards behind the eyes, the latter rather widely separated; antennæ short and slender, moderately enlarged at apex, joint 3 cylindric, not as long as 4-5 combined, 4-7 obconic, 8-10 nearly round, 11 ovate. *Prothorax* $3 \times 5\frac{1}{2}$ mm., widest at base, apex arcuate, anterior angles obtuse, slightly depressed, scarcely advanced, sides arcuately widening to base, posterior angles produced and acute, base strongly bisinuate, lateral margins slightly raised, scarcely channelled within, disc finely punctate, with three small shallow foveæ at base. *Scutellum* triangular, punctate. *Elytra* of same width as prothorax at base, and more than thrice as long, elliptic, very convex, almost gibbous, with the highest point near middle, shoulders obtuse, narrowly margined throughout, striate-punctate, the striæ indistinct, quite obliterated towards apex, the second stria scarcely traceable throughout, the punctures in striæ small and not deeply impressed, intervals quite flat and finely transversely wrinkled; epipleuræ nearly smooth, abdomen very clearly and delicately striolate-punctate; prosternum carinate, its flanks coarsely and sparsely punctate, meso- and metasternum finely and sparsely, their epimera more coarsely punctate, mentum carinate in middle, submentum rugose-punctate at sides, smooth in middle. *Dimensions*, 14 × 6·5 mm.

Hab.—Rockhampton, Queensland (Mr. H. Brown).

A single ♀ specimen, generously given to me by its captor, is nearest to *P. cyaneus* Pasc., and *P. ellipticus* mihi, in form, but is narrower and more convex than either, and quite different in colour and sculpture. It is distinguished by the contrast of nitid head and pronotum, with its subfuscous elytra, the sculpture of the intervals being irregularly and finely striate, like the skin of one's hand. Type in the Author's Coll.

Opigenia Browni, n.sp.

Oblong-oval, convex; upper surface green and blue with purple reflections, the suture golden; underside, legs and antennæ nitid-black, tarsi with a very thin clothing of red tomentum.

Head: epistoma truncate, angulate with the canthus, limiting suture subobsolete, canthus little raised, eyes separated by a space of the width of one, half concealed by thorax, coarsely and closely punctate, antennæ not reaching base of prothorax, joints 3-7 of equal length, 8-9 successively wider and subtriangular, 10 transverse, 11 shortly oval. *Prothorax* 3 (vix) × 5 mm., widest at middle, wider at base than at apex, the latter circularly emarginate, the anterior angles produced, slightly rounded and obtuse, sides widely and evenly rounded, posterior angles rather widely acute, not dentate; base strongly bisinuate, lateral border moderate, narrowly concave within, apical border very narrow; disc very clearly and rather deeply punctate at sides and base with a large smooth transverse middle space, with no indication of a middle line. *Scutellum* triangular and punctate. *Elytra* as wide as prothorax at base, widening at shoulders, subparallel on middle third, evenly convex; striate-punctate, the intervals closely punctate, the seriate and interstitial punctures of almost equal size and scarcely differentiated. Prosternum closely rugose-punctate, slightly compressed and raised in middle, its process widely rounded behind, epipleuræ smooth, metasternum smooth in the middle, strongly punctured on sides and epimera; abdomen finely punctate and striolate. Tibiæ straight, femora unarmed, posterior tarsi rather short, claw-joint longest. *Dimensions*: 15 × 7 mm.

Hab.—Southern Cross, West Australia.

A single specimen, ♀, was given to me by that very enthusiastic collector, Mr. H. W. Brown, amongst some *Chalcopteri*, which it somewhat resembles, except in the structure of head and thorax. It differs from *O. vittata* Westw., (a specimen of which is before me) in the following respects: (1) Colour less brilliant; (2) body more convex and robust; (3) prothorax with nitid spaces, the sides *much* more widely rounded, front angles wider, margins less reflexed; (4) elytral intervals more strongly punctured.

The prothorax is very similar, in form and colour, to that of *Prophanes chalcopteroides* Cart., which is a much larger insect; the elytra are similar, in shape and colour, to those of *Chalcopterus polychromus* Pasc., but the seriate punctures are less distinct. Type in the Author's Coll.

OLISTHÆNA RUFO-ÆNEA, n.sp.

Ovate, slightly convex; head and prothorax castaneous (margins rufous), elytra green-bronze; antennæ, legs, and underside pale red.

Head rather deeply enclosed in prothorax, epistoma short, round in front, widely impressed behind, evidently and clearly punctate, eyes separated by a distance greater than the diameter of one eye, antennæ short, not reaching base of prothorax, apical joints enlarged, two penultimate joints about as wide as long, eleventh elongate-ovate. *Prothorax* 2 × 3·5 mm., deeply bisinuate and and emarginate at apex, the middle lobe a little raised and advanced (this emphasised by the depression behind); anterior angles strongly advanced in front of eyes, acute but a little blunted at apex, sides nearly straight and gradually widened to apex, base bisinuate; posterior angles acute, a narrow horizontal margin within the raised border, widened at the angles; disc very finely and densely punctate, with two small basal foveæ and a large central depression on apical half. *Scutellum* triangular with rounded sides, punctate. *Elytra* of same width as prothorax at base and thrice as long, slightly widening behind shoulders, narrowly bordered, irregularly punctate, with some indications of a lineate arrangement on middle, quite irregular, with smooth intervals on sides; prosternum short, compressed and subcarinate in front, its process triangular behind, with a corresponding mesosternal notch, and finely punctured, abdomen finely striolate, tibiæ slender. *Dimensions*, $7\frac{3}{4} \times 3\frac{1}{2}$ mm.

Hab.—Tambourine Mountain, South Queensland (H. Hacker).

Two specimens, kindly sent by Mr. Hacker, evidently differ from *O. tenuitarsis* Pasc., in the smaller size, coloured thorax and head, with much sharper and more produced front angles, more convex elytra. Type in the Author's Coll.

PROPHANES BROWNI, n.sp.

Elongate-ovate, navicular; coppery-bronze above and beneath, pronotum and scutellum more nitid copper, legs nitid-black, antennæ and tarsi brown, the latter and the tibiæ sparsely clad with red hairs.

Head and *pronotum* rather strongly but not very closely punctate, epistoma convex, with limiting sulcus strongly defined at the sides, subobsolete in the middle, canthus short and raised, eyes very large, prominent, and approximate, the separating lamina not wider than in *Anausis metallescens* Westw., but rapidly widening each way; antennæ extending beyond the base of prothorax, slender at base, moderately enlarged apically, joint 3 cylindric, not as long as 4-5 combined, 4-7 subequal in length, successively wider, obconic, 8 shorter and wider than 7, 9-10 longer than wide, much shorter than 8; 11th longer and wider than 10, ovate. *Prothorax* $5 \times 6{\cdot}5$ mm., length measured in middle, widest at base, apex bisinuate, anterior angles produced obliquely outwards into long acute spines, sides slightly sinuate anteriorly and posteriorly, feebly widened in the middle, posterior angles spinose, obliquely pointing outwards, disc with two large basal and two smaller apical impressions, the latter at the angular emargination, base bisinuate, lateral and basal border narrowly raised. *Scutellum* large, curvilinearly triangular, minutely punctate. *Elytra* slightly wider than prothorax at base, thrice and one-half as long, widening at the shoulders, then subparallel on middle third, then strongly tapering to a narrow apex, each elytron with a short external spine, shorter and more closely placed than in *P. Mastersi* Pasc. Disc moderately convex at base (much less so than in *P. Mastersi*), evenly declivous in all directions; irregularly and rather closely punctate, the punctures much smaller and closer than in *P. Mastersi*, these becoming obsolete towards apex, margins very narrow on front half, gradually becoming wider and horizontal apically; submentum with coarse round punctures, prosternum transversely rugose, strongly compressed and carinate, the process produced behind conically, into a widely raised V-shaped receptacle; mesosternum and epipleuræ very coarsely rugose-punctate, the latter rather abruptly terminating at the last abdominal segment, abdomen finely striolate, the last segment finely punctate, and terminated with a fringe of red hair; legs smooth, front femora swollen, posterior tarsi with basal and claw-joint of equal length. *Dimensions*, 23 x 10 mm.

Hab.—Kuranda, N. Queensland.

A single ♂ specimen, taken by Mr. H. W. Brown, adds another fine species; but it arrived too late to be included in my monograph of the group. It is intermediate in form and character between *Prophanes* and *Anausis*, but is much more convex and less parallel than the latter. Type in the Author's Coll.

Stigmodera suavis Cart.—This is a nom. præocc. by Kerremans (Insecta gen. 1902, p. 210). I therefore propose the name *S. venusta* for the species so described (These Proc. 1913, p. 507).

CHARIOTHES SUBVIOLACEUS, n.sp.

Rather widely ovate, convex; head, thorax, and underside very nitid-black, elytra with a violaceous tinge, antennæ and tarsi pale red, legs piceous (red at knees and apex of tibiæ).

Head strongly unevenly punctate, rather flat, epistoma slightly rounded in front, with a straight indistinct suture behind, eyes large, coarsely faceted and transverse, antennæ short, apical four joints considerably enlarged, joint 3 not longer than 4, apical joint elongate. *Prothorax* 3·4 × 3 mm., rather convex and gibbous in middle at apex, widest at base, very little narrowed at apex, widely arcuate at apex, anterior angles obtuse, slightly depressed, and scarcely advanced, sides nearly straight (feebly arcuate) on anterior two-thirds, sinuate behind, posterior angles acute and slightly produced, base bisinuate, lateral border rounded and somewhat thick, with a very narrow sulcus within, disc clearly punctate, the punctures shallow and not close, a transverse depression behind middle and two basal foveæ. *Scutellum* small, triangular. *Elytra* ovate, convex, slightly gibbous in front of middle, of same width as prothorax at base and twice as long, widening behind, seriate-punctate, the punctures smaller and closer near suture, large and foveolate on sides and apex, general surface rather uneven, with some transverse ridges and depressions, narrowly bordered. Sternum closely, abdomen rather sparsely punctate, prosternal process concave in middle and punctate, imperfectly received into the triangular receptacle of the mesosternum. Fore and middle tibiæ curved, hind tarsi straight. *Dimensions,* 9 × 3·6 mm.

Hab.—Kuranda (H. Dodd).

A single specimen, sent by Mr. Dodd, is congeneric with *C. cupripennis* Pasc., but differs in its more explanate prothorax, its more gibbous elytra and uneven surface, *inter alia multa.* In form, it suggests *Campolene nitida* Pasc. Type in the Author's Coll.

Postscript (added 31st March).—The following extract from a letter received from Mr. R. G. Blair, of the British Museum, is of interest in evidence of the mystery connected with Boisduval's species. "I think I can clear up a few of Boisduval's species. Bates acquired, with La Ferte's Collection, a set of *duplicate* Heteromera from the Dejean Collection, and among these are probably cotypes, possibly types of Boisduval's species. These are as follows :—

Tenebrio australis Boisd. = *Meneristes intermedius* Pasc., a small specimen, resembling one seen by you (from Peak Downs).

T. nigerrimus Boisd. = *M. servulus* Pasc., (? = *convexiusculus* Hope). *T. nigerrimus* Blanch.,(Blessig) = *M. laticollis* Pasc.

Uloma australis Boisd.,(*Heterocheira*) correctly identified.

Amarygmus columbinus Boisd. = *Chalcopterus vinosus* Pasc. = *C. variabilis* Bless.

Adelium harpaloides Boisd. = *A. calosomoides* Kirby.

A. virescens Boisd. = *A. brevicorne* Bless.

In addition to these, there are a few specimens in the Bates Coll., bearing labels which agree with the labels on Dejeanian *types* of other families. These were probably acquired by Bates from Bakewell's Coll., though there is nothing to show this. Amongst these are the last two in the above list, and

Upis crenata Boisd. = *Hypaulax ovalis* Bates.

Cilibe brunnipennis Boisd.,(*Saragus*), King George's Sound."

ORDINARY MONTHLY MEETING.

April 29th, 1914.

Mr. C. Hedley, F.L.S., Vice-President, in the Chair.

The Chairman announced that, under the provisions of Rule xxvi., the Council had elected Messrs. A. H. S. Lucas, M.A., B.Sc., J. R. Garland, M.A., C. Hedley, F.L.S., and W. W. Froggatt, F.L.S., to be Vice-Presidents; and Mr. J. H. Campbell [Royal Mint, Macquarie Street] to be Hon. Treasurer, for the Session 1914-15.

Also, that at the next Meeting, it was proposed to give Members an opportunity of discussing Mr. Andrews' paper on "The Development of the N.O. Myrtaceæ" [Proceedings, 1913, p.529].

The Donations and Exchanges received since the previous Monthly Meeting (25th March, 1914), amounting to 10 Vols., 75 Parts or Nos., 15 Bulletins, 5 Reports, and 11 Pamphlets, received from 60 Societies, etc., and two Authors, were laid upon the table.

NOTES AND EXHIBITS.

The Rev. W. W. Watts submitted specimens of *Ophioglossum vulgatum* L., preserved in formalin. The specimens were collected near Sydney during April by Mr. Thos. Whitelegge. *O. vulgatum* does not occur in Australia in its typical European form; the specimens shown belonged to the varieties *costatum* (R.Br.), collected in Nielsen Park, and *gramineum* Hook., (*O. Dietrichiæ* Prantl), also from Nielsen Park, and possibly a third variety (*lanceolatum*).

Mr. Fred Turner exhibited and contributed notes on :—*Chloris barbata* Sw., collected near Kyogle, Upper Richmond River, New South Wales, in 1899. He gave some additional particulars about *C. barbata* Sw., var. *decora* (Syn. *C. decora* Nees), which was first discovered in this State by the exhibitor and recorded in these Proceedings in 1904.—*Astrebla triticoides* F.v.M., var. *lappacea* [Syn. *Danthonia lappacea* Lindl.,] forwarded to him by Mr. N. Turnbull, Noorama, Cunnamulla, Queensland. The exhibitor first drew public attention to this grass as producing a fairly large grain, like small wheat, at a meeting of the Australasian Association for the Advancement of Science held at Melbourne in 1890.—*Eragrostis major* Host., forwarded to him, for identification and report, by Messrs. P. L. C. Shepherd & Son, Nurserymen and Seedsmen, Sydney, who had received it from one of their clients in the Forbes district.

Dr. H. G. Chapman reported some results of the breeding of guinea-pigs by his wife and himself. Attention had been paid to the colour of the hairs, length of the hairs and arrangement of the hairs on the skin. Experiments had now been in progress for two years, and five generations had been bred.

Dr. Petrie showed, on behalf of himself and Dr. Chapman, a specimen of the African plant *Acokanthera spectabilis*, the milky juice of which affects a photographic plate in the dark. Extracts of this plant are used as arrow-poison by the Zulus and Somalis. Information was asked for, regarding its botanical relations, and poisonous properties.

Mr. Tillyard exhibited both sexes of the interesting archaic Ascalaphid, *Stilbopteryx costalis* Newman, together with the eggs. The eggs had never been seen before. They are very large, about 3·5 × 2 mm., oval and well rounded at both ends. He also showed a pair of the Panorpid, *Harpobittacus tillyardi* Petersen. This species, which is very common round Sydney in October and November, has for a long time been confused with *Bittacus australis* Fabr., a much smaller and rarer species. The insect is mentioned under the latter name in Froggatt's Entomology, and in other publications.

Dr. J. B. Cleland exhibited a silver-fish (*Lepisma* sp.) found alive and active in the crop of a healthy turkey, together with a number of grains of wheat.

Mr. A. A. Hamilton exhibited specimens from the National Herbarium, including *Rosa* Hort. var., (T. Steel; Strathfield;

27/3/09) showing fasciation of the stem and foliar prolification of the inflorescence. A whorl of reduced leaves is noticeable on the faciated stem, below the dilated, abortive ovary, upon which a circlet of sessile, atrophied buds, with foliaceous calyces, is seated. —*Chrysanthemum frutescens* L., (W. M. Carne; Sydney Botanic Gardens; 14/3/14) showing extrafloral prolification; virescence of the tubular florets, which are much enlarged, and have their reproductive organs suppressed, and of the ligulas of the ray-florets; leafy branches, bearing buds, spring from the axils of the floral bracts, a capitula of floral bracts ascending from one of the tubular florets, and a ray-floret of an otherwise perfect flower which has developed its tube at the expense of the ligula. Green flowers, a result of the development of chlorophyll in place of the colouring matter proper to the flower (virescence), have been unusually prevalent in the coastal area, especially among cultivated Asters, during the past exceptionally dry Spring and Summer, furnishing additional evidence in favour of the generally accepted theory that droughty conditions are largely responsible for this habit.—A series of leaves of *Isopogon anemonifolius* R.Br.,(A. A. Hamilton; Cook's River; September, 1913) showing the xerophytic character of reduction of leaf-surface, owing to unfavourable conditions. The plant, from which the leaves were taken, was growing on a plateau overlooking Cook's River at Undercliffe, in a shallow depression, with a few inches of shale covering the rock, which, after rain, becomes a pool of stagnant water.—*Acacia longifolia* Willd.,(A. A. Hamilton; Springwood, Wentworth Falls, and Leura; November, 1913) showing leaf-variation, from linear to ovate-lanceolate; obtuse, acute, to long acuminate; straight to falcate. Some measurements are, $11\frac{1}{4} \times \frac{3}{8}$ in., $8 \times \frac{7}{8}$ in., $6\frac{1}{2} \times 1\frac{1}{2}$ in., $6 \times \frac{1}{8}$ in., $5\frac{1}{2} \times \frac{1}{2}$ in., $3\frac{1}{4} \times \frac{1}{8}$ in., $2\frac{1}{4} \times \frac{1}{4}$ in.—*Hakea dactyloides* Cav.,(A. A. Hamilton; Cook's River, December, 1913; Valley Heights, January, 1914) showing leaf-variation in breadth, contour, and texture.

Mr. Fletcher showed a number of branches of *Lantana Camara* Linn., from Hunter's Hill, exhibiting the cohesion of opposite leaves, basally and upwards to a varying extent. Before the bountiful rains, which began in February, the plants were suffer-ing severely from drought, and many of them lost their leaves. At present, they were growing most luxuriantly, and the anomalies were fairly common. In every case the coherent leaves were terminal, one or both margins being involved, the cohesion being accompanied by the suppression of the growing point, much as if the shoots had been pinched off.

Mr. R. H. Cambage brought before the Meeting the important matter of the safeguarding of the Bulli Pass, on the South Coast, as a beauty-spot and Nature Reserve. Happily the seascape and landscape elements cannot be seriously interfered with; but it is otherwise with the subtropical vegetation, which is such an important factor in the general effect. With the object of securing the continuance of the vegetation, the Council had passed a Resolution—which had been communicated to the Minister—to the effect that it is highly desirable that action should be taken by the State to secure an area of several hundred acres around the Pass, and that the Minister for Lands be respectfully urged to take the necessary action. Mr. Cambage said that he thought that what the Council had done would commend itself to the Society. Scientific Societies in Europe and America were interesting themselves, on an international basis, in the preservation of Nature, and in providing for Nature Reserves. He accordingly moved: That this Meeting cordially supports the action of the Council. The Resolution was seconded by Mr. A. G. Hamilton, and a number of Members took part in the discussion; on being put to the Meeting, the motion was carried unanimously.

Miss S. Hynes moved—That there should be more adequate protection of the native flora. Mr. A. G. Hamilton seconded the motion, which, on being put to the Meeting, was carried.

THE VENOM OF THE FISH, *NOTESTHES ROBUSTA*.

By Leighton Kesteven, M.R.C.S., Eng., &c.

(Communicated by A. R. McCulloch.)

That the Bullrout is a very awkward customer to handle, is an undisputed fact, but the virulence, or otherwise, of the wounds inflicted by the spines about its head, is a "questio vexata" on which the best known authorities differ.

As during some years' residence on the northern rivers of New South Wales, I was frequently brought into contact with cases of "sting" from this fish, I can speak with professional experience of the symptoms presenting on such wounds.

Tenison-Woods(**1**), in his description of the Bullrout, gives a fairly accurate account of the ordinary symptoms met with, and I can confirm his statements, with one exception, viz., that the pain disappears at sunset. Though I am not prepared to say that it never does, I have not found it the usual condition. I have seen several cases where the agony remained unabated for twenty-four hours or more, only to be relieved by morphia or other analgesic drug.

Ogilby(**2**) summarily dismisses the idea of the spines of the Bullrout being toxophorous, without sufficient justification, as my experience teaches me exactly to the contrary.

The symptoms are in no way confined to the mere pain and discomfort of an ordinary cut or scratch, or the irritation arising therefrom. There are very marked and distinct symptoms of the direct effect of venom.

The first of these to manifest itself is the rapid appearance of an erythematous blush, which spreads around the wound for some distance, in a manner not noticeable in ordinary incised wounds; the pain is out of all proportion to the very insignificant nature of the injury; it radiates in an altogether abnormal manner, compared with ordinary pricks or scratches, in many cases extending to the shoulder, or even up the side of the neck: the temperature varies greatly, in most cases going up two, three, or more degrees within a very short time: lasting thus for a varying time, and going down again as rapidly, often below the normal, when severe collapse occurs, necessitating the free administration of stimulants to counteract the heart-failure which threatens.

Cases treated as in the ordinary methods for snakebite —chiefly I have found permanganate the most efficacious – can be relieved considerably if taken in hand soon after the sting: but if the poison has had time to put in its fine work, so much the longer does the recovery take. Extreme prostration, for several days, often follows the stings, leaving the patient weak and exhausted.

These symptoms are not compatible with non-toxic wounds. They are undoubtedly venomous.

LITERATURE.

1. Tenison-Woods, Fish and Fisheries, N. S. Wales, 1882, p.48.
2. Ogilby, Ed. Fish. N. S. Wales, 1893, p.68; and Proc. Roy. Soc. Qsld., xviii., 1903, p.21.

CONTRIBUTIONS TO A KNOWLEDGE OF THE BIOLOGY OF THE RICHMOND RIVER.

By G. I. Playfair, Research Scholar of the University of Sydney in Hydrobiology and Plankton.

(Plates ii.-viii.)

The material which has given occasion for the following notes was obtained from the Richmond River and tributary creeks, principally in the neighbourhood of Lismore, during the spring and summer of 1912-13. Lismore lies on the North arm of the river at the head of the navigable portion, and my richest gatherings were made in the short stretch of river, almost undisturbed by traffic, between the bridge and the boatshed. Here, on either side, were to be found huge beds of weed, chiefly *Myriophyllum* and *Elodea*, many yards in extent, and reaching right up to the surface of the water. The river remained undisturbed by heavy rains from the end of September, 1912, to the beginning of February, 1913, and the current being very slow indeed, the surface of these weed-beds became increasingly rich in both plant and animal life. Upon two occasions gatherings were made with silk plankton-nets, but these proved disappointing, nothing being obtained but *Coscinodiscus lacustris* and a few other diatoms, and as the weed-beds themselves constituted a very efficient filter, it was determined to rely altogether upon them.

On the main river, a single sample was obtained at Casino, near the bridge, three mucous strata from the river-brink at Coraki, and a stripping from a small bunch of weeds in a tributary creek at Kyogle.

Samples.—Nos.1-3, 5, 6, 8, 11-13, 15-18, 20-22* are from squeezings of weeds, chiefly out of the river at Lismore, two or three out of tributary creeks. Nos. 7 and 9 are silk-net gatherings, also from the river at Lismore. No.14 out of weeds and *Hydrodictyon reticulatum* from the river at Casino. Nos. 24 and 33, mucilaginous gouts from an open drain in Keen Street, river-water. Nos.25 and 26, mucous strata on the footpath near the Commercial Hotel, caused by a leaky fire-hydrant, river-water. Nos. 27-29, 39 and 40, mucous strata from the river-brink at Coraki. Nos. 30 and 34, scrapings from the basin of the horse-trough near the Gov. Savings Bank, river-water. No.41 from weeds out of a tributary creek at Kyogle, running water. This last, a very small gathering, is remarkable for the number of forms contained in it, especially Desmids, which do not take kindly to running water.

Character of the Flora and Fauna.—The outstanding feature of the Richmond River flora is undoubtedly its richness in diatoms, of which it forms almost a synopsis of the district. Of 147 forms noted in the latter, from Kyogle to Bexhill, 132 occur in the river-system, belonging to 75 generally recognised species. It is not surprising, therefore, to find also a considerable number of the *Myxophyceæ*, as these two groups generally flourish together. Of seven species of the latter, the principal source was indeed on land, in situations (horse-trough, footwasher, fire-hydrant, or open drain) supplied by river-water, but of these seven, four were also noted in the river itself.

The following tables show the relative proportions of the constituents of the Flora and Fauna of the Richmond River, compared with those of the Nepean River (Sydney water), Yan Yean Reservoir, Melbourne, the Central African Lakes, and the Lochs of the West of Scotland, as far as they have been noted.†

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* For convenience, the local numbers 1-41 have been used in these notes; they correspond to Nos.176-216, inclusive, in the National Herbarium, Sydney, where the originals are deposited.

† Cf. These Proceedings, Vol. xxxvii., 1912; Journ. Linn. Soc. Bot., Vol. xxxix., 1909; *ibid.*, Vol. xxxviii., 1907; Trans. Roy. Irish Acad., Vol. xxxiii., 1906, respectively.

FLORA.

ALGÆ.	Richm.	Nepean.	Yan Yean.	Afr. L.	Scottish L.
Chlorophyceæ.........	57	60	25	43	31
Desmidiaceæ	57	112	61	19	102
Bacillarieæ............	134	48	19	58	38
Myxophyceæ	38	19	4	36	16
Phythelieæ............	...	16	...	2	...
ALGAL FUNGI.					
Chytridiaceæ	6		not noted.		
Schizomycetes	13				
	305	255	109	158	187

FAUNA.

Dinobryon	nil	3	3	nil	6
Peridinieæ	nil	13	1	5	12
Vermes	5	3			
Tardigrada............	1	nil			
Entomostraca.........	6	3	not noted.		
Rotatoria	14	14			
Infusoria	34	35			
Rhizopoda	33	13			
	93	84			

Plankton.—After my experience of the Nepean water, in which the *Phytheliece* and *Peridiniece* were so remarkably well represented, it was disappointing to find them both absent from the Richmond. This was the case with *Rhizosolenia* and *Dinobryon* also.

Desmidiaceæ.—The Desmid flora seems to me to be extraordinarily rich, in face of the decided preponderance of the *Diatomaceæ*, the number of forms being almost equal to that of the Yan Yean plankton with only 19 diatoms. Of the 57 forms noted, exactly half belong to the genus *Cosmarium* (29), and a little more than one-quarter to *Closterium* (15); *Gonatozygon* 1, *Docidium (Pleur.)* 2, *Penium* 2, *Micrasterias* 2, *Euastrum* 1, *Staurastrum* 5, make up the remainder. One is prepared for the absence of *Xanthidium*, the forms of that genus being principally swamp-dwellers, but considering that almost all the gatherings were shaken out of weeds, the extremely poor representation of *Staurastrum* is surprising. In the main gatherings only three species were noted, *St. retusum* Turn., *St. striolatum* Näg., and another; the other two, in an isolated sample from Kyogle, were *St. dilatatum* var. *obtusilobum* De Not., and another (unidentified). Of the long-rayed forms, not a trace was to be found, nor were there present any of the variations of *St. orbiculare*, so common in the Nepean water. *Euastrum* was also conspicuously absent, two specimens only (of *Eu. binale* f.) having been noted in a net-gathering.

Chlorophyceæ.—These total up well, but in the fresh gatherings they were very poorly represented indeed, both in species and in numbers. *Spirogyra maxima* was plentiful at Lismore, and *Hydrodictyon reticulatum* was found in great abundance, covering the surface of the river, at Casino, but the commonest forms of *Protococcoideæ* had to be diligently sought for. All the usual members of the *Chlorophyceæ* were represented, however, the same genera almost exactly as in the Sydney Water with the exception of *Nephrocytium*, *Oocystis*, *Eremosphæra*, *Botryococcus* and *Ineffigiata*. As these are found here in swamps and lagoons, their presence in the Nepean water would seem to indicate some infiltration from a similar source. All five, but especially the last two, get the credit of being plankton-algæ, but all my observations of their occurrence go to show that their home is in swamps and lagoons.

With regard to the Fauna, the *Peridinieæ* and *Dinobryon* have already been mentioned; there was a good array of *Rotatoria*; the *Rhizopoda* were plentiful and in fair variety. Of the *Infusoria*, the flagellates *Euglena*, *Phacus*, *Lepocinclis* and *Trachelomonas* were almost entirely wanting, *Mallomonas* and *Synura* altogether so. But then the swamps and lagoons of the district seem to be quite separate from the river-system.

The number of organisms noted in the Richmond River and creeks amounted to Flora 305, Fauna 93, total 398. Of these, 81 and 14 respectively are here described as, to a greater or less extent, new forms. They are allocated thus :—*Chlorophyceæ* 18, *Desmidiaceæ* 10, *Bacillarieæ* 32, *Myxophyceæ* 13, *Chytridiaceæ* 4, *Schizomycetes* 4, *Infusoria* 4, *Rhizopoda* 10.

CHLOROPHYCEÆ.

Genus Geminella Turpin.

Geminella interrupta var. cylindrica, n.var. (Pl. iii., f.31).

Cellulæ cylindraceæ adpressæ, ad genicula constrictæ; chloroplastidibus crassis parietalibus, totam cellulam complentibus, utroque polo macula minuta nigra.

Diam. cell. 6, alt. 6-10 μ.

Lismore (20*b*).

Genus Spirogyra Link.

Spirogyra maxima (Hassal) Wittr.

Lat. cell. veg. 108-130; cell. alt. 120-340; membr. crass. 1-4 μ.

Zygospora a fronte visa exacte circ., diam. 110-112; subcirc., long. 112-136, lat. 100-116; crass. 84-92 μ.

Lismore (12, 16, 20, 21).

Syn. *Sp. orbicularis* (Hass.) Kütz., in Petit, *Spirog.* de Paris, p.31, Pl. xii., f.1, 2. I have never found this species before, but it is the characteristic *Spirogyra* of the River at Lismore, being found in quantity almost anywhere. The breadth of the vegetative cells is generally 120 μ. The chloroplasts are six in number, making ½ to 1 turn each. The dimensions here given, unite the forma *tenuior* Magn. et Wille, in Wille, Sydamer. Algfl., p.34, with the type as recorded by Petit, l.c., p.31. It seems also very probable that the *Sp. setiformis* f. *minor*, zygotis lenticularibus Magn. et Wille, is a form of *Sp. maxima*, as Möbius (Austral. Süssw., ii., p.334) has recorded the latter from the Darling Downs, Queensland, at still lower dimensions. Petit gives the zygospores of *Sp. setiformis* as elliptic, not lenticular, and the cell-membrane of *Sp. maxima*, as observed by me, was just as often stratified as not. A few filaments (diam. 120 μ) were noted with extremely long cells, yet in perfect condition. The cells varied in length from 1026 to 1035 μ, and contained six chloroplasts making three complete turns each (20).

SPIROGYRA LISMORENSIS mihi. (Pl. iii , f.1).

Diam. cell. veg. 14; cell. alt. 80-300 μ.

Lismore (12).

Cells very long for the diameter, containing a single broad chloroplast, not wound spirally, but twisted round its long axis; pyrenoids in a single row down the centre; chloroplast making 5 to 15 turns, edge somewhat laciniate; ends of the cells reflexed 2 μ. I have given this curious and interesting form a name, but I do not consider it a distinct species. It is highly probable that each chloroplast splits longitudinally into two which become spirally disposed. Some were already divided at the ends, and there were other *Spirogyra* filaments with two tæniæ in the same gathering. The latter (diam. 18 μ, cell. alt. ca. 160 μ) might be *Sp. inflata* (Vauch.) Rab., but with both forms infertile, there could be no certainty about either. Cf. *Spir. Goetzei* Schm., Ergeb. d. Nyassasee, p.251, Pl. iv., f.8.

DESMIDIACEÆ.

Genus GONATOZYGON DeBary.

GONATOZYGON KINAHANI (Arch.) Rab., f. (Pl. iii., f.32).

Forma apicibus extremis quam levissime angustatis.

Long. 288-470, lat. 13-14, ap. 12-13 μ.

Lismore (18).

The apices, which are generally somewhat inflated, are in this form just a little narrower, no membranous tag at the angles.

Genus PENIUM Bréb.

PENIUM AUSTRALE, forma CRASSIOR G. S. West.

Zygospora matura globosa, levita angulata, spinis brevibus e tumoribus orientibus ad angulos munita, spinis maturis bifidis. Membrana crassa.

Long. 66-90, lat. 48-54. Zygo. diam. s. sp. 65; spin. long. ad 14 μ; membr. 4 μ.

Lismore (12), Casino (14).

Cf. G. S. West, Third Tanganyika Exp., p.108, Pl.6, f.4. The diameter of the type is 38 μ. The endochrome is arranged in two main radiating chloroplasts each containing a pyrenoid, but besides these there are 10-15 very narrow radiating laminæ without pyrenoids. A specimen was noted with the central pyrenoid divided into three. (Pl. iii., f.2).

PENIUM GLOBOSUM var. WOLLEI (W. & G. S. West) mihi, f. *maxima*.

Long. 70, lat. 54 μ.

Lismore (12). Cum priori. (Pl. iii., f.3).

Cf. *Cos. globosum* var. *Wollei* f. *major* G. S. West, l.c., p.118, Pl.7, f.10, with which it is practically identical, but half as large again. The naming of this form affords an example of the difficulties arising from the present system of nomenclature, and the absolute impossibility of making the latter the expression of observed biological facts. When any *Penium* of the *Dysphinctium* type undergoes rapidly repeated mitosis, the nascent semicells have (in the short interval between one cell-division and another) no time to attain their full proportions; the resulting *Penium*-cells tend, therefore, more and more to become globose in shape, the diameter remaining practically unchanged. *Cos. globosum* Buln., is such a form, probably (diam. 22-25 μ, Monog., iii., p.27) the shortened form of *Pen. polymorphum* (diam. 21-28 μ, Monog., i., p.91) or some other *Penium*. *Cos. globosum* var. *Wollei* f. *major* G. S. West, (diam. 37-39 μ) l.c., is certainly a diminished *Pen. australe* (diam. 36-38 μ) type, just as my f. *maxima* (*supra*) is of *P. australe* f. *crassior* G.S.W. I find it so in this gathering (12), and if the notes by G. S. West, l c., p.118, on *Cos. globosum* be compared with those, p.108, on *P. australe*, it will be seen that, in the case of Victoria Nyanza at least, the specimens of both were found in the same gatherings:—Bukoba (20 Apr., 1905; No.251 and No.618). *Cos. globosum* is not *really* a species at all, but merely a mixture of degenerate forms of various "species" of *Penium*, brought together under one name on account of a similarity of shape. But it would be unreasonable to make such a distinct form as *P. australe* a variation of *Cos. globosum* (which has priority) although they are biologically connected. There is nothing left, therefore, but to accept *Cos. globosum* as a species, well knowing it to be a mass of contradic tions. I have ventured, however, to move it to the genus *Penium*, as the arrangement of the chloroplasts is not at all that of *Cosmarium* (*sensu stricto*).

Genus CLOSTERIUM Nitzsch.

Four forms of *Closterium* rather common in the river at Lismore are *Cl. Ehrenbergii*, *Cl. Leibleinii*, *Cl. moniliferum* and *Cl incurvum*. I consider these are forms of the same species, the difference being a mere matter of development. The zygospores also of *Cl. Ehrenbergii* and *Cl. moniliferum* are identical, Monog., i., pp.143, 144, Pl.17, f.4. The last three were found together at Kyogle also.

CLOSTERIUM ACEROSUM (Schrank) Ehr.

Long. 460-655, lat. 42-50, ap. 6 μ.

Lismore (3, 16, 19), Casino (14).

Fairly plentiful; the membrane pale pink, smooth or very finely and faintly striate, 10-12 ridged chloroplasts, 11-20 pyrenoids in semicell. The edges of the chloroplasts are sometimes scalloped towards the apices of the cell.

Var. LANCEOLATUM (Kütz.) mihi. (*Cl. lanceolatum*).

Long. 300-310, lat. 48, ap. 6 μ.

Lismore (22).

Cl. lanceolatum is only a short form of *Cl. acerosum*.

Var. ANGOLENSE W. & G. S. West, f. (Pl iii., f.4).

Forma semicellulis infra apices ut in *Cl. turgido* incrassatis; polis levissime recurvatis; apicibus extremis ut in *Cl. aceroso* truncatis. Membranâ hyalinâ (apicibus extremis exceptis) vel dilute rufescente. Interdum ad suturam zona intercalata (lat. 6 μ).

Long. 840, lat. 40. ap. 6 μ.

Casino (14). Cum priori et sequenti.

Cf. W. & G. S. West., Monog., i., p.149, Pl.18, f.6. This form combines in itself the characteristics of four "species." It has the extreme tip of *Cl. acerosum*, the size and shape of *Cl. acerosum* var. *Angolense*, the recurved ends and slight curvature of *Cl. Pritchardianum*, and the subapical incrassate zone of *Cl. turgidum*.

Var. CASINOENSIS, n.var. (Pl. iii., f.5).

Forma semicellulis sciagraphiâ *Cl. aceroso* consimilis ad polos non recurvatis, infra apices seriebus singulis nodulorum incrassatorum circ. 10 ornatis. Membranâ dilute rufescente, dense scrobiculata, utrinque ad nodulos longitudinaliter striata; interdum membranâ glabrâ vel subtilissime striatâ.

Long. 560-640, lat. 44-50, ap. 6 μ.

Casino (14).

This is almost the exact shape and size of *Cl. turgidum* f. *glabra* Gutw., Nonn. Alg. Nov., p.5, T.v., f.10. The scrobiculæ are on the inner side of the membrane, which is striate just for a short distance above and below the incrassations. The striæ run alternately through and between the incrassations.

Other forms of *Closterium* noted were *Cl. acutum* and var. *linea*, *Cl. gracile*, *Cl. cornu*. The plankton-forms, *Cl. gracile* var. *elongatum* W. & G. S. West, and *Cl. acutum* var. *subpronum* (W. & G. S. West), which might have been expected, and are not uncommon round Sydney, were not observed. The current of the river, however, is very sluggish.

Genus COSMARIUM Corda.

COSMARIUM ANGULATUM f. MAJOR Grun.

Long. 70-82, lat. 44-48, ap. 20, isth. 15-16, crass. 30 μ.

Lismore (12), Casino (14). (Pl. iii., f.6).

Syn. *Cos. Bengalense* Turner, Alg. E. Ind., T.8, f.33, and T.9, f.33. A very rare desmid this, only twice noted before, viz., from Banka I. and Bengal. Cf. Grunow, Insel Banka, T.ii., f.24, (whose figure works out at 63 × 40 μ) and Turner, l.c., p.56, T.8, f.35, and T.9, f.25. Our specimens are not so retuse in the sides as in Grunow's figure. Membrane smooth but sometimes faintly and closely pustulate, and there were no signs whatever of the inflations indicated by Grunow. When the chloroplasts are in good condition, their surface is divided into minute digitate fibrillæ, as noted by Turner, l.c., and Wallich. They are most noticeable at the isthmus. My opinion of this desmid is that it is a *forma maxima* of *Cos. Meneghinii.*

Var. CONICUM, n.var. (Pl. iii., f.7*a*).

Forma brevior, lateribus planis nec retusis, superne etiam quam levissime convexis.

Long. *semicell.* 34, lat. 44, ap. 16, isth. 14 μ.

Lismore(12). Cum priori.

Var. SUBCUCUMIS (Schm.) mihi. (Pl. iii., f.8).

Long. 70, lat. 46, isth. 14 μ.

Lismore (12). Cum prioribus duabus.

Syn. *Cos. subcucumis* Schmidle, Schwarz. u. Rheineb., p.98, T.4, f.20-22; W. & G. S. West, Monog., ii., p.155, Pl.70, f.1-3. *Cos. subcucumis* is the result of a double division in *Cos. angulatum* f. *major*, as the figures plainly show. The specimens were all in the same drop. Var. *subcucumis* is reniform, suborbicular or approaching to conical according to growth. Dimensions of the mixed forms :—

1. *Cos. ang.*(a):—long. semi. 40, lat. 46, ap. 16, isth. 14 μ.
   Var. *subc.*(b):—long. semi 34, lat. 44 μ. (Pl. iii., f.9).
2. *Cos. ang.* v. *conic.*(a):—long. semi. 34, lat. 44, ap. 16, isth. 14 μ.
   Cos ang. v. *subcuc.*(b):—long. semi. 28, lat. 40 μ. (Pl. iii., f.7).

The size of var. *subcucumis* (2b, *supra*) agrees with the smallest dimensions (54 × 44) given by Schmidle. Pl.70, f.4, of the Monograph shows a semicell approximating in outline to *Cos. angulatum* var. *conicum*.

COS. SUBCOSTATUM var. BECKII (Gutw.) W. & G. S. West.

Long. 34, lat. 28, ap. 12, isth. 8 μ.

Lismore (12). Plentiful. (Pl. iii., f.10).

The apex was 4-granulate, but the inner two granules were geminate. None of the Casino forms of this group were noted in the Lismore branch of the river.

Var. AUSTRALE, n.var. (Pl. iii., f.11).

Formæ *minori* proximum, granulis autem medianis nullis. Semicellulæ semicirculares, apicibus angustis 4-granulatis, lateribus e basi rectis, superne valde rotundatis, crenis bigranulatis 2, crenis simplicibus basalibus 3.

Long. 26, lat. 22, ap. 10, isth. 6 μ.

Casino (14).

Shows its intimate connection with *Cos. Blyttii* in the characteristic absence of the tumour.

Cos. Blyttii var. Richmondiæ, n.var. (Pl. iii., f. 12).

Forma var. *Novæ-Sylviæ* proxima, paullo autem major, apicibus angustioribus. Semicellulæ lateribus e basi divergentibus, angulis basalibus haud rectis. Apicibus 4-granulatis; lateribus crenis bigranulatis 2, crenis simplicibus basalibus 2; supra isthmum tumore nullo nec granulis.

Long. 24, lat. 20, ap. 7, bas. 16, isth. 6 μ.

Casino (14). Cum priori.

This form is intermediate between *Cos. Blyttii* and *Cos. subcostatum* f. *minor*. It follows the Australian form of the type in having no papilla or granules above the isthmus. There is an odd granule below the depression on either side of the apex.

Var. Casinoense, n.var. (Pl. iii., f.13).

In ambitu formæ typicæ similis, sed major. Semicellulæ lateribus crenis bigranulatis singulis, crenis simplicibus basalibus 2; supra isthmum tumore plus minus circulari, 8 + 1 granulis seriebus verticalibus 3 ordinatis, ornatæ. A vertice ellipticæ, polis late rotundatis, medio utrinque tumore 3-granulato instructæ.

Long. 24-26, lat. 20-22, ap. 10, isth. 6 μ.

Casino (14). Cum prioribus duobus.

Combines the form and marginal granulation of *Cos. Blyttii* with the tumour of *Cos. subprotumidum*.

Cos. Seeleyanum var. elegans, n.var. (Pl. iii., f.14-16).

Semicellulæ tumoribus granulis 9 in seriebus verticalibus 3 ordinatis; lobulis subapicalibus a tumore radiantibus. A vertice ellipticæ, utroque latere, in medio, tumore 3-granulato (lat. 5 μ) ornatæ, utrinque ad tumorem excavatæ.

Long. 24-26, lat. 20-22, ap. 12-13, isth. 6, crass. 13-14 μ.

Casino (14). Cum prioribus tribus.

Since Wolle described it from New York, this rare desmid has only once before been reported, by Möbius from Victoria Park, Brisbane. The apex is 4-granulate, but the two inner granules show a tendency to become geminate. These four were all found together in one gathering (14), and are all intimately connected biologically. Several mixed forms were seen.

Cos. MAGNIFICUM var. ITALICUM Rac.

Long. 118, lat. 96, ap. 30, isth. 78, crass. 60 μ.

Lismore (12).

In this form, there are no decided granules or scrobiculæ in the central portion of the semicells, granules only at the edge and for a short distance inside. It is an intermediate form between the type and *Cos. Askenasyi*, which is the smooth form of *Cos. magnificum*. The fact that this desmid, one of the largest of the genus *Cosmarium*, was reported from Italy by Raciborski, and from Sweden by Borge, after having been originally described from New Zealand by Nordstedt, is not only interesting, but it throws a strong sidelight on the question of the meaning of the word species in the *Desmidiaceæ*.

Var. FLUVIATILE, n.var. (Pl. iii., f.17),

Semicellulæ truncato-conicæ ; lateribus deplanatis ; apicibus truncatis; angulis basalibus late-rotundatis; verrucis quadratis totam marginem complentibus, juxta suturam dente singulo utrinque munitæ. Supra isthmum tumore nullo nec scrobiculis, verrucis regulariter decussatim dispositis.

Long. 132, lat. 94, ap. ca. 30, bas. 74, isth. 36 μ.

Lismore (11). Cum formâ typicâ.

Cf. Nordstedt, Frw. Alg. N.Z., p.62, Pl.6, f.19. *Cos. magnificum*, in common with most of Nordstedt's New Zealand types, is found generally distributed in New South Wales. The short spine at the basal angle seems to indicate that the verrucæ may be interchangeable with spines. Cf. *Cos. subbalteum* Schm., Ost-Afrika ges. Desm., p.25, T.ii., f.29, which is also a form of *Cos. magnificum*.

COSMARIUM DENTIFERUM Corda. (Pl. iii., f.18).

Long. 106, lat. 114, isth. 30 μ.

Lismore (18). Cf. W. & G. S. West, Monog., iii., Pl.78, f.18.

Var SUBLATUM (Nord.). (Pl. iii., f.22).

Long. 110, lat. 110, isth. 28, bas. 94 μ.

Lismore (18). Cf. Nordstedt, Frw. Alg. N.Z., Pl. v., f.3.

Var. PORRECTUM (Nord.). (Pl. iii., f.19, 20).

Long. max. 68-72, centr. 64-70, lat. 70-74, bas. 54-60, isth. 20, crass. 30 μ.

Lismore (12). Cf. Nord., Desm. C. Braz., T.3, f.28.

MIXED FORM. (Pl. iii., f.21).

a. Var. *porrectum* (Nord.).

Long. *semic.* 36, lat 74, isth. 18, bas. 56 μ.

b. Var. *quadrum* (Lund).

Long. *semic.* 36, lat. 64, bas. 56, crass. 36 μ.

Lismore (17).

The above are, undoubtedly, all forms of one species Those in samples 17, 18, were gathered from the same place on the same day; those in 12, from the same position two months earlier. They all have the same characteristic end-view, oblong almost cylindrical, with parallel sides and broadly rounded ends. The arrangement of the granules is the same also, viz., in vertical and decussating series. It should be noted that the forms of *Cos. porrectum*, in figs.20 and 21*a*, are really intermediate between *Cos. porrectum* Nord., type, and *Cos. sublatum* Nord. The forms of *Cos. dentiferum* may nearly always be recognised by the large, quadrate, smooth space at the isthmus, caused by the tendency in the semicells to be reniform, above and below which are generally five granules forming an angle. Besides those mentioned here, other desmids included in this species are :—*Cos. reniforme* Ralfs, and *β compressum* Nord., the latter widespread in this country, *Cos. orthopleurum* R.&B., *Cos. margaritatum* (Lund), *Cos. pardalis* Cohn, *Cos. lacunatum* G. S. West, and *Cos. pseudobroomei* Wolle.

PROTOCOCCOIDEÆ.

Genus CHLAMYDOMONAS Ehr.

CHLAMYDOMONAS INTERMEDIA Chodat.

Long. 17, lat. 10 μ.

Lismore (13).

Four in a mucous cœnobium, stirring but not yet motile, the contractile vesicle, however, could be seen working Chodat gives "long. 18-20 μ, cellules oblongues." *Ch. intermedia* is the prevailing form of the genus in this country. In small two-celled cœnobia, the cells are always disposed head to tail. If by nothing else, immature forms can generally be recognised by the presence of a minute clear spot at one extreme end.

CHLAMYDOMONAS GLOBULOSA Perty. (Pl. ii., f.1),

Diam. cell. 14-16, cell. matric. 26, aplanop. 12 μ.

Lismore (21).

Chl. globulosa (rare) and *Chl. Steinii* Gorosh.,(very rare) are the only other species that I have met with in New South Wales. *Chlamydomonas* could only be said to just occur in the river; it is noteworthy that neither *Gleocystis vesiculosa* nor *Sphærocystis Schröteri* were present. I consider them to be its vegetative stages.

The gathering (14) from Casino having been kept for some months, two minute *Chlamydomonas* forms developed in some quantity. They were non-motile when observed, without flagella or stigma, but in the larger (12 × 7) a contractile vesicle was working. They denote, I fancy, the presence of *Chl. intermedia*. (Pl. ii., f.14, 15).

Genus VOLVOX (L.) Ehr.

VOLVOX AUREUS Ehr. (Pl. ii., f.2-4).

Cœn. matric. diam. 300, membr. crass. 3; cell. diam. 8; parthenog.(8) diam. 45-50 μ.

Lismore (20). Rare.

The cells were globose, the connecting strands quite plain, generally single, but sometimes geminate.

VOLVOX BERNARDII mihi. (Pl. ii., f.5-11).

Forma *V. aureo* similis, nullis autem filis cellulis conjungentibus. Cœnobii membrana plerumque crassa.

Cœn. matric. diam. 290-300, membr. crass. 3-6; cellulis pyriformibus vel globosis (ambitu circa 28) diam. 4-8, inter se distantibus 20-30. Cœnob. filial. (8-12) diam. 60-96, cell. diam. 2-4, inter se distant. 1 diam., parthenogonidiis (8-12) diam. 12-40 μ.

Many young specimens were noted, evidently not long freed from the mother cœnobium; their specifications were :—

Cœnob. diam. 74-96, membr. crass. 2-5, cell. (in ambitu circ. 16-28) diam. 4-6, inter se distant. 2-20, parthenogonidiis (8-12) diam. 16-42 μ.

Lismore (12, 16, 17). Common.

This is the *Volvox* recorded by Bernard, Desm. et Protococc., p.165, as *V. aureus* Ehr. In all the specimens noted, I looked very carefully for the connecting filaments, but without result. Bernard also remarks, l.c., p.166 :—"Je dois dire que, malgré toutes mes recherches, malgré l'emploi des grossissements les plus puissants et de réactifs variés, je n'ai pu arriver à les mettre en évidence . . . . il n'y avait pas le moindre trait plus fortement coloré réunissant les cellules les unes aux autres, ni la moindre trace quelconque pouvant faire croire à la presence de communitions plasmiques." There are so few points in which one species of *Volvox* can differ from another that the absence of these connective filaments seems to me a decided specific character.

A specimen was noted, in material that had been some time in a bottle, with all the cells of one hemisphere developed into oogonia. Cf. Overton, Gatt. Volvox, Pl. iv., f.28.

Cœnob. diam 210, membr. crass. 6; cell. (in ambitu circ. 14) diam. 7-8, oogoniis diam. 15-18 μ. (Pl. ii., f.10, 11).

Genus Eudorina Ehr.

Eudorina elegans Ehr.

Chloroplasts granular, cells diam. 6, 10, 12, 16, 18, 22 μ.

Lismore (12, 18).

A family of 16 cœnobia noted, cœnobia 16-celled. Family diam. 90, cœnob. 25, cells 5-6 μ.

Var. Wallichii Turner.

Chloroplasts very pale green, translucent, with a single large pyrenoid. Cœnob. diam. 60, cell. 10 μ.

Lismore (12).

Cf. Turner, Alg. E. Ind., p.155, T.xxi., f.10; Chodat, Alg. Vertes, p.151, f.76A, B. A fine family of 16 cœnobia seen, each 32-celled. Family diam. 350, cœnob. 60, cell. 10 μ.

Var. RICHMONDIÆ, n.var. (Pl. ii., f.12).

Chloroplasts bright translucent green, 2-4 large pyrenoids, generally 4 at the angles of a tetraëdron.

Cœnob. (16 cell) diam. 130, cell. 16-18 μ.

Lismore (12).

As Wallich remarks (in Turner, l.c.) about the preceding form, the cells (from a certain point of view at any rate) are so arranged in alternating superimposed squares, that the whole sixteen can be seen at one time. *Pandorina morum* present also.

UVA, n.gen.

Character idem ac speciei.

UVA CASINOENSIS, sp.unica. (Pl. ii., f.13).

Cœnobium uviforme, ovatum, fronte latius, e cellulis muco agglutinatis non autem involutis, exstructum; cellulis circa 16 (?8, 16, 32) magnis, ovatis, declinatis; flagellis longis (? binis); chloroplastidibus clare viridibus, granulosis, pyrenoidibus nullis (visis); stigmatibus obscuris.

Cœnob. long. 28-40, lat. 22-.. ; cell. long. 10-14, lat. 6-10 μ.

Casino (14). Plentiful.

This interesting flagellate was obtained from the river at Casino, out of *Hydrodictyon reticulatum*. The cells in the smaller specimens are distinctly ovate, with the narrower ends pointing backwards; but, with growth, they tend to become more nearly elliptical. I was not able to see whether the flagella are double or single; they are very long, quite equal to the breadth of the cœnobium, and seem to arise, not as one would suppose, from the point, but from the broad end of the cell. The organism moves straight forward, broad end first, with the greatest rapidity, revolving at the same time round its long axis, very different from the leisurely progression of *Eudorina* and *Pandorina*.

For genus *Trochisia*, see under *Chytridiaceæ*, *infra*.

Genus HYDRODICTYON Roth.

HYDRODICTYON RETICULATUM (L.) Lag.

Cellulæ perfecte cylindraceæ, endochromâ in reticulo irregulari dispositâ, pyrenoidibus minutis dispersis.

Cell. long. 200-300, lat. 36-44 μ.

Var. MINIMUM, n.var. (Pl. iii., f.23).

Cellulæ minimæ cylindraceæ, endochromâ in laminâ tenui parietali dispositâ, pyrenoidibus singulis minutis.

Cell. long. 22, lat. 7 μ.

Casino(14).

The chloroplast, when in good condition, extends the whole length of the cell, but very often is reduced to a band in the centre, as in *Myxonema*. Eichler, Okolic Miedzyrzeca, 1892, T.ix, f. 6, records a size larger than this (cells 46 × 12), but with the reticulate chloroplasts of the type.

Var. NODOSUM, n.var. (Pl. iii., f.24).

Forma in extremis cellulis leviter inflata, endochromâ reticulatâ.

Cell. long. 100-300, lat. 20-54 μ.

Casino(14).

In many instances, I noted a tendency for the pyrenoids to run in long spirals across the cells.

Var. BERNARDII, n.var. (Pl. iii., f.25).

Forma cellulis maximis, in extremis inflatis, membranâ crassâ, endochromâ dilute luteolo-viridi in granulis minutis diffusâ, pyrenoidibus majoribus granulatis.

Cell. long. 1020; lat. centr. 103, extr. 140, membr. ad 10 μ.

Casino(14).

Cf. Bernard, Desm. et Protococc., Pl. xv., f. 536, 537. All the above forms were found together in the same gathering. Bernard, l.c., records them also from Java. They are, of course, all stages of growth, but are quite distinct enough to be worth naming. It seems to me also that this plant, which I meet now for the first time, raises questions which have a decided bearing on our ideas regarding the growth of the freshwater algæ generally. Here is a plant whose cells can develop from 22 × 7 to 1020 × 140 μ (Bernard gives 25 × 8 to 2000 × 220 μ), while at the same time the endochrome twice entirely changes its disposition. Judged by this standard, all the forms of *Myxonema* or *Ulothrix* resolve themselves easily into one species. If the *Hydrodictyon* cell and its chloroplasts grow and develop, why not *Closterium* or *Gyrosigma?*

A cell that is free, has far greater opportunities for growth than one which forms part of a filament.

Genus PEDIASTRUM Meyen.

PEDIASTRUM TETRAS var. INTEGRUM (Näg.). (Pl. iii., f.26).

Cœnob. long. 26, lat. 20; cell. viv. lat. 12, alt. 10 μ.
Lismore(13).

In company with minute forms of *P. tetras*. This specimen was, originally, evidently a cœnobium of *P. tetras* of the 7 + 1 type. The central cell and four of the peripheral cells have died, but the outer ones still retain the size and shape of the cells of *P. tetras*. The three living cells plainly belong to *P. integrum* Näg. It is evident, therefore, that the cells of a cœnobium are in a state of growth, and that the peripheral cells develop from one form to another.

PEDIASTRUM BORYANUM var. CAPITATUM, n.var. (Pl. iii., f.27).

Cellulæ exteriores ad cornua extrema globulis singulis instructæ.

Cell. diam. 32; alt. centr. 20, c. corn. 36; diam. corn ap. 3, globul. 7-8 μ.
Lismore(15).

Genus KIRCHNERIELLA Schm.

KIRCHNERIELLA LUNARIS (Kirchn.) Möbius.

Cell. diam. 7, crass. 2 μ.

Var. APPROXIMATA, n.var. (Pl. iii., f.28).

Cellulæ crassæ; apicibus acutis approximatis, lateribus interioribus parallelis.

Fam. (8 cœnob., 8 cell.) diam. 80; cœnob. 25, cell. long. 11, lat. 10, crass. 5 μ.
Lismore(11).

Var. APERTA (Teiling). (Pl. iii., f.29).

Cellulæ crassæ; apicibus acuminatis non autem acutis, lateribus interioribus planis, divergentibus.

Cœnob. (cell. 8) diam. 40; cell. diam. 10, crass. 5 μ.

Lismore(11). Cum priori.

Syn. *Kirchn. aperta* Einar Teiling, Svenska Bot. Tidskr., 1912, p. 276. This form is somewhat like *Selenoderma Malmeana* Bohlin, Ersten Regnellschen Exp., i., p. 21, T.i., f. 31-35. I doubt very much whether there is any difference between the two genera. Cf. also *Sorastrum bidentatum* Reinsch, De Spec. generibusque, T. i., f.D iv. *K. lunaris* var. *contorta* (Schm.), Pl. iii., f 30, and var. *gracillima* (Bohlin) also noted.

BACILLARIEÆ.

Genus Amphora Ehr.

Amphora coffæiformis Ag. (Pl. iv., f.1).

Long. 27; lat. valv. 7; crass. frust. 12, ap. 6 μ.

Lismore(5,13).

Syn. *A. salina* W. Sm. Striæ very fine and faint, hardly discernible.

Amphora veneta var. grossestriata, n.var. (Pl. iv., f.2, 3).

Striæ crassæ 6-7 in 10 μ.

Long. 32-75; lat. valv. 11-16, ap. 3-4; crass. frust. 12-16, ap. 6-8 μ.

Lismore(12, 13, 17, 20, 21, 22); Kyogle (41).

For the type, Cleve, Syn., ii., p. 118, gives long. 20-60, lat. 11-18, striæ 20 in 10 μ. In the river, this form was in company with *Cocconema tumidum,* and it was noticeable that the striæ on both were equal in number and of similar character.

Genus Cocconema Ehr.

Cocconema tumidum Bréb. (Pl. iv., f.4).

Long. 70-90; lat. valv. 20-22, ap. 8-10 μ Striæ 6 in 10 μ.

Lismore(1, 2, 6, 8, 11, 12, 15, 18, 20). Casino(14). Kyogle (41, 45).

Very common in the river. The boat-shaped frustule, rostrate-truncate ends, and especially the diamond-shaped area round the central nodule, define this form.

COCCONEMA ASPERUM Ehr.

Long. 105-200; lat. valv. 24-44, ap. 10-14 μ. Striæ 5 in 10 μ.

Lismore (2, 11). Kyogle (41, 45).

Syn. *Cocc. gastroides* Kutz.; Cf. Heribaud, Auvergne, Pl. iii., f. 10; Cleve, Syn. Rare in Lismore gatherings, common in those from Kyogle. Striæ easily resolved, punctate.

Genus NAVICULA Bory.

NAVICULA MUTICA Kutz. (Pl. iv., f. 5, 6).

Valvæ ellipticæ vel elliptico-lanceolatæ.

Long. 16-28; lat. valv. 8-11; crass. frust. 8 μ.

Kutzing's figure, Bac., Pl. 3, f. 32, does not show a pseudostauros, which in our specimens is nearly always present. When absent, in all forms the central nodule is accentuated.

Var. RHOMBOIDEA, n. var. (Pl. iv., f. 7).

Valvæ rhomboideo-lanceolatæ, in medio modice angulatæ, ad apices rapide attenuatæ, lateribus planis vel levissime retusis, apicibus acute rotundatis.

Long. 30-36; lat. 11-12, apic. 3-4; crass. frust. 6-11 μ.

Three forms of this variation were noted:—(1) with strongly accentuated central nodule and no pseudostauros; (2) with a pseudostauros; (3) with pseudostauros and divided columella. In girdle-view the sides are often considerably convex.

Var. OVALIS, n. var. (Pl. iv., f. 8).

Valvæ late ellipticæ, apicibus late-rotundatis.

Long. 22; lat. valv. 10 μ. Rarissime.

Var. SUBHEXAGONA, n. var. (Pl. iv., f. 9).

Valvæ subhexagonæ polos versus cuneatæ; apicibus interdum minute rostratis, lateribus in medio planis, parallelis, apices versus rapide convergentibus.

Long. 18-20; lat. valv. 8-9; crass. frust. 8 μ.

Observed also with a divided columella.

Var. SUBCIRCULARIS, n. var. (Pl. iv., f. 10-12).

Valvæ latissime ellipticæ pæne circulares, apicibus levissime acuminatis.

Long. 12-17; lat. valv. 10-12, crass. frust. 5 μ.

Noted with and without a pseudostauros, also with a narrow obscure fusiform transverse fascia.

Var. GOEPPERTIANA (Bleisch). (Pl. iv., f. 13.)

Valvæ ellipticæ, acuminatæ, interdum minute rostratæ; lateribus regulariter arcuatis.

Long. 24-36, lat. valv. 8-11, ap. 3, crass. frust. 4 μ.

Lismore, all seven forms (1); all except var. *ovalis* and var. *subcircularis* (6); var. *subhexagona* (1, 6, 13); var. *Goeppertiana* (1, 6, 13, 31); var. *subcircularis* (1, 3, 5); var. *ovalis* (1).

All the seven are undoubtedly variations of the same species; they occur together in sample No. 1 (shaken out of weeds from one spot), and have all the same appearance under the microscope. They are finely striate, but appear quite smooth and pellucid under ordinary magnifications. It is impossible, I think, to consider the series of forms without admitting that the diatom-valve changes with growth from one outline to another, one variation developing naturally into another. Cleve, Syn. i., p. 143, 1894, gives several forms with undulate margins, but I have not noted any of these. The girdle-view in var. *subcircularis* is exactly that of *Staur. polymorpha* Lagerstedt, Spetzbergen, Pl. i., f. 12b. (= *Nav. rustica* forma *Cohnii* Hilse, sec. Cleve, l.c.).

Genus DIPLONEIS Ehr.

DIPLONEIS BOLDTIANA var. AUSTRALICA, n. var. (Pl. iv., f. 14-15.)

Valvæ ellipticæ, lateribus haud deplanatis. Striæ 11 in 10 μ.

Long. 35-36; lat. valv. 16-17, crass. frust. 11 μ.

Lismore (2, 11, 13).

Var. OVALIS, n. var. (Pl. iv., f. 16.)

Valvæ late-ellipticæ, ovales. Striæ 10 in 10 μ.

Long. 20-30; lat. valv. 14, crass. frust. 11 μ.

Lismore (2, 11, 13).

Var. ACUMINATA, n. var. (Pl. iv., f. 17.)

Valvæ ellipticæ, apicibus acuminatis, lateribus arcuatis.

Long. 15-26, lat. valv. 11-15, crass. frust. 10 μ. Striæ 11 in 10 μ.

Lismore(1, 6, 11). Kyogle(41).

The central nodule in all these forms is quadrate, diam. 2 or 4 μ.

The longitudinal furrow, 2-4 μ broad, seems (from broken specimens) to be a *lacuna* in the membrane.

Genus VANHEURCKIA Bréb.

VANHEURCKIA RHOMBOIDES var. NEGLECTA (Thw.) f. MINOR, n.f.

Forma dimidio brevior; valvæ lineares-ellipticæ, apicibus rotundatis; areâ centrali indivisâ.

Long. 27-40; lat. valv. 7-8 μ.

Lismore (2, 3, 6, 20). Kyogle (45).

The larger form (*Schizonema neglecta* Thwaites; *Nav. gracilis* var. *neglecta* (Thw.), W. & G. S. West; *Nav. gracilis* var. *schizonemoides* V.H.) measures 50-90 × 8 μ.

VANHEURCKIA CUSPIDATA var. DANAICA (Grun.).

Long. 73-80; lat. valv. 18 μ. Columella broad, undivided.

Lismore(3).

Navicula cuspidata and its forms should be arranged under *Vanheurckia*; there is no real difference between forms with divided and those with undivided central area.

Var. AMBIGUA (Ehr.).

Long. 70-75; lat. valv. 22, ap. 6 μ. Apicibus sæpe levissime capitatis.

Lismore(5). Casino(14). Kyogle(41).

Syn. *Nav. ambigua* Ehr. in Donkin, Br. Diat., Pl.6, f.5. *Nav. cuspidata* var. *ambigua* (Ehr.) Cleve. Specimens were noted with a single broad columella (with incipient median line, however, above and below the central nodule) and also with a double one. The median line (? true raphe or merely a furrow) in these *Vanheurckia* forms develops generally from the centre outwards. Beginning as a minute foramen on either side of the central nodule (and defining it), it gradually extends outwards to the terminal nodules, thus forming a double columella. Cf. *Vanh.* (*Frustulia*) *leptocephala* Oestrup, Oest-Grönland, T. i., f.1.

Var. KYOGLENSIS, n.var.

Forma maxima; valvæ lanceolatæ, apicibus obtusis minime protractis, quam levissime rostratis; areâ centrali (columellâ) longitudinaliter divisâ; membranâ grosse longitudinaliter striatâ, striis 7-8 in 10 μ.

Long. 180-200; lat. valv. 44-50, ap. 8-10 μ.

Kyogle(41).

Except for the longitudinal striæ, this form is identical with *Vanheurckia africana* G. S. West, Journ. Bot., 1909, p.246, Pl. 498, fig.18.

Geuus AMPHIPRORA Ehr

AMPHIPRORA ALATA var. HOLDERERII (Gutw.) mihi. (Pl.iv., f.18).

Long. 52 μ. Alæ valde sinuatæ.

Lismore(1, 2).

This form is only known besides from the Desert of Gobi, Central Asia. Gutwinski (Alg. in Asia coll., p.212, Pl. ix., f.7) makes it a variation of *A. paludosa*, but from the figures in Van Heurck (Diat., Pl.5) it seems much nearer *A. alata*. It is almost certain, however, that all these forms of *Amphiprora* are variations of one species.

Genus GOMPHONEMA Ag.

GOMPHONEMA AUGUR var. ROTUNDATUM (Ehr.) mihi.

Valvæ clavatæ, superne late-rotundatæ, apiculo minuto interdum instructæ; lateribus superne arcuatis, inferne rapide convergentibus, plus minus planis; apicibus inferioribus acute-rotundatis. Striæ 2-3 utrinque ad centralem nodulum plerumque alteris validiores.

Long. 30-54; lat. valv. 12-16, ap. 2-3 μ; striæ 7 in 10 μ.

Lismore (cum sequenti). (Pl. iv., f.19, 20).

Var. ANGULATUM. (Pl. iv., f.21, 22).

Valvæ juxta nodulum centralem latissimæ, hic modice angulatæ et prope etiam apicem superiorem, apiculo minuto interdum instructæ; lateribus inferne rapide convergentibus pæne planis, superne arcuatis convergentibus inter angulos deplanatis. Striæ 2-3 utrinque ad centralem nodulum plerumque alteris validiores.

Long. 40-57; lat. valv. 13-14, ap. 4 μ. Striæ 7 in 10 μ.

Lismore(1, 6, 13, 15, 17, 18, 20, 21, 22), both forms together.

GOMPHONEMA CONSTRICTUM var. AUSTRALE, n.var, (Pl. iv., f.23).

Valvæ parte superiore valde inflata, apiculo lato munitæ; striis binis alteris validioribus utrinque ad centralem nodulum præditæ.

Long 50; lat. valv. cap. 16-18, constr. 10, centr. 13, bas. 5 μ.

Lismore(1, 2, 6, 8), cum forma typica.

Dimensions of the type are, here:—long. 40, lat. valv. cap. 12, constr. 10, centr. 13, bas. 5 μ.

GOMPHONEMA TRIANGULARE, n.sp. (Pl. iv., f.24).

Valvæ minutæ, triangulares, prope apices latissimæ; lateribus ad basin angustatam rapide convergentibus; apicibus depressis subrostratis.

Long. 24; lat. valv. 10, ap. 3 μ.

Lismore(1). Rarissime.

Genus ACHNANTHES, Bory.

ACHNANTHES LANCEOLATA (Bréb.) Grun.

Valvæ elliptico-lanceolatæ, apicibus late-rotundatis.

Long. 12-20; lat. valv. 7-8 μ. Striæ 9 in 10 μ.

Valvæ apicibus productis subrostratis, late-rotundatis.

Long. 20-25; lat. valv. 8-9, ap. 3-4 μ. Striæ 9 in 10 μ, utrinque 20-24.

Lismore(1, 6, 8, 17, 18, 20, 21, 22), both forms intermingled.

Cleve, Syn., ii., p. 192, gives striæ 13-16 in 10 μ.

ACHNANTHES CALCAR var. AUSTRALIS, n.var. (Pl. iv., f.25-26).

Valvæ elliptico-lanceolatæ, formâ typicâ præ latitudine longiores; apicibus acuminatis interdum quam levissime rostratis. Valva inferior lineâ mediâ solâ instructa.

Long. 16-22; lat. valv. 7-8, ap. 2 μ.

Lismore(6, 12, 13, 15, 17, 20).

Var. PULCHERRIMA, n.var. (Pl. iv., f.27).

Valvæ lanceolatæ vel lineari-lanceolatæ, longiores; apicibus acute-rotundatis, interdum quam levissime rostratis.

Long. 24-40; lat. valv. 8-10, ap. 2½ μ.

Lismore(17, 20, 21). In profusion(17).

Cf. Cleve, Diat. Finland, p.51, Pl. iii., f.8, 9. A very rare species, known (living) only from Finland, and fossil in Sweden from freshwater deposits of the Ancylus epoch. Striæ 24-25 in 10 μ according to Cleve, Syn., ii., p.174. Var. *pulcherrima* sometimes approaches in shape to *Ach. Hungarica* Grun.

Genus COCCONEIS (Ehr.) Cleve.

COCCONEIS PLACENTULA Ehr.

"Intus et extus lævis," Kütz., Bac., p.73.

Long. 22-36; lat. valv. 14-22, crass. 3 μ.

Lismore. Cum sequenti.

Var. EUGLYPTA (Ehr.) Cleve. (Pl. iv., f.28).

Forma utrinque ad lineam mediam striis longitudinalibus crassis rectis 5-6 ornata. Dimensiones et cetera ut in formâ typicâ.

Lismore(1, 6, 13, 17, 18, 20, 21, 22); both forms intermingled.

Var. LINEATA (Ehr.) Cleve.

Forma major, striis longitudinalibus 5-6 *undulatis* ornata.

Long. 40-46; lat. valv. 26-30; lat. annul. 3 μ.

Lismore(1, 6, 15, 20, 21). Cum f. typica rarius.

The wavy longitudinal striæ are an optical illusion caused by the transverse striæ decussating at a very obtuse angle. Cleve, Syn., ii., p.169, gives long. 40-70, lat. 30-40 μ for this form.

Var. AUSTRALICA, n.var. (Pl. iv., f.29).

Var. lineatæ consimilis, striis autem nullis; areâ centrali (? nodulo) circulari distinctâ instructa, lineis medianis binis arcuatis.

Long. 44; lat. valv. 30 μ.

Lismore(1). Rarissime.

Genus EPITHEMIA Bréb.

EPITHEMIA GIBBERULA var. PERPUSILLA, n.var. (Pl. iv., f.30).

Var. productæ consimilis sed minor; costis 5-6 dorso crassis ad zonam versus sensim attenuatis.

Long. 15-16; lat. valv. 6; lat. frust. 13, ap. 4 μ.

Lismore(2b), with var. *producta* Grun.

From Van Heurck's figures, Diat., Pl. 9, figs. 359, 360, 361, there would not appear to be any specific difference between *E. musculus* Kütz., and *E. gibberula* var. *producta* Grun., nor are Kützing's figures of the types, Bac., Pl. 30, f. 3, 6, sufficiently different for distinct species. In these latter, the lower figures in each case are not of frustules seen in girdle-view, but represent the two outer and opposite valves of a hemisphere of frustules cohering after division. The same is true of Van Heurck's figures, Diat., Pl. 30, f.825 (*sinistra*). *E. gibberula* has priority, as Kützing refers it to Ehrenberg.

Epi. Sorex, *E. zebra*, *E. turgida* var. *granulata*, and *E. gibba* var. *ventricosa* were also abundant both at Lismore and Casino. The three last from Kyogle also.

Genus Eunotia Ehr.

Eunotia formica var. Richmondiæ, n.var. (Pl. iv., f.31, 32).

Valvæ levissime arcuatæ, medio apicibusque subito inflatæ lateribus plus minus parallelis; apicibus acuminatis cuneatis.

Long. 56-124; lat. valv. 8-9, inflation. 10-14 μ.

Lismore (3, 6, 12, 17, 18, 22).

Forming long ribbons, in company with *Eun. depressa* Ehr. The latter is the only other form of *Eunotia* in the river, long. 24-96, lat. 8, ap. 5 μ, very common; cf. Kütz., Bac., Pl.30, the two unnumbered examples between figs.1 and 2.

Genus Synedra Ehr.

Synedra Lismorensis, n.sp. (Pl. iv., f.33-38).

Valvæ in medio constrictæ, papillâ minutâ etiam nonnunquam ornatæ; superne interdum paullo inflatæ, ad apices attenuatæ, apicibus rostratis. Striis tenuissimis circ 12 in 10 μ, in medio mancis. Latere cingulato frustulum rectangulare, interdum apices versus modice attenuatum, parte non striatâ ad angulos incrassatâ.

Long. 22-88; lat. valv. 4-6, ap. 2-3; lat. frust. 4-6 μ.

Lismore (1, 12, 13, 17, 18, 21). In profusion.

Every length, in successive increments of 2 μ, between 22 μ and 88 μ, was actually observed and measured. The frustules were in long ribbons, the shorter ones (long. 22 μ and upward) being quite as broad as the longest (or even broader) were very unlike *Synedra* in appearance.

Genus SURIRELLA Turpin.

SURIRELLA OVALIS var. PINNATA (W. Sm.) Van. Heurck.

Long. 30-40; lat. valv. 10-12, ap. 3-4; lat. frust. 8-12 μ. Costæ 5-6 in 10 μ.

Lismore (3, 12, 22). (Pl. iv., f.39, 40).

Syn., *Suri. lapponica* Astrid Cleve, Recent Frw. Diat., p.25, Pl. i., f.26. *S. ovalis* type also noted (long. 44-48, lat. 26 μ, costæ 18-20 a side) in Nos.2, 3, 11.

Var. LEWISII mihi. (Pl. iv., f.41-43).

Valvæ facie inflatâ ; membrana media distincte marginata; costæ breves, validæ, lateribus parallelis, ad marginem membranæ abrupte terminatæ.

Long. 50-64; lat. valv. 32 μ.

Lismore (5).

Cf. *Suri. ovalis* Lewis, Diat. U. S. seaboard, p.63, Pl. 1, f.3. Lewis calls it "a sparangial form." Var. *Lewisii* has the same relation to the type that *Cyclotella Meneghiniana* β (var. *convexa* mihi, *infra*) has to its type. The costæ are convex and terminate abruptly at the edge of the central smooth membrane. In this form they increase in number by new ones forming between the others, growing from the edge outwards. Usually in *Surirella* the new marginal costæ, verrucæ or denticulations form at the apices, the latter being the growing points of the frustule.

SURIRELLA PLANA G. S. West, forma. (Pl. v., f.1).

Long. 100-134; lat. valv. max. 44-50; lat. frust. ap. 36-48, bas. 24-30 μ.

Verrucæ marginales circ. 20; latere cingulato ut in *Suri. robustâ*.

Lismore. Cum sequenti rarius.

Var. ALGENSIS, n.var. (Pl. v., f.2, 3).

Valvæ breviores, præ longitudine latiores, ellipticæ plus minus ovatæ; costis 10-12, terminalibus 3 vulgo (interdum omnibus) simplicibus. Latere cingulato valde cuneato, apicibus latissimis ad basin rapide attenuatis; marginibus alarum medio retusis.

Long. 56-106; lat. valv. 34-56; lat. frust. ap. 36, bas. 20 μ.

Lismore (5, 7, 8). Cum priori.

Cf. G. S. West, Third Tanganyika Exp., p.165, Pl. 8, f.5; also *Suri. margaritacea* O. Müller, Bac. a.d. Nyassaland, p.37, Pl. 2, f.12, the latter probably a smaller size of var. *algensis* with the costæ broken up into rows of minute granules. I consider *Suri. plana* a variation of *Suri. robusta*, with one end (or both) very broadly rounded and a tendency to be ovate; in girdle-view they are identical. The girdle-view in var. *algensis* is characteristic, being strongly cuneate. The costæ are distinct to the centre, or merely marginal according, of course, to the silicification of the membrane. Some forms were noted with simple costæ only, proceeding from marginal denticulations as in *Suri. elegans* and *S. ovalis*. These costæ do not remain simple, however, but become double with growth of the frustule. *S. robusta* var. *splendida* in the same water (long. 136-140, lat. 48-50 μ); Lismore (6, 7, 8, 18), and Casino (14).

Genus NITZSCHIA Hassal.

NITZSCHIA PARADOXA (Gmel.) Grun.

Long. 80-100; lat. valv. 6, ap. 2 μ. (*Bacillaria paradoxa* Gmelin).

Var. MAJOR Van Heurck. (Pl. v., fig.4).

Long. 100-120; lat. valv. 8; lat. frust. 8, ap. 6 μ. Puncta 5 in 10 μ.

Var. PERPUSILLA, n.var. (Pl. v., f.5).

Forma minima; valvæ lineari-ellipticæ, apicibus acute-rotundatis nec rostratis.

Long. 22-40; lat. valv. 5; lat. frust. 6 μ.

Lismore (1, 2, 6, 8, 15, 17, 20, 21), type and var. *perpusilla*; var. *major* (7, 8).

NITZSCHIA VERMICULARIS var. SIALIS, n.var. (Pl. v., f.6).

Forma a latere cingulato visa, apicibus attenuatis. Puncta carinæ 5 in 10 μ.

Long. 180-186; lat. valv. 8, ap. 3; lat. frust. 14, ap. 8-10 μ.

Lismore (3, 12); in *Lyngbya* stratum (26).

Var. MINUTA, n.var. (Pl. v., f.7).

Forma minima, latere cingulato apicibus attenuatis, punctis carinæ sæpissime carentibus.

Long. 44-48; lat. valv. 4, ap. 2½ μ.

Lismore, in *Lyngbya* stratum (26) cum priori.

The carinal dots in these forms increase gradually in number. They first elongate longitudinally and then divide into two granules, Granular and elongated puncta were noted intermingled in the same specimen, and with them also were some which were quite evidently half divided. It is one indication of a very slow process of growth and development which is taking place in the frustule.

Genus TRYBLIONELLA W. Smith.

TRYBLIONELLA HANTZSCHIANA var. MINOR, n.var. (Pl. v., f.8).

Formæ typicæ (fig. *a* in Grun., Oesterr. Diat., T. xii) consimilis sed minor.

Long. 40; lat. valv. 14 μ.

Var. VICTORIÆ (Grun.) mihi. (Pl. v., f.9-11).

Long. 30-60 ; lat. valv. 15-22 ; lat. frust. 13-20, cingul. 5-8 μ. Striæ 24-36, 5-6 in 10 μ, equal in number to the marginal dots when present. Syn. *Trybl. Victoriæ* Grun., Oesterr. Diat., p.553, T.12, f.34. Both figures are tilted sideways, 34*b* very much so.

Var. CALIDA (Grun.) V. Heurck. (Pl. v., f.12).

Long. 70-72; lat. valv. 10-12, ap. 2-3; lat. frust. 11, cingul. 3-4 μ.

Var. OVATA (Lagerstedt) mihi. (Pl. v., f.13).

Long. 26-36; lat. valv. 14-18. Striæ circ. 20, 6 in 10 μ. Syn. *T. ovata* Lagerst., Spetzbergens, p.48, T.2, f.23. Lagerstedt's figure also is tilted sideways.

Var. AUSTRALICA, n.var. (Pl. v., f.14).

Valvæ elliptico-lanceolatæ, apices versus paullulo cuneatæ, apicibus modice subrostratis; lateribus in mediis valvis paullulo deplanatis; striis crassis haud punctatis, apices versus sæpe carentibus.

Long. 76; lat. 28 μ.

This variation combines in itself the characteristics of several forms. There is a general resemblance, especially in the subrostrate apex, to *Trybl.* (*Nav.*) *punctata*; in size, however, it agrees with *Trybl. Hantzschiana*, while in shape it leans somewhat to *T. ovata*.

TRYBLIONELLA CRUCIATA, n.sp. (Pl. v., f.15).

Valvæ late-lineares, in medio inflatæ, apicibus late-rotundatis. Striis transversis, 8 in 10 μ, evidenter punctatis.

Long. 48; lat. valv. centr. 16, ap. 11 μ.

Only one frustule noted, and the only one, too, among numbers of the others, in which the striæ were distinctly punctate. If *Trybl. punctata* had been present, I would have made it a form of that species.

Lismore, all six forms (1); var. *Victoriæ* (1, 3, 6, 12); var. *ovata* (1, 11, 18); var. *calida* (3, 20).

It is noticeable that these six forms of Tryblionella were all found in the same sample(1) out of a few heads of *Myriophyllum* gathered in one place. I cannot but consider them, therefore, all forms of one species. On account of its punctate striæ, however, *Tr. cruciata* has been kept separate. Following W. Smith, and Grunow (originally), I have classed these forms together under the old genus *Tryblionella*. Why should *Hantzschia* and *Stenopterobia* (whose forms much more resemble *Nitzschiæ*) be separated from *Nitzschia* and these forms remain? The structure of the frustule is on the lines of *Surirella*; the pseudoraphe, the costæ radiating more and more towards the apices where they are often absent or more delicate, the submarginal keel *on both sides* of the connecting zone (as also in *Stenopterobia*), the carinal dots originating near the apices and getting more complex as they approach the centre, all these remind one of *Surirella*. Also in *Suri. margaritacea* Müller, Nyassaland, i., Pl.2, f.12, we have a form of that genus with punctate costæ (probably temporarily only, however). The frustules of these *Tryblionellæ* are very narrow and compressed in girdle-view, and slightly twisted round their long axis. I am inclined to believe them degraded forms of *Cymatopleura solea*, which is found in the upper reaches of the river at Kyogle. In this connection, cf. Müller, Bac. aus Nyassaland, i, p.23, f.4.

Genus MELOSIRA Ag.

MELOSIRA VARIANS var. MONILIFORMIS (O.F.M.). (Pl.v., f.16, 17).

Diam. 16-26; alt. cell. 16-26 (rare usque ad 60 μ).

Lismore (3, 5, 22). Cum formâ typicâ.

Cf. Kützing, Bac., p.53, T 3., f.ii., 1-3, whose figures work out at diam. 12-20 μ. *M. varians* (diam. 14-30 μ) is common in the river, being found in almost every gathering. (*M. granulata*, very rare, only once noted). In var. *moniliformis*, the cells become first semi-detached and later entirely free, in which condition they are liable to be mistaken for *Cyclotella* frustules.

Genus CYCLOTELLA Kütz.

CYCLOTELLA MENEGHINIANA Kütz., forma. (Pl. v., f.18).

Diam. 12-28; crass. 11-14 μ. Striæ in ambitu circ. 30.

In the type, the central area of the valve is not sharply outlined, the striæ are delicate, and the edge shows as a well-defined rim 1-1$\frac{1}{4}$ μ in thickness. The girdle-view is rectangular, the face of the valve, with the exception of the inflated half of the central undulation (when present), being beneath the level of the edge. These specimens were not quite typical, since they were not quite rectangular in girdle-view, but somewhat inflated, the striæ showing over the edge.

Var. CONVEXA mihi. (Pl. v., f.19, 20).

Valvæ areâ centrali distincte definitâ, glabrâ, areâ marginali rugosâ vel striatâ. A latere cingulato visæ, lateribus convexis in medio planis vel plus minus undulatis.

Diam. 8-36, diam. areæ centralis 8-15; crass. 8-20 μ. In ambitu striæ 24-30 vel, apud cell. validiores, rugæ 50-60.

This is var. β Kützing, Bac., T.30, f.68. It is quite unlike a, but the "*forma*" recorded above is quite certainly intermediate. Var. *convexa*, which is the characteristic *Cyclotella* of the river here, has a sharply defined exceedingly smooth area (generally in diameter about half that of the cell) in the centre of the face of the valve, and this part alone is undulate (but the undulation is often slight and sometimes absent). The marginal portion of the valve is convex, and in large forms of 30 μ and over, the striæ appear to be the edges of radiating corrugations. In a tilted cell, these show as crenulations at the edge. There is no definite rim.

Var. QUADRATA, n.var. (Pl. v., f.21, 22).

Valvæ sine striis, punctis autem intra margines notatæ. Cellulæ a latere cingulato pæne quadratæ, lateribus rectis. Tota facies valvæ levissime undulata.

Diam. 8-9; crass. 7 μ.

Var. *quadrata* is a form produced from var. *convexa* by long-continued mitosis. The striate marginal area has been gradually whittled away concentrically, and the frustule now consists merely of the central smooth area of the original cell, in which the undulation occurs. Hence in this form the undulation in girdle-view runs right across the valve instead of being confined to the central portion. The marginal striæ are represented by faint puncta within the rim itself. The diam. of the valve also is exactly the breadth of the smooth central area in the smaller sizes of var. *convexa*.

Var. BREVISTRIATA, n.var. (Pl. v., f.23).

Forma areâ centrali glabrâ præ diametro valvæ latissimâ, areâ marginali striatâ angustissimâ, striis brevissimis.

Diam. 12-14, areæ centr. 10 μ. Striæ in ambitu circ. 30.

This would seem to be an intermediate form in which the marginal striate area is not yet quite deleted, or else one in which it is gradually developing again by growth. The striæ end abruptly at the edge of the smooth central area, which is relatively very wide. With central area of 10 μ broad, the valve in var. *convexa* would have a diameter of 20-24 μ.

Var. FLUVIATILIS, n.var. (Pl. v., f.24).

Forma striis brevibus e denticulationibus marginalibus cuneatis orientibus.

Diam. 15-18, areæ centr. 8 μ. Striæ in ambitu circ. 30.

Lismore, all five forms (2, 20); var. *convexa* (2, 13, 17, 18, 20, 21, 22); var. *quadrata* (2, 5, 20, 21, 22); var. *fluviatilis* (2, 5, 20).

Genus HYDROSERA Wallich.

HYDROSERA TRIQUETRA Wallich. (Pl. v., f.26).

Long. (latere cingul.) 75-130; lat. 80-100; diam valv. 80 μ.

Lismore (16, 19, 21).

The valves are strengthened internally by septa across the salient (? and intermediate) angles, the lower, free, edges can be seen in girdle-view as flying arches. The two smooth vertical bands are the extension of the papillæ which appear at the margin in optical section. These are really (as in all other diatoms where they appear) loops of the inner incrassate membrane, which run right round the valve. The thin outer membrane remains flat, but often breaks away, showing the loop plainly as a marginal indentation. "Grunow and H. L. Smith unite the genus *Hydrosera* with *Pleurodesmium* and *Terpsinoë*, which have the same structure."—Van Heurck, Diat., p.453. The latter relies on the triangular valve as a generic character. I have not found any biradiate forms in the river. All three genera have this in common, that they consist of marine forms which are just as often found in the fresh water of rivers and far above all tidal influence.

Genus COSCINODISCUS Ehr.

COSCINODISCUS LACUSTRIS Grunow.

Diam. 34-78; striæ 8-9 in 10 μ; puncta circ. 10 in 10 μ.

The puncta may be noted arranged in many different ways, but most of these are merely transitory arrangements due to growth. In the perfect form, the puncta are in regular radiating lines, but frustules are common in which they are disposed quite irregularly or in fascicles with shorter rows filling the triangular marginal interspaces, or in arcs (decussating) from point to point of the circumference. In some specimens, they appear as arcs or in irregular radiating lines according to the focus. Sometimes, the puncta are very distinct and separate, at others, obscure or inclined to be confluent, at others, again, very delicate and hardly visible, sometimes, apparently absent.

There is a great general likeness between *Coscinodiscus lacustris* and *Cyclotella Meneghiniana* var. *convexa*, and I am not at all convinced that they are not stages of the same plant, and that this, the only freshwater *Coscinodiscus*, is not, as W. Smith considered it, a *Cyclotella*.

Var. PELLUCIDUS, n.var.

Valvæ membranâ glabrâ, striis punctisque nullis.

Diam. observ. 52-61 μ.

Var. STELLATUS, n.var. (Pl. v., f.27).

Valvæ membranâ glabrâ, areâ centrali nudâ, granulis marginalibus distinctis, striis spatio distantibus. Unicum frustulum tantum vidi.

Diam. observ. 50 μ, striæ long. 15 μ.

?Syn. *Cyclotella Kützingiana* Kirchner, in Forbes and Richardson, Biology of the Upper Illinois River, Pl.85, f.1. Each of the striæ proceeds from a marginal granule, probably intermediate striæ form between the others. No doubt an abnormal outgrowth of the foregoing.

Var. DENTICULATUS, n var. (Pl.v , f.28).

Valvæ granulis marginalibus in denticulos productis, inter se paullo magis distantibus.

Diam. 44-55 μ.

The marginal denticulations are 3 μ apart from centre to centre, in the type 2 μ. Is this identical with *Stephanodiscus Hantzschianus* Grun., in Van Heurck, Diat., p.520, Pl.23, f.662?.

Var. PAPILLATUS, n.var. (Pl. v., f.29).

Valvæ intra margines papillis humillimis 8, pari intervallo inter se distantibus instructæ. Unicum frustulum tantum vidi.

Diam. observ. 50; crass. 20 μ.

This rare form of *Coscinodiscus lacustris* may possibly constitute the genus *Perithyra* Ehr.

Var. TYMPANIFORMIS, n.var. (Pl. v., f.30)

Cellulæ a latere cingulato latissimæ, sæpe rectangulares; lateribus planis vel modice convexis, in medio interdum levissime inflatis, nec undulatis. Valvæ margine distinctâ, granulis marginalibus nullis.

Diam. observ. 40-54; crass. 25-26; lat. zonæ 12 μ.

Very broad in girdle-view, rectangular, the angles sometimes sharp, sometimes just rounded off; the sides flat, not undulated, but occasionally a little inflated towards the centre.

Var. IRIS (Heribaud & Brun). (Pl. v., f.31).

Diam. 50-70; crass. centr. 16, c. infl. unic. 22, c. infl. binis. 28 μ.

This answers exactly to *Cyclotella Iris* Heribaud & Brun, Diat. Auvergne, Pl.vi., f.1, 3, when allowance is made for the latter being fossil. The outer zone of the valve is striate, with coalesced puncta, one line to each marginal granule, and one intermediate; in the central area, the puncta of the striæ are distinct. The total breadth (*crass.*) across *both* inflations in girdle-view is just about the same as that in var. *tympaniformis*. In quantity, alive (9).

Lismore, type (1, 2, 7, 11, 12, 13, 21); var. *pellucidus* (7, 11); var. *stellatus* (11); var. *denticulatus* (7, 12); var. *papillatus* (6); var. *tympaniformis* (12); var. *Iris* (7, 9, 12).

MYXOPHYCEÆ.

Genus ANABÆNA Bory.

ANABÆNA OSCILLARIOIDES Bory.

Cell. carent.; heterocyst. oblong., long. 6, lat. 5; sporis oblongis vel cylindraceis, apicibus rotundatis, immaturis long. 9 12, lat. 6; maturis long. 15-23, lat. 7-8 μ.

Lismore, swamp (10); not noted in river.

Forma TORULOSA, n.f.

Fila torulosa diam. 4 μ, cell. truncato-globosis; heterocyst. sphæricis vel ovalibus, diam. 6 μ.

Lismore (2*b*). Cum var. *cylindraceâ*.

Forma CIRCINALIS, n.f.

Fila circinalia, diam. 5; cell. sphæricis, ovalis vel truncato-globosis; heterocyst. sphæricis, diam. 5; ovalibus, long. 7, lat. 6 μ.

Lismore (3). Cum var. *cylindracea*.

Var. CYLINDRACEA, n.var. (Pl. vi., f.1).

Fila diam. 4-6 (7), apicibus attenuatis; *cellulis quadratis vel cylindraceis*, alt. 2-8, plerumque 4-6, endochromâ homogeneâ vel vacuolatâ, Heterocystidibus sphæricis, diam. 6; oblongis vel ovalis, long. 6-8, lat. 5-7; aut cylindraceis, long. 6-10, lat. 5-6. Sporis oblongis vel cylindraceis, long. 12-16, lat. 5-10 μ.

Lismore (2*a*, 2*b*, 12, 16).

Differs from var. *stenospora* Born. et Flah., only in the shape of the cells and the breadth of the spores, the latter, except when immature, having the dimensions of the type. The dimensions given above for the spores are the greatest noted in this district; round Sydney, I have observed spores up to 34 × 11 μ, very rarely, however. A torulose form of this variety, all dimensions agreeing, was also observed there (at Rookwood). *Anabæna Volzii* Lemm., Dr. Volz ges. süsswass., p.153, T.xi., f.4, 5, 20, is a form of this species distinguishable from var. *cylindracea* only by its barrel-shaped spores. I have found it at Canley Vale in company with the type (in fruit). A var. *Novæ Zelandiæ* Lemm., Reise n.d. Pacific, p.355, has very narrow cylindrical spores 3 μ broad and 16 μ long, but the cells are spherical and smaller, diam. 2-3 μ.

Genus NODULARIA Mertens.

NODULARIA SPUMIGENA Mertens. (Pl. vi., f.2).

Fila diam. 8; cell. veg. alt. 2-4, plerumque 2; heterocyst. depressis, diam. 8, alt. 4-8; sporis immaturis diam. 8, alt. 4, maturis diam. 8-9, alt. 6-7 μ.

Coraki, river-bank near Commercial Hotel (29)

The sheath was evident. There is, I think, no doubt that the appearance generally referred to in descriptions of the *Lyngbyeæ* as "trichomata ad genicula constricta" is due to the formation of a cellulose ring on the sheath, opposite the junction of the cells. In the projecting sheath of a broken filament in the above, they were plainly visible. In large forms, they develop into true septa across the sheath distinct from the cells themselves. Cf. Sydney Water-Supply, Pl. lvi., f.17.

Genus Plectonema Thuret.

Plectonema Nostocorum Bornet.

Fila. diam. $1\frac{1}{2}$; cell. alt. 2-4 μ.

Lismore (30).

Colour very pale blue, not yellow-green as in Gomont, but in this country yellow-green forms of generally pale blue species are not at all uncommon. I consider that the two colours are practically interchangeable. Filaments very little branched, sheath distinctly observed. In the case of trichomes which had been forced from the sheath, I noted, on more than one occasion, a very interesting phenomenon. The terminal cells, one by one, broke away, and after a short pause became motile. In some instances a portion of the trichome, containing several cells, became disconnected first, and then broke up. The cells thus set free do not move like *Vibrio* or *Bacillus*, but fly through the water, spinning rapidly round their shorter axis. By examination of the base of the æruginous stratum of *Phormidium corium*, with which the *Plectonema* was intermingled, it could easily be seen that the filaments of the latter were originally sessile. Hence these motile cells evidently settle down and form new filaments.

Genus Oscillatoria Vaucher.

Sheath always present, but generally very delicate. In all the species of Oscillatoria mentioned below, I clearly demonstrated the presence of a sheath—repeatedly in the case of *O. splendida* and its various forms. If a fragment of the stratum (or even a drop of water in which filaments are present in any quantity) be thoroughly *mashed up* on a glass-slip with the thumbnail, the sheath can generally be detected, either as a minute tag at the angles of a broken filament, or as a faint projecting tube, or as a connecting link between two trichomes on the two halves of a bent filament. It seems doubtful, therefore, whether there is any valid reason for retaining the genus *Lyngbya*. Cf. Gomont's remarks, Monog. d. Oscill., ii., pp.92, 93.

OSCILLATORIA SPLENDIDA var. ATTENUATA W. & G. S. West.

Fila diam $2\frac{1}{2}$-3; cell. disjunctis, alt. 4-10 μ.

Lismore (20*b*). Cum formâ typicâ.

Fila diam. $2\frac{1}{2}$-3; cell. conjunctis, alt. 4; cell. apic. long. 8-20, lat. 1-$1\frac{1}{2}$ μ.

Lismore (12, 13, 20).

O. splendida Grev., (*O. leptotrichâ* Kütz., in Möbius, Austral. Süssw., p.449, f.22; Bailey's Bot. Bull. vi.) is common in rivers and creeks here, but the type-form, as in Gomont, l.c., T.7, f.7, 8, is very rare. I have only once seen it. The colour of *O. splendida* in all its forms is a characteristic pale blue, hardly ever greeny-blue, and the filaments very translucent except in var. *amylacea*. The cells are occasionally disjoined, and the two minute granules at each side of the septa, as figured by Gomont and W. & G. S. West, are very rarely found here. (Pl. vi., f.3).

Var. LIMNETICA (Lemm.) mihi. (Pl. vi., f.4).

Fila ut in formâ typicâ vel in var. attenuatâ, dissepimentis autem utrinque granulis magnis singulis ornatis.

Diam. $1\frac{1}{2}$-2; cell. alt. 3-10, sæpe 8 μ; apicibus rotundatis vel modice attenuatis.

Lismore (13); with var. *amylacea* in *Lyngbya* stratum (26).

Diam. $1\frac{1}{2}$-3; cell. alt. 6-10, sæpe 8 μ; apicibus attenuatis subcapitatis diam. $1\frac{1}{2}$ μ.

Coraki, river-brink, with var. *amylacea* in *Spirulina* stratum (27).

In this country, forms of *O. splendida*, if granulate at all, almost invariably have a large single granule at each side of the dissepiments. I have only once seen it otherwise. That these *are* forms of *O. splendida*, is evident, as they often possess the characteristic apex of var. *attenuata*. In sample No.153, from Canley Vale, near Sydney, a pure growth of this kind is preserved, filaments diam. 2 μ, cell. alt. 3-6 μ, sheath distinctly observed, and many of the filaments are twisted exactly as in *Lyngbya perelegans* Lemm., Volz ges. süsswasseralg., T. xi., f.14.

In this var. *limnetica* (1898) should be included all Lemmermann's granulate *Lyngbyæ*, viz., *L. gloiophila*, Reise n.d. Pac. p.355 (1899); *L. perelegans*, l.c. (1899); and *L. bipunctata*, Forsch. Biol. Stat. z. Plön, T. 2, f.48 (1900). These differ from one another very slightly, and that, too, only in the breadth of the filament and length of the cells, points which are valueless for the formation of even distinct variations when the general characteristics are identical. From a note by G. S. West, Third Tanganyika Exp., p.175, it would appear that *L. Nyassæ* Schmidle, should be included here as a synonym also; it has the attenuate and capitate apex of the type.

Var. BACILLIFORMIS, n.var. (Pl. vi., f.5).

Fila clare cærulea, diam. $1\frac{1}{2}$ (vaginâ observatâ) cellulis disjunctis, alt. 6 μ, utroque polo granulis magnis singulis ornatis.

Lismore (2*a*).

Var. AMYLACEA, n.var. (Pl. vi., f.6).

Fila pallide cærulea, dissepimentis indistinctis rarissime cernendis. Protoplasma homogeneo amylo diffuso spissum.

Diam. 2-3 μ, cell. haud visibilibus, apicibus rotundatis.

Lismore (12, 21), in *Lyngbya* stratum (26).

Diam. 2 μ, et basi affixa et libera.

Lismore (16).

Diam. $2\text{-}2\frac{1}{2}\mu$ (vaginâ observatâ); cell. alt. 4-8 (rarissime ad 12 μ), apicibus attenuatis nonnunquam capitatis etiam vel subcapitatis, dissepimentis interdum sed rare cernendis.

Coraki, river-brink, in *Spirulina* stratum (27).

I have had this form under observation for years in Sydney, where it generally occurs in almost every mixed gathering of freshwater algæ. Its colour and size had already connected it in my mind with *O. splendida*, and this became a certainty by finding it, in this district, with the characteristic apical cell of var. *attenuata*, and by its close association with the granulate forms. The protoplasm is opalescent, with diffused amylum, so that the dissepiments are generally quite hidden, and the filaments very different in appearance from the transparent filaments of the type. Var. *limnetica* and all other granulate variations are formed from this one by the agglomeration of the diffused amylum into granules at the septa, thus leaving the protoplasm clear and pellucid. The apices are generally truncate or rounded, but this is the case to a greater or less extent with all the forms of *O. splendida.*

Forma CLARESCENS, n.f. (Pl. vi., f.7).

Fila diam. 2-3, apicibus rotundatis, cell. alt. 4 μ, granulis minutis singulis, utrinque ad dissepimenta; *et dissepimentis et granulis difficile cernendis* ob protoplasma amylo spisso.

Lismore, in *Lyngbya* stratum (24).

Forma (Pl. vi., f. 8).

Fila minutissima incipientia, epiphytica vel sessilia, basi affixa. Cytoplasma pallide cæruleum homogeneum.

Long. fil. incip. 10, 12, 14, 17, 18, 50; lat. 2-4 μ.

Lismore (13, 16, 17).

These incipient filaments were noted in fresh samples both epiphytic on *Oedogonium*, and sessile on flocculent matter. They also made their appearance on the sides of glass-jars in which samples were kept, *vide* Pl. vi., f.8*c*, where green cells have been deposited first, and these incipient *Oscillatoria* filaments have become epiphytic upon them. They must, therefore, be the outcome of motile cells or of micro-zoospores (see note under *Plectonema, supra*). They certainly develop into filaments of var. *amylacea*, Pl. vi., f.8*d*.

OSCILLATORIA TENUIS Ag. (Pl. vi., f.9).

Fila diam. 9 μ, cell. alt. 4 μ. Cf. Gomont, Pl.7, f.3.

Casino (14).

Var. CHLORINA, n.var. (Pl. vi., f.10).

Fila clare luteo-viridia, diam. 7 μ, vaginâ observatâ tenuissimâ; cellulis disjunctis alt. 3-4 μ; dissepimentis haud granulatis.

Lismore (22).

Trichomata diam. 5 μ ad genicula constricta, cellulis conjunctis alt. 4 μ. Dissepimentis haud granulatis.

Casino (14).

Genus LYNGBYA Ag.

LYNGBYA LISMORENSIS, n.sp. (Pl. vi., f.11).

Stratum fusco-olivaceum. Fila semper recta, margine glabra, pallide griseo-viridia, translucentia; apicibus attenuatis, interdum calyptrâ instructis. Cellulæ apicales conicæ vel rotundato-conicæ, rarius capitatæ, plerumque ad extremos membranâ incrassatâ. Vaginæ achroæ tenuissimæ. Trichomata ad genicula haud constricta, dissepimentis crassis, plerumque pellucidis glabris, interdum minute granulatis. Cytoplasma homogeneum translucens.

Diam. fil. 7-9, sub calyptrà 4; cell. alt. 4-8, sæpe 6 μ.

Lismore, on curbstone near Commercial Hotel(26), river-water.

Diam. fil. 6-8, cell. alt. 4-8 μ.

Lismore, river (12, 13).

Var. NIGRA, n.var. (Pl. vi., f.12).

Fila obscure griseo-cærulea vel obscure griseo-viridia; apicibus sæpe late-rotundatis. Cetera ut in formâ typicâ.

Lismore, horse-trough near Gov. Savings Bank (30, 34).

The characteristic points of *L. Lismorensis* are the pale (or, in var. *nigra*, dark) grey colour of the filaments, *flashed* with pale green or pale blue, this latter point especially noticeable when the filaments are slightly out of focus. Also the quadrate cells, with their broad pellucid dissepiments, and the finer and fainter septa which sometimes alternate with the others, and are often to be noted just starting from the margins. The tips of the filaments, when fully formed, are capitate or calyptrate; but such are very rare, and conical tips, with the calyptra in process of formation, are more common. The broadly rounded ends often seen, are merely the result of broken filaments, and are not typical. Separated on a watchglass, in the mass the filaments are of a dull olive-green.

Genus PHORMIDIUM Kütz

PHORMIDIUM TENUE (Menegh.) Gomont. (Pl. vi., f.13).

Diam. fil. 1-2; cell. alt. 2-6, plerumque 3-4, raro 8-10 μ.

Lismore (2, 2*b*, 12, 13, 18); Coraki, river-brink, with *Spirulina* (27), and *Nodularia* (29).

Diam. fil. $2\frac{1}{4}$; cell. alt. 2-6; sporâ immaturâ sphæricâ diam. 4; sporâ maturâ oblongâ, long. 8, lat. 4 μ.

Lismore (13).

Var. CHLORINA, n.var.

Trichomata pallide luteo-viridia; diam. fil. 1 μ; cell. alt. 3-6 μ.

Casino (14).

Phormidium tenue occurred sparsely in a considerable number of samples, and in some quantity in Nos.2 and 2*b*, but in no case was it in the *Phormidium* state. This is also my experience with gatherings made near Sydney, where I found it only once in the agglutinated condition, viz., in an open drain in Park Rd., Auburn (No.48, N.H.S.). I am of the opinion that the *Phormidium* state is merely an accidental condition brought about by exposure of a stratum to the air and sun. A filament with a spore, as given in Pl.vi., f.13*c*, was noted also at Auburn (Nov. 16th, 1909). The spherical cell is not a heterocyst, but an immature spore.

PHORMIDIUM FRAGILE (Menegh.) Gomont. (Pl. vi., f.14).

Diam. fil. 2-$3\frac{1}{2}$; cell. alt. 2-3 μ.

Lismore (12).

Generally found sparingly in mixed gatherings as short filaments, here and around Sydney. Meneghini made it an Anabæna, and here it was found in company with *A. oscillarioides* var. *cylindracea* (Pl. vi., f.1) with cells of the same shape, diam. 4-6 μ. I should not be surprised if it turned out to be the transition-stage between the two genera. I have never found it either in the *Phormidium* condition. Gomont makes it a marine form.

Genus SPIRULINA Turpin.

SPIRULINA MAJOR Kütz. (Pl. vi., f.15).

Spira diam. 4; anfr. 4-6 inter se distant.; trich. diam. $1\frac{1}{2}$ μ.

Lismore (12), loose filaments.

Spira diam. 4; anfr. 2-3 inter se distant.; trich. diam. $1\frac{1}{2}$ μ.

Coraki, river-brink (27), mucous stratum.

SPIRULINA LAXISSIMA G. S. West. (Pl. vi., f.16).

Spira laxissima diam. 4; anfract. 10-15 inter se distant.; trich. diam. 1-1¼ μ.

Lismore (20), in *Lyngbya* stratum (26).

A very rare *Spirulina*, only known besides from Tanganyika. Generally found here in short pieces, 30-80 μ long. Cf. G. S. West, Third Tanganyika Exp, p.178, Pl.9, f.6.

SPIRULINA CORAKIANA, n.sp. (Pl. vi., f.17).

Trichomata angustissima in spiram laxissimam regularem diametro 2 μ æqualiter contorta; anfractibus 6-10 inter se distantibus; cytoplasmate pallide ærugineo et homogeneo. Crass. trich. 0·8 μ.

Lismore (12); Coraki, with *Spirulina major* (27).

Genus MERISMOPEDIA Meyen.

MERISMOPEDIA PUNCTATA var. OBLONGA, n var. (Pl. vi., f 18).

Cellulæ oblongæ, long. 3, lat. 2 μ.

Lismore (2).

MERISMOPEDIA ELEGANS A.Br. (Pl. vi., f.19).

Cœnob. long. 300, lat. 200; cell. sphæric. diam. 4-5, oblongis long. 6-7, lat. 4-5 μ.

Lismore (9, 18).

Cœnobia very large and membranous. Cells very numerous, 1024 and 2048 actually observed (32 rows × 32 and 64 rows × 32), closely approximated, only 1-2 μ between, pale blue or pale green, oblong, constricted or spherical according to stage of division. Syn., *M. nova* Wood, cf. Tilden, Minnesota Algæ, i., pp.42, 43.

Genus CŒLOSPHÆRIUM Näg.

CŒLOSPHÆRIUM KUETZINGIANUM Näg. (Pl. vi., f.20).

Cœnob. long. 40, lat. 36; cellulis clare cæruleis, diam. 3 μ.

Lismore (20).

Var. PUNCTATA (Näg.) mihi. (Pl. vi., f.21).

Cœnob. diam. 6-16, cell. diam 2 μ.

Lismore (16).

Syn., *Gleocapsa punctata* Näg., Gatt. Einz. Alg., T. i., f.F6. These are the younger stages of development of *Cœlosphærium Kützingianum.* In gathering (16) there were quantities of them, the growth from a single cell being easily seen (Pl. vi., f.21). This cell is indistinguishable from *Merismopedia punctata* (also noted in the river), and I consider, therefore, that *Cœlosphærium* is a *facies* of *Merismopedia*, with a globose cœnobium instead of a flat one. How this is accomplished (the plant still retaining its division in one plane) is very simple. The four cells resulting from the division of the original cell in two directions, arrange them at the angles of an imaginary tetraëdron, and each cell thenceforward divides regularly in its own plane. The same two modes of development occur in *Tetraëdron lobulatum*, where both flat and tetraëdral forms are produced by growth from the same flat cell.

CHYTRIDIACEÆ.

Genus Trochisia Kütz.

Trochisia hirta var. elliptica, n.var.

Cellulæ irregulariter ellipticæ. Cytoplasma hyalinum.

Long 58-60, lat. 36-40, spin. long. ad 12 μ

Lismore, on decaying cells of *Spirog. maxima* (20). (Pl. vii., f.1).

Cf. De Bary, Conj., T. i., f.6. This is a half-grown form of *Tr. hirta.*

Formæ valde immaturæ. (Pl. vii., f.2).

Cellulæ minimæ globosæ, primum glabræ deinde minute denticulatæ. Cytoplasma hyalinum.

Diam. cell. 8-14 μ, spin. long. ad 1 μ.

Lismore, on decaying cells of *Spirog. maxima*(16); on decaying specimens of *Penium australe* and *Doc. trabecula*(12).

Cf. Reinsch, De Spec. generibus, T.5D, f.iii. 3, whose figure works out at diam. 20 μ. On a single *Spirogyra* cell, 30 were observed, each surrounded by the excavated (?), circular space characteristic of *Trochisia, in situ.* Six were noted also on one specimen of *Pen australe.* I have observed *Tr. hirta* also in *Eremosphæra viridis.* Wille's excellent account and figures of a variation of *Tr. granulata* (Studien über Chlorophyceen, 1900, ii.) leave no doubt that *Trochisia*, under certain circumstances, develops chlorophyll, living and reproducing itself in the manner of the Algæ. Nevertheless, though I have noted *Tr. hirta*, *Tr. granulata* and *Tr. reticulata* from a number of localities in this country, the cytoplasm has been invariably hyaline, as was also the case in the forms observed in these samples. Add to this their development, as shown in the *formæ immaturæ* above, and the fact that they are always found on decaying cells, and I can only conclude that the forms of *Trochisia* are essentially saprophytic in character. The genus seems to me nearest to *Chytridium* of all the algal fungi. The minute immature forms of the green algæ may occasionally be pale blue, but never hyaline, as in this plant.

TROCHISIA VERRUCOSA, n.sp. (Pl. vii., f.3).

Cellulæ globosæ vel ellipticæ, verrucis quadratis dense obtectis. Cytoplasma hyalinum.

Long. 58, lat. 34; verrucæ long. 2-3 μ.

Lismore, on decaying *Spirog. maxima* (20).

Genus CHYTRIDIUM A.Br.

CHYTRIDIUM GREGARIUM Nowakowski. (Pl. vii., f.4).

Cell. long. 32-48, lat. 26 μ.

Lismore, in dead Rotifer (16).

Cf. Nowakowski, Kentnn. d. Chytridiaceen, i., p.77, T.iv , f.2.

CHYTRIDIUM AMPHORIDIUM, n.sp. (Pl. vii., f.5).

Cellulæ lageniformes; corpore globoso superne in collum angustum protracto. Cytoplasma hyalinum.

Long. cell. 12, corp. 7, coll. 5; lat. corp. 6, coll. 2 μ.

Casino, on *Hydrodictyon* (14).

Genus RHIZIDIUM A.Br.

RHIZIDIUM MYCOPHILUM A.Br. (Pl. vii., f.6).

Zoosporangia immatura, *subglobosa* diam. 7-10, cell. basal. (dauerspora) diam. 7-10, *pyriformia* long. 13-22, lat. 9-14, cell. basal. diam. 10-14. Zoosporangia matura ovata, long. 40, lat. 24, cell. basal. diam. 18; zoospor. diam. 6, flagell. long. 20-25; hyphæ lat. 1-2 μ.

Casino, on decaying *Hydrodictyon* (14).

Cf. Nowakowski, l.c., p.88, T. v., f.6-12, T. vi., f.1-5. He gives the size of the mature zoosporangium as, long.40, lat.25, zoospores diam. 5, dauerspores diam. 18-30 μ. The young zoosporangium is globose, becoming pyriform or ovate with growth; and, at the base, four rugæ form, disposed crosswise Occasionally these are found also in very young zoosporangia, in which case the latter are somewhat dome-shaped. The corrugations are not shown in Nowakowski's figures, probably because his specimens were growing freely in the mucus of *Chætophora*; this also accounts for many other differences of growth. In our specimens, growing, as they were, on decayed algal cells, the zoosporangia lie outside and the dauerspores and hyphæ inside the cell-wall, being connected by a minute pore. It would appear, therefore, that, in these cases, the zoosporangial cell forms first, pierces the cell-wall of the host, and gives rise to the mycelium and dauerspore within. The dauerspore evidently acts as a reservoir, gradually passing on its contents to the zoosporangium, for when the latter is mature, the dauerspore is always empty and the hyphæ atropied.

Rhizidium Spirogyræ, n.sp. (Pl. vii., f.7).

Zoosporangium maturum globosum; in speciminibus vacuis superne truncatum, oris levissime eversis; (cellulæ immaturæ sæpe plus minusve ovatæ); ad basin petiolo brevissimo instructum, dauersporis nullis.

Long. = lat. = 10-34 μ.

Lismore, on decaying cells of *Spirogyra maxima* (20).

Quantities of minute growing cells were noted also, from diam. 4 μ upwards, globose Very rarely, there is found a minute ($\times$ 3 μ) swelling where the dauerspore should be.

SCHIZOMYCETES.

Spirillum volutans.

In filament-form, and in active and non-motile spirals. The filamentous form looks like an *Oscillatoria* or *Lyngbya.* It is generally hyaline or very pale blue, and very lively, coiling and twisting until it breaks into short lengths. These remain quiescent for a short time, then gradually coil into non-motile spirals, which finally, after some spasmodic movements, become active. I have watched the whole process.

Lismore (3, 11, 12).

Var. MAXIMUM n.var. (Pl. vii., f.8).

Long. s. flag. 50; diam. anfract. 14, diam. fil. $1\frac{1}{2}\mu$. Anfractibus 3; in extremis flagello distincto praeditum.

Casino (14).

SPIRILLUM TENUE Cohn. (Pl. vii., f.9).

Long. s. flag. 10; diam. anfr. 3, diam. fil. 1 μ. Anfract. 2.

Lismore (20); Coraki, river-brink, in *Spirulina* stratum (27).

SPIRILLUM LAXISSIMUM n.sp. (Pl. vii., f 10).

Trichomata brevissima hyalina in spiram regularem laxissimam contorta; anfractibus semper singulis.

Long. s. flag. 4-8; diam. anfr. 2-3; diam. fil. $\frac{3}{4}$-1 μ.

Long. s. flag. 10-16; diam. anfr. 3-4; diam. fil. $1\frac{1}{2}\mu$.

Lismore (16), both forms together in quantity.

I have always taken this to be *Spirillum undula* Cohn, and indeed that name would describe the plant very well. However, reference to Q. Journ. Micr. Sci., n.s., Vol. xiii., Pl. v., shows that *Sp. undula* (f.20) cannot be distinguished from *Sp. tenue* Ehr. (f.19), and must be considered, therefore, as a synonym of the latter. Note that the figures of *Sp. undula* and *Bacillus subtilis* in Strasburger's Botany (Eng. ed., p. 333, f. 252*d* and f.254*b*) are entirely different from those given by Cohn, *l.c.*, which, the writer says, "must furnish the basis for all future nomenclature."

[OSCILLATORIA AMPHIBIA Ag.]

Fila glabra, diam. 1-3 μ, dilutissime cærulea pæne hyalina, granulis sparsis primum hyalinis, deinde nigrescentibus impleta.

Lismore (18, 27), Casino (14). Plentiful in (18).

Var. MAJOR, n.var.

Diam. 4 μ. Lismore (18), cum priori multo rarius

Var. MAXIMA, n.var. (Pl. vii., f.11).

Diam. 8 μ. Lismore (2), rarissime.

Var. ASPERA, n.var. (Pl. vii., f.12).

Fila dilutissime cærulea vel achroa, minute aspera, granulis atris sparsis projicientibus, diam. 1-2 μ.

Casino (14). Plentiful.

Geddes and Ewart, *l.c.*, have shown, though not by name, that *Oscillatoria amphibia* is the sporangial state of *Spirillum*. It is developed from the same filamentous form which gives rise to *Spirillum volutans* and *Sp. tenue*. The scattered granules, at first hyaline, and later deep black, are loculi full of spores, which are set free and develop into *Sp. undula*. These three Spirilla are, of course, merely polymorphic forms, one of the other. In var. *aspera*, the granules project through the cell-wall.

BACILLUS SUBTILIS. (Pl. vii., f.13).

Fila diam. 1-2 (vulgo $1\frac{1}{2}$); cell. alt. 5-10, vel. 10-22 μ.

Lismore (6, 7, 20), Casino (14), Kyogle (41, 45).

Was more in evidence in these gatherings than I have ever known it before. The cells, in the filaments, are generally disjointed, but in (41) short filaments were noted with contiguous cells. *Bacterium termo* and *Vibrio serpens* were also met with. Two curious zooglœa stages of the former are figured(Pl.vii.,f.14).

Fauna.

ENTOMOSTRACA.

MACROTHRIX SPINOSA King. (Pl. viii., f.1).

Long. carap. 530, lat. 330; long. caud. proc. 142, set. 124; long. antenn. 105; spin. ad. 70 μ.

Lismore (11, 12, 13, 15), Casino (14).

Common in the river. The caudal processes often end abruptly, each terminating in a pair of long setæ. Noted with winter eggs in December and January (midsummer). Dorsal edge of the carapace minutely serrulate. It is doubtful, therefore, whether the species is distinct from *M. laticornis* (Jurine), as Sars(Austral. Cladocera, ii., p.26) makes this the chief point of difference.

Var. DENTATA, n.var. (Pl. viii., f.2).

In capite glabra minute autem serrulata; a fronte et a tergo dentibus nec spinis instructa.

Lismore (16, 20).

Cyclops quadricornis, *Diaptomus gracilioides*, *Alona clathrata* Sars, and *Alona lævissima* Sars, were also observed.

INFUSORIA.

TRACHELOMONAS VOLVOCINA var. PELLUCIDA, n.var.

Lorica achroa, forma minuta, diam. 8-10 μ.

Lismore (1, 8). Common. (Pl. viii., f.3).

The type, diam. 17 μ, with deeply yellow-brown lorica, noted at Casino (14), rare.

TRACHELOMONAS OVALIS, n.sp. (Pl. viii., f.4).

Lorica ovalis vel oblonga, collo nullo, perfecte glabra, achroa vel luteo-fusca. Long. 30, lat. 22 μ.

Casino (14), with *Tr. hispida.*

LEPOCINCLIS STEINII var. SUECICA Lemm. (Pl. viii., f.5).

Long. corp. 26-32; lat. 11-12, ap. 3; long. caud. 3 μ.

Lismore (22), Casino (14).

Cf. Lemmermann, Plankt. Schwed. gewass., T. i., f.20.

Var. AUSTRALICA, n.var. (Pl. viii., f.6).

Forma latior, corpore late-ovali, caudâ brevi, oblique spiraliter striata.

Long. corp. 32, lat. 24; long. caud. 8 μ.

Lismore (22). Common.

Neither form was noticeable in the freshly gathered material, being present only as minute vegetative resting cells, unrecognisable. After the sample had been standing for several months (in a corked phial without preservative), exposed to a strong diffused light, they were found in numbers, alive and active, having developed in the bottle.

MENOIDIUM PELLUCIDUM var. INCURVUM (Fresenius).

Long. 16, lat. 5 μ. Common. (Pl. viii., f.7).

Lismore (13). Cf. Daugeard, Les Eugléniens, p.151, f.46.

Var. CLAVATUM, n.var. (Pl. viii., f.8).

Forma clavata, parte superiore elliptico-lanceolata, protoplasmate granulato, apice angusta truncata; parte inferiore angusta in caudâ protracta, protoplasmate homogeneo; flagello recto.

Long. 40, lat. 6, ap. 2, caud. 1 μ.

Lismore (12, 13). Cum priori.

Looks like *Peranema (Astasia) trichophorum* var. *pusillum* Stokes, but the motion is that of *Menoidium*.

Other interesting forms of Infusoria noted were, *Mastigamœba longifilum* Stokes, *Anthophysa vegetans* Stein, *Dendromonas virgaria* Stein, *Cothurnia parallela* Maskell, and *Operculata elongata* Kellicott.

RHIZOPODA.

DIFFLUGIA CASINOENSIS, n.sp. (Pl. viii., f.9).

Lorica subglobosa, in ambitu late-ovalis, ore lato margine levissime recurvata. Membrana glabra pellucida, frustilis *Cocc. placentulæ* confirmata.

Long. 48, lat. 40, or. 28 μ.

Casino (14).

DIFFLUGIA ACUMINATA var. LEVANDERII mihi. (Pl. viii., f.10).

Lorica angusta lateribus subparallelis, extremitate posteriore acuminata in caudâ brevi protracta. Membrana granis arenæ confirmata.

Long. 190, lat. 60, or. 48 μ.

Casino (14). Cf. Levander, Wasserfauna, T. i., f.7.

Var. BACILLIFERA, n.var. (Pl. viii., f.11).

Long. 110, lat. 70, or. 40 μ.

Lismore (13).

DIFFLUGIA RICHMONDIÆ, n.sp. (Pl. viii., f.12).

Lorica ovalis, apice truncato, ore minuto circulari. Membrana granulis rugosa, dilute luteo-fusca. Pseudopodia crassa.

Long. 14, lat. 12, lat. oris. 3 μ.

Lismore (2). Common.

Difflugia globulosa, D. lobostoma, Sphenoderia lenta, and *Trinema enchelys* were also observed. The most common species, however, was *Centropyxis aculeata,* generally var. *ecornis.*

EUGLYPHA ALVEOLATA var. HAMULIFERA, n.var. (Pl. viii., f.13).

Forma laminis circulari-hexagonis minime marginibus transilientibus ornata.

Long. 44, lat 24, oris 8 μ.

Lismore (13). Plentiful.

Var. LÆVIS (Perty) mihi. (Pl. viii., f.14).

Forma minuta, parte posteriore rotundata vel acuminata; ore dentibus truncato-conicis 6 (visis 4) circumcincto; membranâ glabrâ sine notis spinisque.

Long. 30-34, lat. 16, or. 8-10 μ.

Lismore (1, 6). Plentiful

ARCELLA PAPYRACEA, n.sp. (Pl. viii., f.15).

Lorica a fronte visa circularis; ore circulari, serie unicâ punctorum circumcinxo; a latere crateriformis, margine levi, ore recesso. Membrana glabra sine notis, texturâ papyraceâ, dilute luteo-fusca.

Diam. 60-80, crass. 32; lat. oris. 20-30 μ.

Casino (14).

The membrane is without the usual markings, semitransparent, and cloudy like thin straw-paper. *Arcella vulgaris* and *A. discoides* were also present, the latter very common.

ACTINOPHRYS SOL var. SIMPLEX (Schaudinn) mihi.

Diam. corp. 7-22, pseudopodia long. ad 25 μ.

Lismore (7, 12).

Syn., *Acanthocystis simplex* Fr. Schaudinn, Mém. Acad. St. Pétersbourg, 1893, p.11, f.8; (diam. 15-22 μ). The figure given by Schaudinn shows quite plainly the characteristic *lumpy,* sharp-pointed pseudopodia of *Actinophrys* and *Actinosphærium.* The pseudopodia of *Acanthocystis* are of quite a different kind, being smooth and bacillar, with or without a minute knob at the end, or minutely bifid. In the specimens I noted, the pseudopodia were smooth and very faint, in the smallest (diam. 7 μ) only 15 μ long, but even so, they had the characteristic attenuate shape. (Pl. viii., f.16).

Var. EICHHORNII mihi

Diam. corp. 80-240; pseudopodia long. ad 160 μ.

Lismore (16).

Actinosphærium Eichhornii is merely the mature form of *Actinophrys sol.* Minute forms of the latter (var. *simplex* Schaudinn, *supra*) have solid bodies; in well grown specimens of *Actinosphærium*, the whole is composed of large cells; while, in the type, the body is a mass of small cells, with larger ones making their appearance on the surface. The pseudopodia are similar in every case.

AMŒBA VERRUCOSA. (Pl. viii., f.17).

Long. circ. 50-60 μ. The usual size in this country.

Lismore (11, 12).

With var. *quadrilineata* (Carter) mihi (Syn. *A. quadrilineata* Carter), showing four longitudinal lines. There are always four, neither more nor less. The contractile vesicle is generally very distinct in this species, as it only discharges at considerable intervals. It is almost always at the extreme end.

Var. LIMAX (? Duj.) mihi. (Pl. viii., f.18).

Long. circ. 30, lat. circ. 10 μ.

Kyogle (41). Cum prioribus duabus.

I consider this a minute form of *A. verrucosa*, on account of its mobility, its straightforward movement, the distinct contractile vesicle, and the broad edging of ectosarc at the anterior end, all of which are characteristic of that species. In shape, it is cuneate.

Var. MAXIMA, n.var. (Pl. viii., f.19).

Formæ typicæ consimilis sed maxima. Long. 120, lat. 90 μ.

Casino (14). Twice as large as the type.

AMŒBA RADIOSA var. MINUTISSIMA, n.var.

Diam. max. pseudop. incl. 20-30, diam. corp. 4-8 μ.

Lismore (7, 12, 15).

The usual size is considerably larger than this. These minute specimens retain the characteristics of the species, which is quite distinct. The cytoplasma is much more solid than in *A. proteus* or *A. verrucosa*, and the shape always radiate. The contractile vesicle is small, with a long systole, and sudden discharge. (Pl. viii., f.20).

Var. STELLATA, n.var. (Pl. viii., f.21).

Forma pseudopodiis longissimis angustissimis filiformibus.

Diam. corp. circ. 50, pseudopodia long. ad 150 μ.

Lismore (12).

The pseudopodia are of clear ectosarc, very narrow, often quite filiform, and always blunt at the ends. They are often more or less stable, and are moved about bodily like the tentacles of *Hydra.*

Amœba proteus, *Vampyrella lateritia*, *Pamphagus mutabilis*, *Clathrulina elegans*, *Cochliopodium bilimbosum*, and *Acanthocystis* sp. were also found.

EXPLANATION OF PLATES II.-VIII.

Plate ii.

(In figures of *Volvox*, the flagella have been omitted).

Fig.1.—*Chlamydomonas globulosa* Perty; *p.* pyrenoid, *gr.* granule (×704).

Fig.2.—*Volvox aureus* Ehr., part of the wall of the cœnobium, showing connective filaments; *p.* pyrenoids (×528).

Fig.3.—*Volvox aureus*, cell; *p.* pyrenoid, *gr.* granule, *st.* stigma (×1056).

Fig.4.————— one of the parthenogonidia (×704).

Fig.5.—*Volvox Bernardii*, n.sp. Family of eight cœnobia (×235).

Fig.6.————— a younger cœnobium (×528).

Fig.7.————— with crowded cells (×528).

Fig.8.————— one of the parthenogonidia of fig.7 (×704).

Fig.9.————— a young cœnobium, with few cells(×528).

Fig.10.————— with oogonia (×235).

Fig.11.————— one of the oogonia (×1056).

Fig.12.—*Eudorina elegans* var. *Richmondiæ*, n.var., cell (×880).

Fig.13.—*Uva Casinoënsis*, n.gen. et. sp. (×1056).

Figs.14-15.—*Chlamydomonas* sp., (prob. *intermedia* Chod.), young non-motile forms; *p.* pyrenoid, *c.v.* contractile vesicle (× 1056).

Figs.16-17.—*Gleocystis*-forms of (probably) *Chl. intermedia;* 16, a homogeneous cœnobium which has got frayed out at the periphery, the cells, as a result, tending to be cordate; 17, a compound cœnobium with cells in pairs, head to tail (×352).

Plate iii.

Fig.1.—*Spirogyra Lismorensis*, n.sp. (×470).

Fig.2.—*Pen. australe* Rac., end-view of choroplasts (×352).

Fig.3.——— *globosum* var. *Wollei*, f. *maxima*, n.f. (×352).

Fig.4.—*Closterium acerosum* var. *angolense* W.&G.S.West, f. (× 264; (*a*), tip (×704).

Fig.5.——————————— var. *Casinoënse*, n.var. (×704).

Fig.6.—*Cosmarium angulatum* f. *major* Grun. (×352).

Fig.7.——————————— var. *conicum*, n.var. (*a*) + var. *subcucumis* (Schm.),(*b*),(×352).

Fig.8.——————————— var. *subcucumis* (Schm.) (×352).

Fig.9.—*Cos. angulatum* f. *major* Grun., (*a*) + var. *subcucumis* (Schm.), (*b*) (×352).

Fig.10.——— *subcostatum* var. *Beckii* (Gutw.) W. & G. S. West (×704).

Fig.11.——————— var. *australe*, n.var. (×704).

Fig.12.——— *Blyttii* var. *Richmondia*, n.var. (×704).

Fig.13.——————var. *Casinoënse*, n.var. (×704).

Figs.14-16.—*Cos Seeleyanum* var. *elegans*, n.var. (×704).

Fig.17.—*Cos. magnificum* var. *fluviatile*, n.var. (×352).

Fig.18.——— *dentiferum* Corda (×235).

Fig.19.——————— var. *porrectum* (Nord.) (×352).

Fig.20.——————————————— forma (×352).

Fig.21.——————————————— (Nord.) (*a*), + var. *quadrum* (Lund.) (*b*) (×352).

Fig.22.——————— var. *sublatum* (Nord.) (×235).

Fig.23.—*Hydrodictyon reticulatum* var. *minimum*, n.var. (×704).

Fig.24.——————————— var. *nodosum*, n.var. (×175).

Fig.25.——————————— var. *Bernardii*, mihi (×70); (*a*) chloroplast very much magnified.

Fig.26.—*Pediastrum tetras* var. *integrum* (Näg.), development out of cœnobium of *Pedi. tetras* (×704).

Fig.27.—————— *Boryanum* var. *capitatum*, n.var. (×352).

Fig.28.—*Kirchneriella lunaris* var. *approximata*, n.var. (×704).

Fig.29.—————————— var. *aperta* (Teiling) (×704).

Fig.30.——————— var. *contorta* (Schm.) (×704).
Fig.31.—*Geminella interrupta* var. *cylindracea*, n.var. (×704).
Fig.32.—*Gonatozygon Kinahani* forma (×704).

Plate iv.

Fig.1.—*Amphora coffaeiformis* Ag. (×704)
Fig.2.——— *veneta* var. *grossestriata*, n.var. (×704).
Fig.3.——————— long form (×528).
Fig.4.—*Cocconema tumidum* Bréb. (×528).
Figs.5-6.—*Navicula mutica* Kütz.(×1056).
Fig.7.——————— var. *rhomboidea*, n.var. (×1056).
Fig.8.——————— var. *ovalis*, n.var. (×1056).
Fig.9.——————— var. *subhexagona*, n.var. (×1056).
Figs.10-12.——————— var. *subcircularis*, n.var. (×1056).
Fig.13.———————var. *Göppertiana* (Bleisch) (×1056).
Figs.14-15.—*Diploneis Boldtiana* var. *australica*, n.var. (×1056).
Fig.16.——————— var. *ovalis*, n.var. (×1056).
Fig.17.——————— var. *acuminata*, n.var. (×1056).
Fig.18.—*Amphiprora alata* var. *Holdererii* (Gutw.) mihi (×528).
Figs.19-20.—*Gomphonema augur* var. *rotundatum* (Ehr.) mihi (×704).
Figs.21-22.——————— var. *angulatum*, n.var. (×704).
Fig.23.——————— *constrictum* var. *australe*, n.var. (×528).
Fig.24.——————— *triangulare*, n.sp. (×704).
Fig.25.—*Achnanthes calcar* var. *australis*, n.var. (×1056).
Fig.26.——————— lower valve (×1056).
Fig.27.——————— var. *pulcherrima*, n.var. (×1056).
Fig.28.—*Cocconeis placentula* var. *euglypta* (Ehr.) Cleve. (×1056)
Fig.29.——————— var. *australica*, n.var. (×528).
Fig.30.—*Epithemia gibberula* var. *perpusilla*, n.var. (×1056).
Figs.31-32.—*Eunotia formica* var. *Richmondiae*, n.var. (×528); (31*a*), apex in girdle-view (×704).
Figs.33-38.—*Synedra Lismorensis*, n.sp. (×704); (*a*), girdle-view (×704).
Figs.39-40.—*Surirella ovalis* var. *pinnata* (W.Sm.) Van Heurck (×704).
Figs.41-42.——————— var. *Lewisii* mihi (×792).
Fig.43.——————— portion of the edge, showing incipient costa; much enlarged.

Plate v.

Fig.1.—*Surirella plana* G.S.West, forma (×528).
Figs.2-3.——————— var. *algensis*, n.var.; (2), valve (×704); (3), girdle-view (×528).

Fig.4.—*Nitzschia paradoxa* var. *major* Van Heurck (×704).
Fig.5.——————— var. *perpusilla*, n.var. (×1056).
Fig.6.——— *vermicularis* var. *vialis*, n.var. (×352).
Fig.7.——————— var. *minuta*, n.var. (×704).
Fig.8.—*Tryblionella Hantzschiana* var. *minor*, n.var. (×704).
Fig.9.——————— var. *Victoriæ* (Grun.) mihi (×704).
Fig.10.——————— girdle-view (×704).
Fig.11.——————— edge in ¾-face; much enlarged.
Fig.12.——————— var. *calida* (Grun.) V. Heurck(×528).
Fig.13.——————— var. *ovata* (Lagerstedt) mihi; (*a*), girdle-view (×704).
Fig.14.——————— var. *australica*, n.var. (×528).
Fig.15.——— *cruciata*, n.sp. (×704).
Fig.16.—*Melosira varians* var. *moniliformis* (O.F.M.), semi-detached frustules in a short filament (×704).
Fig.17.——————— isolated cell dividing (×528).
Fig.18.—*Cyclotella Meneghiniana* Kütz., forma; (*a*), girdle-view (×704).
Fig.19.——————— var. *convexa* mihi; (*a*), girdle-view (×704).
Fig.20.——————— another form (×1056).
Figs.21-22.——————— var. *quadrata*, n.var.; (22), girdle-view (×1400).
Fig.23.——————— var. *brevistriata*, n.var. (×1056)
Fig.24.——————— var. *fluviatilis*, n.var. (×1056).
Fig.25.—*Diadesmis confervacea* var. *peregrina* (W.Sm.) (×704).
Fig.26.—*Hydrosera triquetra* Wallich (×352); (*a*), end (×704).
Fig.27.—*Coscinodiscus lacustris* var. *stellatus*, n.var. (×704).
Fig.28.——————— var. *denticulatus*, n.var. (×704).
Fig.29.——————— var. *papillatus*, n.var. (×352).
Fig.30.——————— var. *tympaniformis*, n.var. (×528).
Fig.31.——————— var. *Iris*(Herib.&Brun) mihi(×528).

Plate vi.

(All figures magnified 660 diameters unless stated otherwise.).

Fig.1.—*Anabæna oscillarioides* var. *cylindracea*, n.var.; (*a*) filament diam. 7μ one end, 5μ the other, with rounded apical cell, and a terminal heterocyst; (*b*) terminal heterocysts, two forms, (×1000); (*c*) filament with two forms of heterocyst; (*d, e*) cells quadrate and vacuolate, (*c, d, e*) show plainly the development of the heterocysts from globular to cylindrical; (*f*) spores; (*g*) cells with granular and homogeneous protoplasm in same filament; (*h*) minute filaments like this in profusion (16), outgrowth probably of isolated cells.

Fig.2.—*Nodularia spumigena* Mertens; (*a*) infertile filament with three forms of heterocyst; (*b*) with ripe spores; (*c*) with immature spores.

Fig.3.—*Oscillatoria splendida* var. *attenuata* W.& G.S.West.

Fig.4.————————————var. *limnetica* (Lemm.) mihi.

Fig.5.————————————var. *bacilliformis*, n.var.

Fig.6.————————————var. *amylacea*, n.var.; (*a, b, d*) rare forms of apex; (*c*) filament with sundered trichome, showing sheath and also the common type of tip.

Fig.7.—*Oscill. splendida* var. *amylacea* forma *clarescens*, n.f.; the markings hardly visible.

Fig.8.———————————— incipient filaments, outgrowth of motile cells; (*a*) on *Oedogonium* (×330); (*b*) on vegetable débris; (*c*) on previously deposited living cells; (*d*) becoming filamentous by growth.

Fig.9.—*Oscillatoria tenuis* Ag.

Fig.10.———————— var. *chlorina*, n.var.

Fig.11.—*Lyngbya Lismorensis*, n.sp.; (*a, b, c*) common and characteristic apices; (*d, e, f*) rare forms of tip; (*g*) broken filament showing sheath.

Fig.12.———————— var. *nigra*, n.var.; (*a*) with broad smooth dissepiments and fine incipient septa; (*b*) with granulate septa.

Fig.13.—*Phormidium tenue* (Menegh.) Gomont; (*a*) three forms of trichome in the same filament; (*b*) tip of a filament with contiguous cells; (*c*) a filament with spores.

Fig.14.—*Phormidium fragile* (Menegh.) Gomont; two sizes, cells showing the characteristic appearance of the protoplasm.

Fig.15.—*Spirulina major* Kütz.; two forms.

Fig.16.————— *laxissima* G.S.West.

Fig.17.————— *Corakiana*, n.sp.

Fig.18.—*Merismopedia punctata* var. *oblonga*, n.var.

Fig.19.—————— *elegans* A.Braun.

Fig.20.—*Cœlosphærium Kützingianum* Näg. (×500).

Fig.21.———————————— var. *punctata* (Näg.) mihi; (*a*) diam. 2μ; (*b*) 5μ × 2μ; (*c*) 5μ × 5μ; (*d*) tetraëdral form, diam. 6 μ; (*e*) eight-celled cœnobium, diam. 8μ; (*f*) diam. 10 μ; (*g*) diam. 12 μ; (*h*) diam. 16 μ: (*a*) to (*h*) show development of a young form of *Cœlosphærium Kützingianum* from the single cell. In profusion in No. 16, the above all noted in the same drop.

Plate vii.

Fig.1.—*Trochisia hirta* var. *elliptica*, n.var.(×330).

Fig.2.————— minute immature forms of growth, (*a*) smooth, (*b*) denticulate (×330).

Fig.3.———— *verrucosa*, n.sp. (×330).

Fig.4.—*Chytridium gregarium* Nowakowski, in carapace of a rotifer (×330).

Fig.5.—*Olpidium amphoridium*, n.sp., discharging (*a*) microzoospores, (*b*) a mass of spores (×660).

Fig.6.—*Rhizidium mycophilum* A.Braun, (*a*, *b*) immature forms, (*c*) mature, (*e*) extrusion of a mass of zoospores, (*d*) zoospores wriggling free (×330).

Fig.7.—*Rhizidium spirogyræ*, n.sp., (*a*) incipient forms, (*b*, *c*, *d*, *e*) discharged cells (all ×330); (*f*, *g*, *h*) other forms (×660).

Fig.8.—*Spirillum volutans* var. *maximum*, n.var. (×660).
discharged cells (all ×330); (*f*, *g*, *h*) other forms (×660).

Fig.9.—————*tenue* Ehr. (×1000).

Fig.10.———— *laxissimum*, n.sp., (*a*) small form, (*b*) larger (×1000).

Fig.11.—[*Oscillatoria*] *amphibia* var. *maxima*, n.var. (sporiferous *Spirillum* filament) (×330).

Fig.12.————— var. *aspera*, n.var. (sporiferous *Spirillum* filament), (*b*) part with spore capsules, part without (×500).

Fig.13.—*Bacillus subtilis* Ehr., (*a*, *b*) in filament form, (*c*) free cells with flagella (×660).

Fig.14.—*Bacterium termo* (Ehr.) Duj., (granular form), two zooglœa states (×660).

Fig.15.—*Operculata elongata* Kellicott, (*b*) retracted (×330).

Fig.16.—*Cothurnia parallela* Maskell, (*b*) retracted (×660).

Fig.17.—*Chætonotus larus* var. *maximus* (encysted) (×330).

Fig.18.—*Pamphagus mutabilis* (×330).

Plate viii.

Fig.1.—*Macrothrix spinosa* King, female with winter egg, (*e*) only one pair of antennæ figured (×100).

Fig.2.——————— var. *dentata*, n.var., front edge of carapace (×660).

Fig.3.—*Trachelomonas volvocina* var. *pellucida*, n.var., (*b*) with short neck (×1000).

Fig.4.——————*ovalis*, n.sp. (×660).

Fig.5.—*Lepocinclis Steinii* var. *suecica* Lemm. (×660).

Fig.6.——————— var. *australica*, n.var. (×660).

Fig.7.—*Menoidium pellucidum* var. *incurvum* (Fresenius) mihi. (*a*) from above (×1300).

Fig.8.——————————var. *clavatum*, n.var. (×1000).
Fig.9.—*Difflugia Casinoënsis*, n.sp. (×660).
Fig.10.—————*acuminata* var. *Levanderii* mihi (×250).
Fig.11.—————————var. *bacillifera*, n.var. (×330).
Fig.12.—————*Richmondiae*, n.sp., (*a*) from above (×660).
Fig.13.—*Euglypha alveolata* var. *hamulifera*, n.var. (×1000); (*a*) overlap of plates, more enlarged.
Fig.14.——————— var. *laevis* (Perty) mihi (×660).
Fig.15.—*Arcella papyracea*, n.sp. (×500).
Fig.16.—*Actinophrys sol* var. *simplex* (Schaudinn) mihi, but the rays show much fainter (×500).
Fig.17.—*Amoeba verrucosa* var. *quadrilineata* (Carter) mihi (×500).
Fig.18.——————— var. *limax* (? Dujardin) mihi (×660).
Fig.19.——————— var. *maxima*, n.var. (×330).
Fig.20.——— *radiosa* var. *minutissima*, n.var. (×660).
Fig.21.—————— var. *stellata*, n.var. (×220).

THE XEROPHILOUS CHARACTERS OF *HAKEA DACTYLOIDES* Cav. [N.O. PROTEACEÆ].

By A. G. HAMILTON.

(Plates ix.-x.)

Hakea dactyloides is a low shrub, very common in sandy places about Sydney, and on the coast and mountains wherever the Hawkesbury Sandstone occurs. It is associated with *Petrophila pedunculata, Banksia ericifolia, B. serrata, Lambertia formosa, Hakea pugioniformis, Leptospermum, scoparium, Darwinia fascicularis* and other xerophytes.

Like all drought-resisting plants, it is of slow growth, and the stems are tough and woody. They are covered with hairs of two kinds, long and slender, and capitate hairs of small size. The vascular bundles contain many thick-walled fibres, which make the twigs very tough.

The leaves are rather few in number, arranged spirally, and placed vertically, so that the edges are presented to the light. They are obovate in shape, narrowing to a short petiole. The apex of the leaf is sometimes quite rounded (*a*, Fig. 1), and sometimes narrowing to a short point(*b*, Fig.1). In the latter variety, they are relatively rather narrower than the round-topped leaves are. There are three principal veins, the secondary veins ramifying in between, and these sometimes have blind ends (Fig. 1). There is also a vein round the edge. They vary in size according to the character of the season in which they develop. If the growth period—November to February—be wet, they reach a size of 14 × 3·5 cm.; if rain is scarce, they barely reach 6 × 1·5 cm. They are thick, rigid, and tough. The colour is light olive-green (darker in plants growing in shady places), with the marginal thickening reddish. The surface is smooth and dull, and the primary veins project on both sides. The young leaves and shoots have a dense vestiture of hairs, those on the outside being a beautiful golden-brown, and those beneath silvery. They are spindle-shaped and thick-walled (Fig. 2). They fall off soon after the leaf has reached full size.

The stomates are found on both sides. They are sunk beneath the surface, and open into a vestibule formed by an upward arching of the surrounding epidermal cells, the aperture being at one end of the chamber, and directed towards the apex of the leaf. The chamber is 0·06 mm. long, 0·04 mm. wide, and the aperture 0·01 mm. in diameter. The stomata are numerous, as many as 120 to the square millimètre, making about 120,000 to an average-sized leaf. The epidermal cells are small, 0·01 mm., and rounded in form.

Seen in transverse section, the epidermis is composed of small cells, about 0·005 mm. high. The cuticle is very thick, 0·015 mm. (Fig. 3), of a dull olive-brown colour after the rest of the leaf has been decolorised by spirit. The cells are usually empty, but now and then contain cubical crystals. Scattered about in the epidermis are found capitate hairs in sunken cavities (Figs. 6-7). In the young leaf, these hairs are more plentiful. The interior wall of the epidermis projects downwards into the palisade tissue(Fig.6*a*). The hairs are thick-walled, and apparently empty; but the cavity stains with saffranin or gossypimin very deeply.

In the young leaf, the hairs project above the surface of the epidermis, and apparently as the leaf gets older, the cuticle grows up, so as to surround the hairs. Many of the hairs drop off while the leaf is young, and the portions of the epidermis, on which they were seated, grow up to the level of the rest, leaving no trace of the former existence of the hairs.

The mesophyll consists of palisade cells in two layers under each face of the leaf. The cells are rather large, 0·06 mm. long, and 0·0075 mm. wide, packed with rather large granular chloroplasts. There are no intercellular spaces, except just under the stomata (Fig. 5). Between the two layers of palisade cells, the mesophyll consists of irregularly rounded cells, containing chlorophyll, and measuring 0·04 to 0·06 mm. in diameter. There are no intercellular spaces here either. These cells do not contain so much chlorophyll as the palisade cells.

All through the mesophyll are numbers of large scleroblasts or stone-cells, columnar and simple (Fig. 8), or massive and irregularly branched in all directions (Fig. 9). Occasionally, a detached cell is found among the palisade cells, but the greater number have one or more of their branches touching the inner wall of the epidermis, and this part is usually expanded as if it were soft, and pressing against the epidermis. The greatest axis of these cells is at right angles to the plane of the leaf. They only rarely pass into the central region of the mesophyll, and still more rarely extend through from one palisade layer to the other. In some of them, a central cavity is seen, very narrow and branching, but the branches do not always correspond to the arms of the cell (Figs. 8 and 9 *a*). There are also narrow openings in the thickened wall, leading straight in to the central cavity.

The vascular bundles have a very strong development of hard bast—sclerenchymatous fibres with thick walls and small lumina. The few spiral vessels and sieve-tubes are embedded in the centre of this. In the marginal vein, the fibres lie outside the veins, but not inside.

The foregoing description applies to mature leaves growing in the open. Plants growing in shady places show marked differences. The leaves of the plants in the open average 0·4 mm. in thickness, while those of shade-plants are only 0·3 mm. The following table shows the main differences in measurements between ordinary and shade-leaves.

	Ordinary leaf.	Shade-leaf.
Leaf, thickness	0·4 mm.	0·3 mm.
Epidermis, thickness...	0·04 mm.	0·01 mm.
Cuticle, thickness	0·015 mm.	0·005 mm.
Palisade cells, length	0·05 mm.	0·03 mm.

In the shade-leaves, each cell of the epidermis almost always contains a single cubical crystal. The stomates are fewer in number than in the ordinary leaf, and the vestibules are shallow and wider. The palisade tissue is not so close, and is composed of shorter and narrower cells. The cuticle has not the brown tint of that in the ordinary leaf, being quite clear and transparent. The capitate hairs occur very sparsely. The scleroblasts are also rare. There is little difference in the external characters, except that the leaves of shade-plants have much darker green leaves, which may be accounted for by the thinness of the cuticle, and the absence of brown colour from it.

There can be no doubt but that the thick cuticle is a powerful factor in checking transpiration and this is aided by the deeply sunken stomates. The closeness of the palisade cells and the absence of intercellular spaces also aid in this. The young leaf is effectively protected by the thick coating of hairs.

The most remarkable feature of the leaf is the great development of scleroblasts. In the young leaf, even up to the time when it has reached full size, there are none to be found; and we have seen that, in those growing in the shade, they are rare or absent. But as the mature leaf, exposed to sun and wind, grows older, small masses of sclerenchyma appear in the middle region of the leaf; these increase in size and number till they occupy a very large part of the mid-region of the leaf—as much, I estimate, as 45 % of it. They begin their growth among the palisade cells, and extend gradually outwards till they reach the epidermis, and then the part touching the epidermis extends laterally. As to their origin, it is most likely, as Sachs conjectures, that they are nothing more than peculiarly developed parenchyma cells(**1**,p.146). From the fact that they develop most in leaves exposed to intense light, heat, and wind, it would appear that their occurrence is a direct consequence of those conditions. Their function is probably the same as that of the closeness of the mesophyll, viz., diminishing transpiration by, as Sachs states (**1**,p.144), slowing the exchange of sap between the parenchymatous tissue and the veins.

The function of the sclerenchymatous fibres round the vascular bundles is apparently to give rigidity to the leaf, but they would also undoubtedly assist in slowing transpiration, as they are always very strongly developed in plants exposed to dry conditions, and particularly so in the Proteaceæ(2). That they are effective in enabling the plant to withstand the effects of a dry environment, may be inferred from their common occurrence in such conditions in plants of very diverse natural orders.

REFERENCES TO LITERATURE.

(1) SACHS, On the Physiology of Plants.

(2) HAMILTON, "On the structure of the leaf in *Banksia serrata*," Report Aust. Assoc. Adv. Sc. 1907.

EXPLANATION OF PLATES IX.-X.

Plate ix.

Fig. 1.—Venation of leaf, ($\times \frac{1}{2}$).
Fig. 2.—Hairs on young leaf.
Fig. 3.—Epidermis and one row of palisade cells of ordinary leaf; *c*, cuticle.
Fig. 4.—Epidermis and one row of palisade cells of shade-leaf; *c*, cuticle.
Fig. 5.—Section of stomate and vestibule; *v*, vestibule; *g*, guardcells.
Fig. 6.—Capitate hair in cavity; *a*, projection of epidermis into mesophyll.
Fig. 7.—Ditto.
Fig. 8.—Simple scleroblasts; *a*, cavity.
Fig. 9.—Massive, branched scleroblasts; *a*, cavity.

Plate x.—Microphotographs.

Fig. 10.—Cross-section of ordinary leaf; *c*, cuticle; *s*, scleroblasts.
Fig. 11.—Cross-section of shade-leaf; *c*, cuticle; *s*, scleroblasts.
Fig. 12.—Section parallel to plane of leaf; *s*, scleroblasts cut at right angles.

ORDINARY MONTHLY MEETING.

May 27th, 1914.

Mr. C. Hedley, F.L.S., Vice-President, in the Chair.

Mr. W. J. Enright, West Maitland, was elected an Ordinary Member of the Society.

The Chairman regretfully announced the decease, on 15th inst., of Mr. E. G. W. Palmer, a Member of the Society elected in 1885, for some time a Member of the Council, and subsequently one of the Society's Honorary Auditors; and who, for many years, took an active interest in the Society's work and welfare.

The Secretary communicated a letter from the Hon. N. C. Rothschild, representing the Society for the Promotion of Nature-Reserves, recently established in England, accompanying a prospectus and circulars relating thereto. The writer said—"Although the Society primarily conducts its operations in the British Islands, we think that a similar movement should be encouraged in all parts of the Empire, and it is to ask you if you could bring the objects of the Society to the notice of the Government, the various men of Science, and lovers of Nature in Australia, that I am venturing to send you this letter. Australia being still largely undeveloped, affords, I think I may say, a unique opportunity for securing adequate Nature-reserves to preserve its fauna and flora in perpetuity, and, therefore, I think no excuse is needed for sending you details of this Society." [See an article on "Nature-Reserves," by Sir E. Ray Lankester, in "Nature," March 12th, 1914, p.33].

The Secretary called attention to some historically interesting as well as scientifically valuable, old prints of Australian plants, framed and glazed, presented to the Society by the Rev. James Lamont, F.L.S., of Mosman, since the last Meeting. They are Plates 2, 3, 7, 8, 9 and 10 (with two others still to come) of Parts i. and ii. of the very rare coloured issue of "Illustrationes floræ

Novæ Hollandiæ sive icones generum quæ in 'Prodromo Floræ Novæ Hollandiæ et Insulæ Van Diemen descripsit Robertus Brown,' Londini, 1813," by Ferdinand Bauer (1760-1826), the botanical draughtsman who accompanied Robert Brown on Flinders' Expedition, 1801-05, and subsequently. So much of Bauer's botanical work had not been published, that the speaker thought the Society was under great obligations to the donor for his thoughtfulness and liberality in making provision for these fine examples of Bauer's beautiful work becoming better known to present and future Australian botanical students.

On the motion of Mr. A. G. Hamilton, seconded by Mr. E. Cheel, it was resolved unanimously : That this Meeting desires to record its cordial appreciation of the Rev. J. Lamont's kindness in enabling the Society to take charge of the stimulating relics of an early botanical enthusiast, for the edification of Australian plant-lovers, present and to come.

The Donations and Exchanges received since the previous Monthly Meeting (29th April, 1914), amounting to 11 Vols., 101 Parts or Nos., 13 Bulletins, 2 Reports, and 4 Pamphlets, received from 64 Societies, etc., were laid upon the table.

NOTES AND EXHIBITS.

Mr. Froggatt exhibited specimens of a freshwater crustacean allied to *Branchipus stagnalis*, from a pond at Trangie, N.S.W., sent by Mr. Sarcombe. Also a pair of small butterflies "Blues" (*Ogyris hewitsoni* Waterh.) from Yarrum Burrum Plains, which visit the flowers of a Loranthus common on the Belar.

Dr. J. B. Cleland exhibited specimens from the River Murray, near Morgan, S.A., the work of white cockatoos, *Cacatoes galerita*. They consist of cones of *Callitris*, of which the upper parts have been bitten off, apparently with the object of obtaining the seeds before the cones had expanded. Also a number of fine twigs from an adjacent Eucalypt, which had apparently been nipped off, for some unknown purpose, by the same birds.

Dr. H. G. Chapman exhibited, for Dr. Burton Bradley and himself, a specially designed and locally constructed oven for imbedding histological material in paraffin. The imbedding vessels are set in trays, and surrounded with oil-jackets. Closed vessels for melting paraffin serve to keep the latter free from dust. In three trays, there is provision for imbedding 36 specimens in separate vessels.

Dr. Chapman communicated a note on the origin of the precipitate in precipitin-reactions from the globulin-fraction of the antiserum. Experiments showed that the main weight of the precipitate was due to denatured globulin.

Mr. A. A. Hamilton exhibited, from the National Herbarium, specimens of (1) *Olearia myrsinoides* F.v.M., (*Aster myrsinoides* Labill); Mt. Victoria (Fairy Bower) [A. A. Hamilton; November, 1913]. A form of this species, which owes its altered facies to environment The examples commonly found on the Blue Mountains, grow on the poor, rocky hillsides, and exhibit the xerophytic characters of low straggling growth (1-2 ft.), sclerophyllous leaves, etc. The specimens exhibited were taken from a luxuriant bush growing in a rich deposit of vegetable detritus in the midst of forest-vegetation, and near a watercourse, 5 feet in height, and with leaves 3 inches long, and nearly 2 inches wide, on petioles of ½ inch. The ordinary mountain-form, of which a specimen was shown for comparison, has leaves from ½-1 inch long, and ½ inch wide, with a short petiole. The original species (*A. myrsinoides* Labill.) has sessile leaves, rarely above ½ inch. There are examples of the form, under review, in the National Herbarium from Mt. Victoria (J. H. Maiden: December, 1896); between Lawson and Wentworth Falls (Captain Murray; October, 1899); Jenolan Caves (W. F. Blakely; January, 1900).—(2) *Lepidosperma flexuosum* R.Br.; Leura (A. A. Hamilton; April, 1914); showing a transition in the inflorescence from a single spikelet to a branching panicle. This, and the following species have not been recorded from the Blue Mountains previously.—(3) *Lepidosperma filiforme* Labill.; Leura (A. A. Hamilton; April, 1914); the specimens have, in nearly every case, one spikelet only. Labillardière's figure (Pl. Nov. Holl., i., t.15) shows a spike with four spikelets.—(4) *Acacia floribunda* Willd.; Meadow

Bank (A. A. Hamilton; April, 1914); showing a reversion to juvenile leaves, due to arrested growth. Pinnate leaves are to be noted springing from the ends of branches from which twigs have been violently torn off; the surrounding phyllodes are more or less attenuated.—(5) *Escholtzia californica* Cham. Hort.; Yass (Rev. J. W. Dwyer; May, 1911); showing heterotaxy. Adventitious buds arise from the recurved margin of the floral receptacle in company with the flower, and, a short distance below, leaves are produced on the peduncle, whose distended recurved base, which represents the floral receptacle, indicates an abortive attempt at flower-production.—(6) *Rosa viridiflora* Hort. var.; Bot. Gardens, Sydney (J. L. Boorman; August, 1913); showing phyllody of the corolla, petalody of the stamens, and virescence. The upper portion of the petal is lobed, disclosing its foliaceous character; the barren anthers are seated on the central portion of the particoloured laminæ, the lower portion being produced into a claw, representing the staminal filament.—(7) *Lomatia silaifolia* R.Br.; a series of leaves of this plant, exhibiting an exceptionally large range of leaf-variation.

Mr. Halero Wardlaw reported the results of his recent daily observations of the temperatures of a number of Echidnas which were living in captivity at the University. The animals had been living in perfect health for the past few months now, so that their temperatures were presumably normal. These are peculiar, inasmuch as they do not remain at a constant high level, like those of higher mammals; nor do they follow the external temperature at a level a few degrees higher like those of reptiles. The temperature of Echidnas varies from 25-33°C., and shows a diurnal variation of about 3°, the highest temperatures being in the afternoon. This variation is independent of alterations in the external temperature. During the last few days several of the animals under observation had commenced hibernation, and their temperatures were now at the level of that of the air, but were following the alterations of this exactly.

Mr. E. Cheel exhibited a series of specimens of seventy distinct forms of cultivated legumes, chiefly belonging to the genus *Phase-*

olus, which had been grown for five years in some instances, for the purpose of testing the characters of growth and noting any changes in the colour of the flowers and seed-coats, etc., without resorting to artificial pollination.—(1) The various forms of *Phaseolus vulgaris* were found to be fairly constant, reproducing their flowers and seeds true to the parent-forms. In two instances, however, dwarf forms were found intermixed with climbers; these were marked, and grown again separately; and in each case, the dwarf or climbing habit of their respective parents was retained. With regard to certain forms of *P. multiflorus*, considerable variation occurred in the colour of the flowers and seed-coats. For example, from seeds of the form known in the trade as "Papilio" or "Butterfly-Runner," plants were obtained producing three distinct forms; viz., (1) flowers and seeds like the parent-form, (2) flowers pale scarlet, and seed with cream background with cupreous markings, and (3) flowers similar to No.2, but with seed having a pale reddish-mauve or amethyst background, and marked with purplish splashes or stripes. The latter had flowered again, producing flowers exactly like the original "Papilio"-forms, namely, scarlet standard and white wings. Another form producing seeds somewhat resembling those of the typical "Scarlet Runner," but paler, with less dark-coloured markings, and flatter irregular seeds, which may be temporarily designated a "Pale form of Scarlet Runner," occasionally produces plants having white flowers, and white seeds, almost identical with those of the form known in the trade as "Czar" or so-called "White Scarlet-Runner." As the different forms were grown quite close to each other, it is quite possible that cross-pollination had taken place, as bees were observed, on two occasions, visiting the flowers, irrespective of colour.—(2) Examples of *P. lunatus* and the forms of var. *macrocarpus* were likewise exhibited; these, so far, have given no variants.—(3) Pods and seeds of three species of *Stizolobium* (Velvet Bean); these, too, so far, have given no variants.—(4) Examples of *Canavalia obtusifolia* DC., *C. ensiformis* DC., and *C. gladiata* DC., which appear to be constant. The last two are regarded by some authors as belonging to one species, but *C. ensiformis* (commonly known as "Jack

Bean") is an annual about 2 ft. 6 in. high; whereas *C. gladiata*, which is known as "Red Bengal Bean," or sometimes "Sword Bean," is a very vigorous climber of perennial habit, according to Mr. B. Harrison, of Burringbar, Tweed River.—Mr. Cheel showed, also, specimens of an introduced plant, known in Europe as the "Caltrop-like Medick" (*Medicago truncatula* Gaertn., = *M. tribuloides* Lam.), from the Scone and Yanco districts, which was an undesirable plant in sheep-country, on account of its harsh, spiny fruits.

Mr. G. H. Halligan exhibited, in quantity, examples of an undetermined Amphipod, which after rain, and with the wind in a certain direction, were to be found, regularly, strewn over the floor of the porch of his house at Hunter's Hill. As his garden was kept in order, and there was nothing out of the ordinary in the way of cover for the animals, he was at a loss to know how they came to be so abundant; and he asked for an explanation of their occurrence.

Mr. Fletcher exhibited an additional set of specimens illustrating the cohesion of opposite leaves in *Lantana Camara* L. A very complete gradational series had been obtained showing the results of (*a*) temporary adherence of the petioles only, followed by separation, but bringing about the extinction of the shoot; (*b*) incomplete fusion of the petioles on one side, accompanied by coherence of one margin of each leaf, sometimes allowing of the escape of the shoot through a chink, but more often extinguishing it; (*c*) complete cohesion of the petioles resulting in the smothering of the shoot, accompanied by the cohesion of more or less of both margins of the leaves; (*d*) cohesion of portion of the underside of each of two leaves, brought about partly by a twisting of one of the petioles; and (*e*) cohesion of the petioles of one pair of opposite leaves and of that of one leaf of the pair next below, accompanied by cohesion of both margins of one leaf with one margin of each of the other two leaves involved.

The Chairman invited discussion on Mr. Andrews' paper on "The Development of the N.O. *Myrtaceæ*" (Proceedings, 1913, p.529). Mr. Fletcher, Dr. J. R. Dixon, and Mr. Tillyard took part in the discussion; and Mr. Andrews replied.

ON SOME PROBLEMS CONCERNING THE DEVELOPMENT OF THE WING-VENATION OF *ODONATA*.

By R. J. Tillyard, M.A., F.E.S., Science Research Scholar in the University of Sydney.

(Plates xi.-xiii., and twenty text-figures.)

Introduction.

During the course of some researches into the tracheal system of *Odonate* larvæ, I had occasion to examine a very large number of these interesting creatures. Thus a beautiful series of developing nymphal wings was presented to me, which it was impossible to ignore or to cast away unexamined. Hence it was that I determined to photograph the wings of each species, as opportunity offered, and to use them with a view to familiarising myself with the problems and theories set forth by Needham in his now famous paper.*

It soon became evident that there were certain portions of the question in hand that needed special attention, while new aspects of the problem presented themselves to my mind and demanded investigation. It seemed to me that the whole problem of the development of the unique venation of the *Odonate* wing might conveniently be divided into two parts, viz.:—

i. The study of the tracheæ of the developing wing, and their relationships to the imaginal wing-veins.

ii. The study of the source of the oxygen-supply of the wing-tracheæ.

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* Needham, J. G., "A genealogic study of Dragonfly Wing-Venation," Proc. U. S. Nat. Mus., xxvi., pp.703-764, 1903.

Now Needham's paper deals with i. only, and that chiefly in so far as it concerns the *Anisoptera*. The investigations into the *Zygoptera* seem to have been on a much smaller scale, and it is very evident that a wide field of research remains open in this direction. With regard to the *Anisoptera*, it seemed to me that the study of the anal tracheæ had been left in a somewhat unsatisfactory state. Hence I have devoted a considerable part of my paper to an elucidation of this problem, with special reference to the development of the so-called *anal loop*.

With regard to ii., it seems quite clear that the wing-venation cannot be fully understood until we go to the *root* of the problem. That is to say, we must go a stage back beyond i., and enquire carefully how the oxygen-supply is brought to the wing-tracheæ; or, in other words, we must connect up these wing-tracheæ with the complex tracheal system of the larva, and study the connection between them.

The general tracheal system of the *Odonate* larva is so peculiar that it might well be suspected of exercising some special influence on the developing wing. Its chief peculiarity is the fact that the oxygen-supply is derived in all cases *from the anal end of the body* during practically the whole period of growth; either by means of the internal "branchial basket" in the rectum of *Anisoptera*, or by the external caudal gills of *Zygoptera*. Hence, chiefly by means of the huge dorsal tracheal trunks, but also in a less degree by the visceral and ventral trunks, the oxygen is conveyed forwards to all parts of the body. As regards the head and thorax, the supply comes entirely from the dorsal trunks, since the ventral trunks do not reach so far forward, and the visceral trunks send only their attenuated anterior ends into the thorax to connect with the tracheæ of the middle leg.

Now in all cases so far investigated, the tracheal supply of the developing wings of insects has been found to arise from two sources*:—

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* Comstock and Needham, "The Wings of Insects," American Naturalist, xxxii., pp. 45 *et seq.*, 1898.

A. A branch from the great dorsal trunk enters the *costal side* of the wing-base and supplies the *costo-radial* group of wing-tracheæ (viz., *costa*, *subcosta*, *radius* and *media*).

B. A branch from the ventral trunk enters the *anal side* of the wing-base and supplies the *cubito-anal* group of wing-tracheæ (viz., *cubitus* and *analis*).

In all cases, except *Plecoptera* and some Cockroaches, the branches A and B are connected by a transverse trachea, so that a continuous loop is formed passing from the dorsal trunk into the costal side of the wing-base, thus making a loop projecting slightly into the wing-base (from this loop the wing-tracheæ arise in order), and finally leaving the wing-base at its anal side and joining the ventral trunk.

It is quite clear, therefore, from the start, that this last connection with the ventral trunk could not exist in *Odonate* larvæ; since this trunk does not enter the thorax. However, it is equally clear that a complete loop exists in the base of the wing-rudiment, since it can be seen both in the living larvæ, and in the cut-off wing-cases. I propose to call this loop the *alar trunk* (AT), since it is the trachea from which all the principal longitudinal tracheæ of the wing arise. The question of its connections costally and anally with the general tracheal system, will be fully dealt with in Part ii. of this paper.

It is fitting that I should state here how valuable and inspiring I have found Professor Needham's work, already quoted. It is, indeed, a solid and excellent foundation, on which all future researches on *Odonate* wing-venation must be built, and a work that merits the highest meed of praise. Nor can I pass on without recording my indebtedness to all those who, during my long period of ill-health, have so generally assisted me in obtaining the many rare larval forms necessary for the work in hand. For these, I have to thank my wife, Mr. F. W. Carpenter, M.A., Mr. Gregory Geake, and my brother, Mr. S. J. Tillyard.

Owing to the fact that the wing-cases of so many larvæ are very deeply pigmented, and sometimes also very hairy, I have adopted the plan of illustrating this paper by drawings traced from actual photomicrographs taken by myself. In these, it is both permissible and desirable to omit all traces of the permanent wing-venation, except such as immediately concern the question in hand. The resulting incompleteness is more than compensated for by the clearness of view thus gained. I have, however, reproduced, in the Plates, such photomicrographs as are most essential to the discussion, in order that their interpretation should not be allowed to rest upon my own drawings.

The contents of the paper may be arranged as follows:—

Part i.

The study of the tracheæ of the developing wing, and their relationships to the imaginal wing-veins.

Section A.—The development of the anal trachea in Anisoptera, and its relationships to the cubitus, anal loop, and anal triangle.

For the purpose of this section, I studied all the Anisopterous larvæ available within a radius of one hundred miles of Sydney, except some of the rarer species which I failed to obtain. In all, the wings of nearly fifty larvæ in different stages of development, but chiefly nearly full-grown, were cut off and examined. From these, a set of more than forty photomicrographs was prepared, giving a wide view of the problem in hand.

The following is a complete list of the genera and species studied :—

Subfamily.	Genus.	Species.
Gomphinæ	*Austrogomphus*	*A. ochraceus* Selys.
		A. heteroclitus Selys.
Æschninæ	*Austrophlebia*	*A. costalis* Tillyard.
	Austroæschna	*A. multipunctata* Martin.
		A. longissima Martin.
	Dendroæschna	*D. conspersa* Tillyard.
	Æschna	*Æ. brevistyla* Ramb.
	Anax	*A. papuensis* Burm.
Corduliinæ	*Synthemis*	*S. macrostigma orientalis* Tillyard.
		S. eustalacta Burm.
	Metathemis	*M. guttata* Selys.
	Austrocordulia	*A. refracta* Tillyard
	Hemicordulia	*H. tau* Selys.
		H. australiæ Ramb.
	Cordulephya	*C. pygmæa* Selys.
Libellulinæ	*Orthetrum*	*O. caledonicum* Br.
		O. villosovittatum Br.
	Diplacodes	*D. bipunctata* Br.
		D. hæmatodes Burm.

This list comprises thirteen genera (properly fourteen, since *Austrogomphus heteroclitus* Selys. is not congeneric with *A. ochraceus* Selys.), and nineteen species. It is fortunate that the *Corduliinæ* are so well represented in Australia, since the principal changes in the anal area of the wing take place in this subfamily.

In his remarks on the anal trachea A., Needham (loc. cit., p.721) points out that it fuses with the cubitus Cu close to the base, and later on branches away from it. This fusion was seen in all *Anisoptera* examined by him. It occurs also in all the forms which I have examined; so that we may be fairly certain that it is as universal an occurrence as the fusion of the radius with the media.

The very great importance of this basal fusion of Cu and A, and its bearing on the imaginal wing-venation, seems to have escaped Needham. Two very important facts need to be emphasised in connection with it:—

(1). The so-called "first cubito-anal cross-vein" of Needham is not a true cross-vein at all, but is formed about the anal trachea itself, at the point where it descends from Cu. It may be called the *anal crossing*(Ac).

(2). The so-called "anal vein" of Needham is not a true anal vein, *i.e.*, not developed along the anal trachea, but is a secondarily formed bridge-vein from the lower end of Ac back towards the wing-base, to which it is connected posteriorly in a manner different from the other main veins. Hence the correct notation for this part of the wing is as follows:—

The cubitus(Cu) of the imaginal wing becomes Cu + A as far as Ac.

The "anal vein" (A) must be distinguished as the *secondary anal vein*, and designated A′.

To make these points quite clear, let us compare the nymphal and imaginal wings of *Æschna brevistyla* Ramb.(Figs.1-3, and Plate xi., figs.1-2). The course of the anal trachea is best followed in the hindwing.

The convergence of A towards Cu near the base, as also that of M towards R, is primarily due to the gradual narrowing of the base of the developing wing in comparison with its length. At first, all these tracheæ are separate; but by the time the wing-cases are half-grown, the fusion of Cu + A, as well as that of R + M, can be clearly seen. As the wing grows, the fusion becomes greater, until, in the nearly full-grown nymph, A is seen to run obliquely up to join Cu very near its base, and then runs closely alongside it as far as Ac. At this point, A turns sharply downwards away from Cu, in the same manner that M turns away from R at the arculus. Hence Ac is the exact analogue of the upper portion of the arculus. It is, for this reason, that at least one "cubito-anal cross-vein" occurs in every *Odonate* wing.

At the lower end of Ac, A branches into two, just as M branches into two when leaving the arculus. These branches were primarily an upper one, $A_{1\text{-}3}$, and a lower one, A_4, exactly comparable to $M_{1\text{-}3}$ and M_4. But owing to the altered shape of the wing-area to be supplied, the upper branch $A_{1\text{-}3}$ becomes a *distally-running* branch, while the lower branch A_4 becomes a *basally-running* branch. In the half-grown *Æschna*-wing, the

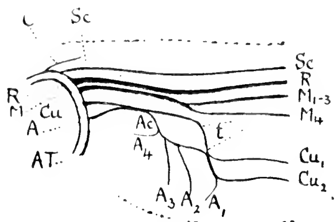

Fig. 1.

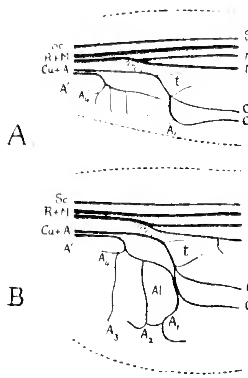

Fig. 2.

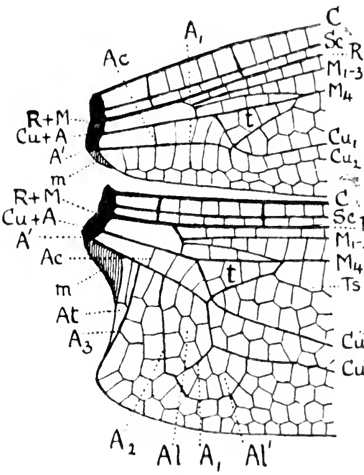

Fig. 3.

Fig. 1.—*Æschna brevistyla* Ramb. Tracheation of a half-grown nymphal hindwing. (Sydney, N.S.W.; Sept., 1913).

Fig. 2.—*Æschna brevistyla* Ramb., ♂. Tracheation of nearly full-grown nymphal wings. (Sydney; Sept., 1913). A, forewing; B, hindwing.

Fig. 3.—*Æschna brevistyla* Ramb., ♂. Basal portion of imaginal wing-venation. (Sydney; Oct., 1913).

two branches may be seen in this position, $A_{1\text{-}3}$ running distally from Ac and giving off in turn $\mathbf{A}_3$, A_2 and A_1, while A_4 runs basalwards back from Ac (Fig. 1). Later on, owing to the development of the strong *anal triangle* in the male, or the corresponding rounded portion of the wing in the female, A_3 tends to migrate from $A_{1\text{-}3}$ across Ac, to become attached to A_4 very close to Ac(Fig.2). But, in the forewing, it still remains attached to $A_{1\text{-}3}$.

Let us now study the four branches of A from the base outwards Firstly, A_4 is a short, weak trachea, only reaching back from Ac to about half-way towards the wing-base. In many forms, it comes downwards at its end. Towards the *posterior edge* of the true wing-base, the line of A_4 parallel to Cu + A is continued by the formation of the *secondary* anal vein A′, which becomes attached to the wing-base of the imaginal wing. Hence we see that A′ is a bridge-vein continuing the weak trachea A_4 back to the wing-base; its distal portion is formed about A_4 itself, but its basal portion is not formed about any important tracheal branch at all. It is comparable, therefore, to the "bridge-vein" connecting Rs backwards to $M_{1\text{-}2}$, which occurs in all *Anisoptera.*

Secondly, A_3 is a fairly strong trachea descending either (primarily) from $A_{1\text{-}3}$ (Fig.1), or (secondarily) from Ac or A_4 (Fig.2), towards the posterior border of the wing. About it, in the imaginal wing, the *distal side of the anal triangle* is formed in the male (Fig.3). In the female, it is usually less regressed towards the base, and generally descends straight from Ac, though individual variations, both basad and distad from Ac, are sometimes seen. It gives rise, in the female imago, to a descending vein of less importance than the distal side of the triangle in the male, but corresponding to it. The fate of this branch, in both sexes of the *Libellulinæ*, is of interest, and will be followed out later.

Thirdly, A_2 is a strong branch descending sharply from $A_{1\text{-}2}$ somewhat distad from Ac, and roughly parallel to A_3. In the *Æschninæ* (and, indeed, in all forms in which a "loop" is developed) it forms the proximal or basal side of the "anal loop" (Al, Fig.3)

Fourthly, A_1 is a strong trachea which continues distally towards Cu_2, which it meets quite close under the point of bifurcation of Cu_2 from Cu_1. It then fuses with Cu_2 for some distance, turning slantingly downwards to run alongside it, and finally leaves Cu_2 by bending downwards and backwards, so as to complete the formation of the distal side of the "anal loop." In the genus *Æschna*, it bifurcates, near its end, into two small branches. One of these turns basad to join A_2, thus completing the closure of the anal loop; while the other turns away distad in a curve, and helps to form the well-known secondary loop of this genus (A1′, Fig.3). The fate of A_1, in the *Libellulinæ*, is also of great interest, and will be dealt with later on.

Having traced the course and fate of the various branches of A in *Æschna*, we may now exhibit, in a table, the complete comparison between the two pairs of combined tracheæ, viz., R + M and Cu + A.

	R + M combine		Cu + A combine	
	2-branched trachea R.	4-branched trachea M.	2-branched trachea Cu.	4-branched trachea A.
First branch	R_1	M_1	Cu_1	A_1
Second branch	Rs	M_2	Cu_2	A_2
Third branch	—	M_3	—	A_3
Fourth branch	—	M_4	—	A_4
Point of departure ...	Arculus (arc.)		Anal-crossing (Ac.)	
Backward vein from fourth branch	[Upper side of triangle]		Secondary anal vein (A′)	
Supplementary sector under lower branch of two-branched trachea	Rspl.		Cuspl. (only in *Libellulidæ*, vide infra).	

In the above table, corresponding parts in the two main columns are true analogues of one another, except in one case, viz., the upper side of the triangle. This is, of course, not analogous to A′, but it is included in the table in brackets in order to call attention to the manner in which it continues M_4 backwards, just as A′ continues A_4 backwards.

We turn now to the study of the *Anal Loop*. The structure known by this name is found throughout the *Æschninæ* and the whole series of the *Libellulidæ*. But whereas it varies very little in shape throughout the *Æschninæ*, it exhibits very great diversity of form in the *Libellulidæ*. On the one hand, we have the wide, roundish loop of *Macromia* and *Synthemis*, while, on the other, we see the extremely elongated and narrow, foot-shaped or *Italian** loop of the majority of the *Libellulinæ* and the *Eucorduliini*.

There are two theories in the field to account for the development of this remarkable Italian loop. They may be termed the *Theory of Double Descent*, and the *Theory of Single Descent* respectively. They are of special importance, because the whole of one's view of the phylogeny of the *Libellulinæ* depends upon which theory one is willing to accept.

The *Theory of Double Descent* postulates a separate origin for the *Æschnine* and *Macromian* loops, on the one hand, and the Italian loop on the other. As formulated by Dr. Ris,† and up till now accepted by the majority of students of the *Odonata*,‡ it depends mainly on the following interpretation of the venation of the two forms of loop concerned(Fig.4A). The *Æschnine* and *Macromian* loops are enclosed (as shown above) by A_2 as basal side, and A_1 as distal side. But the Italian loop is formed with A_3 as basal side, and A_1 as distal side, while A_2 forms its strong midrib.† Hence the two forms of loop are not homologous, and cannot be descended along a single line. According to the exponents of this theory, the *Libellulinæ* are descended from narrow-winged forms similar to *Tetrathemis*, and hence the Italian loop arose by *secondary broadening* from this narrow form of wing.

The *Theory of Single Descent*, which I formulated in 1912,|| postulates a single line of descent for all the different known

* I suggest this as a convenient name for this form of loop, which much resembles the map of Italy in shape.

† See diagram of typical *Libelluline* wing (*Scapanea frontalis* Burm.) in Dr. Ris' *Libellulinen*, Fasc. i.-xvi. of de Selys' Monographs, 1910-1914.

‡ In the short account of the anal loop given by Needham (*loc. cit.*, p.722), there is nothing to indicate that he favoured this theory. On the contrary, his words, so far as they go, seem to oppose it, but no lettering is attached to his figures of loops. It seems unlikely that the question of a double descent ever occurred to him. The theory was, however, a direct outcome of the impetus given to venational study by his paper.

§ These Proceedings, xxxvii., p.724, 1912.

forms of anal loop. Without attempting to homologise the corresponding parts of the *Æschnine* and Italian loops, it was a protest against the assumption of a double origin for two essentially similar formations; and, in particular, it was a special protest against the assumption that the narrow-winged forms, such as *Tetrathemis*, *Cordulephya*, *Agriogomphus*, lay anywhere close alongside the main line of descent of the *Anisoptera*. In brief, I considered all such narrow-winged forms to be highly specialised *asthenogenetic* offshoots from the main stem, while the main line of advance had consisted of *broad-winged* forms from the very beginning; and hence, there could be only one origin for all kinds of anal loop. The notation that agrees with this theory is given in Fig.4B.

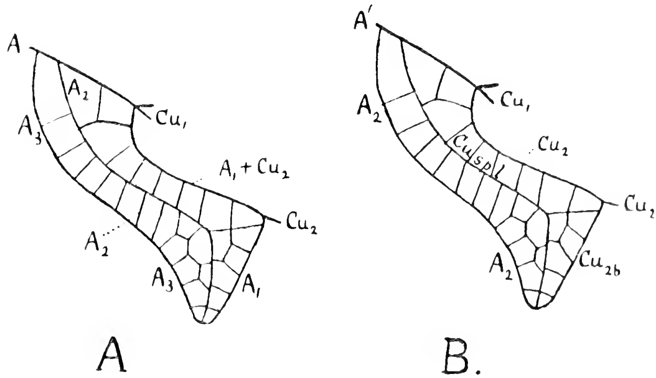

Fig.4.

Fig.4.—*Scapanea frontalis* Burm., ♂. Diagram to show the notation of the anal loop. A, as given by Ris; B, as worked out in this paper. Compare Figs.11-12.

These two theories are, in this paper, put to the crucial test by a careful study of the *tracheation* of the developing anal loop. Putting aside the *Gomphinæ*, in most of which no anal loop is formed, the twelve other genera studied by me can be arranged in four distinct groups or stages, which show a distinct phylogenetic connection as regards their anal loops, and may be arranged in ascending order of development, as follows :—

Stage 1.—*Æschninæ* [*Austrophlebia*, *Austroæschna*, *Dendroæschna*, *Æschna*, *Anax*].

Stage 2.—*Synthemini* [*Synthemis*, *Metathemis*].

Stage 3.—*Idocorduliini* [*Austrocordulia*].

Stage 4.—*Eucorduliini* + *Libellulinæ*[*Hemicordulia*, *Orthetrum*, *Diplacodes*; with *Cordulephya* a specialised offshoot from near the base of the *Eucorduliini*].

Let us now study these four stages in turn :—

Stage 1.—*Æschninæ* (Figs.1-3, and Plate xi., figs.1-3). All the genera studied under this stage, agree exactly, in the formation of their anal loops, with the description already given in the case of *Æschna brevistyla*(Figs.1-3). In all cases, the basal side of the loop is A_2, and the proximal side is A_1, the latter fusing with Cu_2 for some distance, and finally turning inwards to complete the loop below.

Stage 2.—*Synthemini* (Figs.5-8, and Plate xi., figs.4-5). At first sight, there seems to be very little difference between the anal loop of the *Synthemini* and that of the *Æschninæ*. But a little consideration will show us that those forces which culminate in the formation of the complex Italian loop are already at work. Two important changes are *beginning* to take place :—

(1). Ac bends off from Cu + A much closer to the base of the wing than to the triangle. [In Stage 1, it bends off somewhat nearer to the triangle than to the base, while in the *Gomphinæ* it is still nearer to the triangle].

(2). Consequently A_1 is stretched longitudinally, tends to decrease in diameter, and makes a weaker union with Cu_2.

Probably the larva of *Macromia* will be found to exhibit a similar arrangement, though we must not be too hasty in assuming a near relationship between this genus and the *Synthemini*. *Metathemis* agrees exactly with *Synthemis*.

This stage shows the *first attempt to enlarge the basal area of the hindwing*. It is carried out on very simple lines, viz., by a purely longitudinal stretching of the area between Ac and the triangle. Developed to its logical conclusion, it culminates in such forms as *Synthemis regina* ♂ and ♀, in which the enormously widened anal loop is split into two by the development of a straight supplement parallel to A_2 (Fig.8, X); while, in the very broad-winged female, even A_3 is dragged in to make a third support, giving the insect an apparently three-portioned anal loop of immense width.

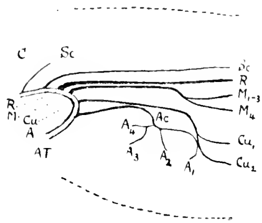

Fig.5.

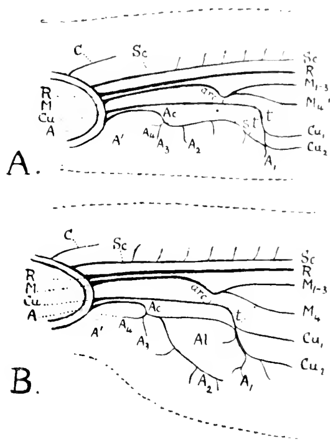

Fig.6.

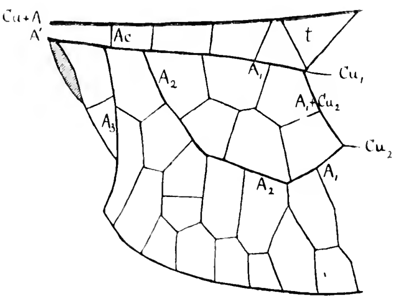

Fig.7.

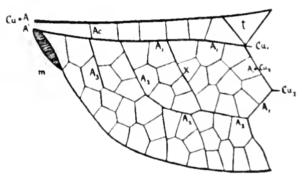

Fig.8.

Fig.5.—*Synthemis macrostigma* Selys. Tracheation of a half-grown nymphal hindwing. (Blue Mountains; Sept., 1913).

Fig.6.—*Synthemis macrostigma* Selys, ♂. Tracheation of nearly full-grown nymphal wings. A, forewing; B, hindwing.

Fig.7.—*Synthemis macrostigma* Selys, ♂. Portion of imaginal venation, to show structure of anal loop.

Fig.8.—*Synthemis regina* Selys, ♀. Portion of imaginal venation, to show structure of compound anal loop. The vein X is not developed along any main tracheal branch, but is a supplement comparable to Cuspl in *Hemicordulia* and the *Libellulinæ*.

It is scarcely necessary now for me to say that these phylogenetic stages, taken from living examples, do not lie along one absolutely straight line of descent. Each, rather, lies a little off the direct line that culminates in the Italian loop; nevertheless, each is a true advance on the one before it.

Stage 3.—*Idocorduliini* (Figs.9-10, and Plate xi., fig.6). We now come to a stage exhibited by the rare larva of *Austrocordulia*

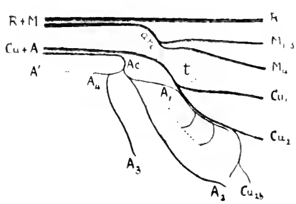

Fig.9.

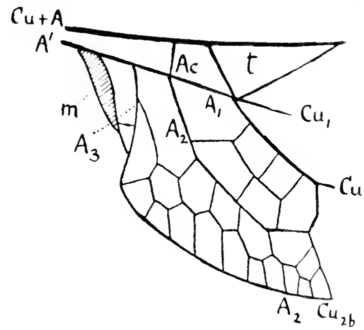

Fig.10.

Fig.9.—*Austrocordulia refracta* Tillyard, ♂. Tracheation of full-grown nymphal hindwing. (Stanwell Park, N.S.W.; Feb., 1914).

Fig.10.—*Austrocordulia refracta* Tillyard, ♂. Portion of imaginal venation, to show structure of anal loop. (Heathcote, N.S.W.; from a specimen, bred Dec. 20th, 1912).

refracta Tillyard,(the only known larva of the tribe *Idocorduliini*) which stands, in my opinion, very nearly in the direct line of ascent to Stage 4. The line branched off from Stage 2 at a time when the area between Ac and the triangle, though tending to stretch more widely, was still only wide enough to support a loop of two cells' width. At this point, a new force came into play, viz., the beginning of a stretching *transverse to the longitudinal axis of the wing*. The combination of forces started that *diagonal stretching* which brought the Italian loop into being, and to which the slantwise-elongated cells of the hindwings of almost all *Libellulidæ* bear irrefutable witness. *Not by growth of new wing-material, but by stretching out of the old, did this beautiful formation arise.*

We cannot omit, here, a reference to the behaviour of the hindwing-triangle. In Stage 2, that triangle was still distal from the arculus. Had it remained so, while Ac receded basad, the anal loop must inevitably have widened, and *Synthemis regina* might even to-day then stand as the apex of *Anisopterous* wing-development. But, as soon as the tendency to *transverse* stretching began, the hindwing-triangle followed the anal-crossing basad, and began to recede towards the arculus, until its basal side finally came to lie exactly under it. It is, indeed, curious to see how the necessity of *broadening* the hindwing should cause the triangle to recede and tend to broaden out *longitudinally*, while the almost equally insistent necessity for *narrowing* the forewing (to prevent overlapping on to the hindwing) should bring about an exactly opposite result, viz., the procession of the triangle away from the arculus, and an excessive broadening of it *transversely* to the wing-axis. In the case of the hindwing, the *pull* on the triangle stretched it longitudinally; while in the case of the forewing, the *push* on it, due to the rapid narrowing of the anal area, shut it up transversely like a collapsed framework, at the same time that it drove it away from the wing-base.

We are now in a position to understand Figs.9-10. The shape of the area to be supplied by the anal trachea and its branches, has now altered so considerably, that we need not be surprised at the change in the relative importance of the various branches. As this area becomes elongated in a slantwise direction, A_2 becomes directly attached to Ac, and in this very favourable position, it begins to show a distinct gain in size and length compared with the other branches. Forming, as it now does, a kind of mid-channel along the whole anal area, it supplies the latter with the greater part of its oxygen. On the other hand, A_1, originally more important than A_2, now shows a further slight reduction from the form reached in Stage 2 (*Synthemis*). It still reaches Cu_2 just below its bifurcation from Cu_1, but is an exceedingly slender trachea, very small in comparison with Cu_2. It gives off slender branches inwards to help to form the separate cells of the loop, as far as the third set of cells from its base. But the rest of the loop, consisting of two more sets of cells, is formed on its distal side by a strong descending branch of Cu_2, which we call Cu_{2b}.

It is evident from this, that the elongation of the anal loop was first brought about by the inclusion of *extra sets of cells* beyond the original distal end still to be seen in Stage 2. If, in the loop of *Synthemis* (Fig.7), we imagine the wing to be somewhat stretched in a slantwise direction so as to straighten out Cu_1, A_1 at the same time becoming straighter but not longer, while A_2 becomes both straighter and also considerably longer, we get an approach to Stage 3, which can then be completed by a basal narrowing and by the development of a strong Cu_{2b} distally. Hence we see that the loop of *Austrocordulia* is a composite structure, and no longer a true "anal loop," *i.e.*, no longer enclosed purely between A_1 and A_2.

Further peculiarities in this area of the wing of *Austrocordulia* must here be noticed. Now that A_2 has obtained the commanding position under Ac, A_3 has shifted considerably basad, and become reduced in size. Hence arises the beginning of the *decline of the anal triangle in the male*—a movement which leads inevitably to the complete loss of the angulated wing, as seen in *Hemicordulia* and *Libellulinæ*. Hence, in so far as the elongation of A_2 necessitates the reduction of A_3, so far may we say that the Italian loop is developed at the expense of the anal triangle. In *Tetragoneuria* (Needham, *loc. cit.*, Fig.19, p.724) we see the maximum development permissible to both at the same time; a development which may well be claimed to be the high-water mark of *Anisopterous* evolution, and from which the whole mass of the *Libellulinæ* may be judged to stand on a lower level by regression, as they certainly do in powers of flight.

In *Austrocordulia*, the hindwing-triangle is greatly stretched out longitudinally, more so than in any other *Libellulid*, yet its basal side does not quite succeed in reaching the arculus. This excessive stretching, together with the extreme narrowing of the proximal part of the loop, are special to this genus, and are not to be judged as developments along the direct line between Stages 2 and 4.

Stage 4.—The final stage in the phylogenetic development of the anal trachea is to be seen in most of the *Libellulinæ* and in the *Eucorduliini* (see Figs.11-12, and Plate xi., figs.7-9). Here A_2 has outdistanced all the other branches in development, and is to be seen as a very long and strong trachea running slantwise distad from Ac. As in the *Æschninæ*, it still forms the basal

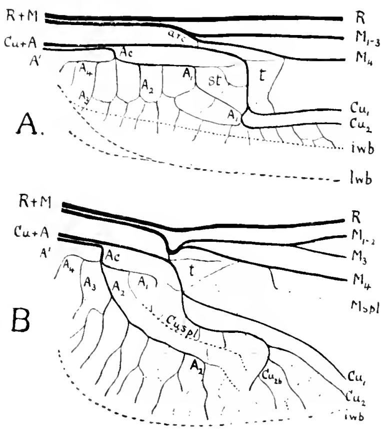

Fig.11.

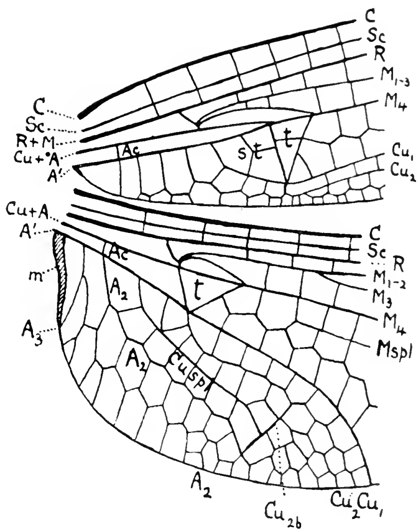

Fig.12.

Fig.11.—*Hemicordulia tau* Selys, ♂. Tracheation of full-grown nymphal wings. A, forewing; B, hindwing. (Sydney; Jan., 1914). Note the narrowing of the imaginal wing-border in the forewing.

Fig.12.—*Hemicordulia tau* Selys, ♂. Basal portion of imaginal venation. (Heathcote, N.S.W.; March, 1907).

border of the so-called "anal loop," though that term can no longer strictly be applied to the elongated Italian loop now before us, since A_1 has ceased to play any part in its formation. A_1, shrivelled up almost beyond recognition, now fails even to reach Cu_2. But the latter, strongly developed in a slantwise direction, very similarly to A_2, now forms the complete distal border of the loop, and also gives off a branch Cu_{2b}, which breaks back to form the posterior border or "sole" of the now stocking-shaped or Italian loop. The loop is still only two cells wide for the most part, but tends to widen at both ends, so that it is not unusual to find three or more cells in a row, both at the base and towards the tip. Finally, by the convergence of the distal ends of A_2 and Cu_{2b}, an exceedingly elongated and pointed "foot" may be formed, such as is to be seen in *Neurothemis* (Needham, *loc. cit.*, fig.18, p.724).

We have now to consider the formation of the midrib or symmetrical axis of the Italian loop. By reference to Fig.11, it will at once be seen that this is not formed about a trachea at all. The midrib is, in fact, nothing more nor less than a *cubital supplementary sector* (Cuspl), formed on exactly the same lines (and even carrying, in *Hemicordulia*, the same mass of pigmentation) as Mspl under M_4 and Rspl under Rs, though attaining a far greater measure of usefulness owing to its fortunate position. In cases where the "toe" is not fully formed, as in *Hemicordulia*, this Cuspl runs straight to within one cell's breadth of the "sole." But where there is a well-developed toe (*e.g.*, in *Diplacodes*, Plate xi., fig.9), it is cut off by yet another branch of Cu_2 (Cu_{2c}), which descends from Cu_2 about midway between its point of bifurcation from Cu_1 and its point of branching to give off Cu_{2b}, and runs almost straight to the tip of the toe. Hence, in this extreme case, the midrib is formed *chiefly* by Cuspl; but its apical end, penetrating into the toe, is formed about the new branch from Cu_2.

Having now traced the development of the anal trachea through all its stages, we are in a position to give the true homologies of the much-discussed Italian loop. First of all, it is not an *anal loop* in the sense that the *Æschnine* loop is, for it is formed as much from Cu_2 and its derivatives as it is from A. Of the branches of the latter, only A_2 enters into its composition. It is, strictly speaking, a *cubito-anal loop*, and should be designated as such, with the abbreviation Cual. The basal side of Cual is in all cases A_2. Nearly always, it descends directly from Ac. But, in some genera, it may lie a little distad from or proximad to Ac. In all such cases, where larvæ are obtainable, a strict study should be made, in order to discover any possible exceptions to the rule laid down; though such are not likely to occur, seeing that A_2 forms the basal side in all known forms throughout the series.

The distal side of Cual is Cu_2. It is, therefore, not homologous with the distal side of the anal loop of the *Æschninæ*, which is formed from A_1, or more strictly from the fusion of A_1 with Cu_2 for part of its length, and then from A_1 alone lower down.

The midrib of Cual is a cubital supplement (Cuspl). It has no true homologue in any other subfamily. The straight supplement X, in *Synthemis regina*, is comparable to it, but is not its true homologue, since it is not formed by the fusion of small tracheal branches from Cu_2. The midrib is strictly analogous to Rspl and Mspl, the sectors developed similarly under Rs and M_4 respectively.

As regards the two rival theories, our investigations have, without doubt, proved the Theory of Double Descent to rest on an unsound basis, since it depended upon an incorrect interpretation of the homologies of the basal side and midrib of the Italian loop. On the other hand, the Theory of Single Descent is supported by the whole weight of the evidence obtained from the study of the nymphal wings.

Before passing on from the study of the anal loop, one more problem presents itself, viz., the question of the phylogeny of the reduced forms of the *Libellulidæ*. Only one larva is obtainable, that of *Cordulephya pygmæa* Selys, a form in which the imago has an extremely reduced and narrowed hindwing, with an anal loop comprised by only two large cells. I have already indicated my belief* that this loop is a reduction from a more normal loop, and must be considered as a very highly specialised offshoot of the *Eucorduliini*. Let us now see what evidence is afforded by the nymphal wing.

Fig.13 shows the anal area of this larval wing. The reduction from a considerably broader wing is very evident (as in the *Zygoptera*; see Plate xii., fig.1) by the fact that the imaginal wing-border is drawn in, leaving a broad space below, into which

* "On the genus *Cordulephya*," These Proceedings, 1911, xxxvi., p.388.

the fine ends of the tracheæ penetrate for a very considerable distance. The same thing may be seen in the forewing of *Hemicordulia* (Fig. 11A). What is of greater interest, however, is the fact that, as in Stage 4, A_1 does not help to form the distal border of the loop at all, but is a weak trachea curving in half-way between Ac and Cu_2 to form the distal border of the first of the two large cells forming the loop. A_2, on the other hand, is a very strong, thick trachea, descending from Ac and forming the basal side and part of the lower border of the loop. Cu_{2b} is visible as a fairly strong trachea descending from Cu_2 into the space below the imaginal wing-border. From these considera-

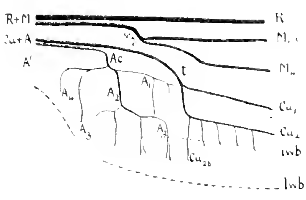

Fig. 13.

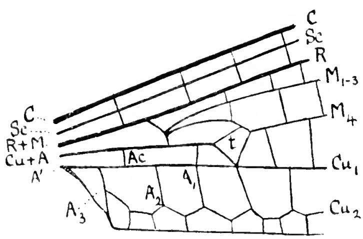

Fig. 14.

Fig. 13.—*Cordulephya pygmæa* Selys, ♂. Tracheation of full-grown nymphal hindwing. (Lily Vale, N.S.W.; Feb., 1914). Notice the narrowing of the imaginal wing-border.

Fig. 14.—*Cordulephya pygmæa* Selys, ♂. Basal portion of imaginal venation of hindwing. (Lily Vale; March, 1907).

tions, it is quite clear that the loop possessed by the *unreduced* wing ancestral to *Cordulephya* was definitely a *cubito-anal* loop, formed between A_2 and Cu_2. Such a loop really distinguishes the *Eucorduliini* and *Libellulinæ* from all other *Odonata*. Hence we may fairly place *Cordulephya* as a specialised side-branch of the *Eucorduliini*, which must have branched off from the main stem at some period between Stage 3 and Stage 4. This agrees exactly with the argument already advanced by me,* as a result of a general study of its larva, that *Cordulephya* is a member of the *Eucorduliini*, and has its nearest existing ally in the unreduced genus, *Hesperocordulia*, from Western Australia.

* "On the genus *Cordulephya*," These Proceedings, 1911, xxxvi., p. 388.

It is probable that the larval wings of all the narrow-winged *Libellulinæ* would yield similar evidence of descent from broader-winged forms. None of the larvæ are, however, at present obtainable. But in the exuviæ of *Nannophlebia* and *Lathrecista*, which I have seen, the breadth of the hind wing-case certainly suggests a descent from a broader-winged form.

The foregoing discussion has been confined to the hindwings. The forewings of the *Anisoptera* are not, however, without interest. First of all, we notice the absence of pigmentation throughout the posterior longitudinal portion of the wing-case, due to the fact that the hind wing-case overlaps the forewing to that extent (see Plate xi., fig.8). This may well be a contributing cause to the narrowing of the anal area, since absence of light means absence of pigmentation, and pigmentation precedes the development of the permanent venation. [Contrast the development of the wings of *Ephemeridæ*, in which the fore wing-case overlaps the hind, and the forewing far outruns the hind in development].

Secondly, changes take place as we pass from stage to stage, although these changes are small compared with those in the hindwing.

In Stage 1 (*Æschninæ*), the four typical branches of A are present, and placed in the primitive positions. A_1 reaches and fuses with Cu_2, and *keeps this position* through all succeeding stages.

In Stage 2 (*Synthemini*), the final development of A_1 is already almost accomplished. Stage 3 being very similar to Stage 2, we may study the forewings of these two stages together. We then notice the following advance from Stage 1.

As in the hindwing, Ac has come to be much closer to the wing-base, while A_3 has become hitched to A_4. A_2 keeps its original position somewhat distad from Ac, while A_1 is greatly lengthened out, and consequently gives off supplementary tracheæ downwards to supply the elongated area below it. Owing to the compression of the triangle (explained above), which is already, considerably advanced in *Synthemis*, though not so evident in *Austrocordulia*, A_1 takes a bend slightly downwards (Plate xi.

fig.5) so as to meet Cu_2 just at its point of greatest curvature. Thus A_1 and Cu, between them, form two sides of a large triangular space, the *subtriangle* (st). One of the set of cross-veins developed transversely between $Cu_{1\cdot 2}$ and A_1 now becomes specialised by slantwise lengthening, so as to run from the first bend of $Cu_{1\cdot 2}$ towards the bend of A_1, and thus develops into a firm support for both bends, as the *inner side of the subtriangle.* In *Austrocordulia*, owing to the small amount of transverse elongation of the triangle, st is rather small, and consists of one strongly-formed triangular cell. But in *Synthemis*, owing to further transverse elongation of the triangle, st has increased very much in area. Hence is developed the system of supporting cross-veins, which divides the subtriangle into three cells, and which persists throughout the rest of the phylogenetic series with only slight variations.

Stage 4 (*Eucorduliini* and *Libellulinæ*) shows very little advance from *Synthemis*. The growth of A_1 is stronger, the bend much sharper (approaching a right angle), the subtriangle larger and more strongly formed, but essentially of the same structure (Fig.11A). It tends, however, to become *four-sided* through a second bending of A_1, and at this same point A_1 gives off a fairly strong branch, which runs at first considerably basad, then bends completely round, and finally runs distad to meet A_1 itself after its "break-back" from Cu_2. Thus there is formed a small and complete "anal loop," represented in the imaginal venation by two strong supporting cells lying under st.

In Plate xi., fig.13, the very interesting forewing of *Cordulephya* nymph is figured. It shows several peculiarities. Ac runs very slantingly, parallel to the basal side of the triangle. The bridge-vein is extremely well developed. The postnodal area of the wing is excessively shortened, and the tip of the wing is formed irregularly, as if a small part of the margin had been broken off. This last peculiarity is to be seen also in *Hemicordulia*, and probably in other *Eucorduliini*, while the shortening of the postnodal area is also noticeable in this group. These are two further links in the chain of evidence which binds *Cordulephya* to the *Eucorduliini*.

In *Synthemis*, the hindwing of the larva outgrows the forewing very much more than in other genera. This may be due to the diverging position of the wing-cases, which do not lie parallel along the back of the insect, but resemble those of *Cordulegaster*. Such a position must be regarded as a specialisation connected with the form and habits of the larvæ. In a nearly full-grown nymph of *S. macrostigma*, I found the forewing to be *only slightly more than half* as long as the hindwing.

Having now completed the study of the anal loop, let us turn our attention to the *Gomphinæ*, where no loop is formed, and study the anal area there. The only genus available to me was *Austrogomphus*. There are, however, two distinct types of larvæ included in this genus. *A. ochraceus* Selys, and *A. heteroclitus* Selys, represent these two types. As will be seen from Figs.15-16, the tracheation of the anal region shows considerable differences in the two types.

In *A. ochraceus* (Fig.15), the anal trachea, at the end of Ac, branches into three. The branch running basad is A_4, and from it the secondary anal vein A′ is developed as a bridge-vein. The branch descending directly from Ac is almost certainly A_3, since it forms the distal side of the anal triangle in the male. The branch running distad represents $A_{1\text{-}2}$, but does not reach Cu_2 at any point. This branch divides into two rather low down. These two branches *may* be A_2 and A_1 respectively, but their determination is doubtful.

In *A. heteroclitus* (Fig 16), the anal trachea, at the end of Ac, branches as usual into two. The branch running basad is $A_{3\text{-}4}$. A_3 descends from A_4 somewhat basad from Ac, and forms the distal side of the anal triangle of the male. This distal side is *strongly bent* in the imago (Fig.18), and slants away from the anal vein, instead of descending perpendicularly to it as in *A. ochraceus*. The branch running distad from Ac is $A_{1\text{-}2}$. At first it curves downwards parallel to Cu_2. It then gives off a strong branch descending straight to the wing-border; this is almost certainly A_2. From the point of origin of A_2, the more distal branch A_1 bends again towards Cu_2; but, having bridged only half the distance separating it from Cu_2, it again turns rather sharply downwards, and runs to the wing-border. A small trachea from Cu_2 meets it a little below this final bend (Fig.16, and Plate xi., fig.12).

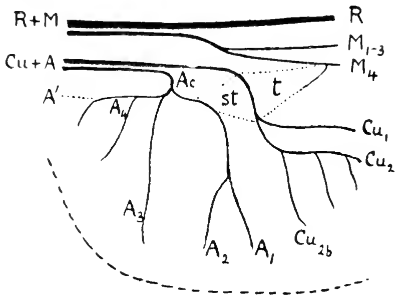

Fig.15.

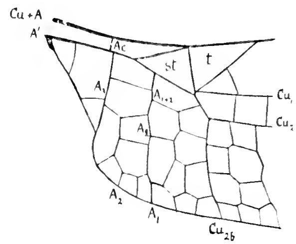

Fig.17.

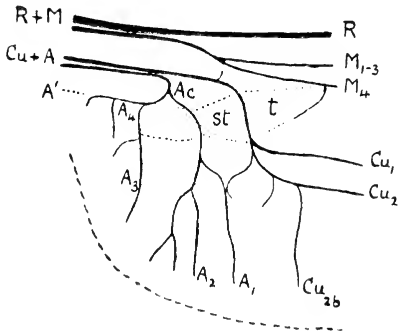

Fig.16.

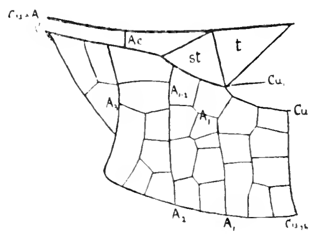

Fig.18.

Fig.15.—*Austrogomphus ochraceus* Selys, ♂. Tracheation of a nymphal hindwing, not quite full-grown. (Lily Vale, N.S.W.; Feb., 1914).

Fig.16.—*Hemigomphus heteroclitus* Selys, ♂. Tracheation of full-grown nymphal hindwing. (Stanwell Park, N.S.W.; Feb., 1914).

Fig.17.—*Austrogomphus ochraceus* Selys, ♂. Portion of imaginal venation of hindwing. (Heathcote; Nov., 1911).

Fig.18.—*Hemigomphus heteroclitus* Selys, ♂. Portion of imaginal venation of hindwing. (Heathcote; Nov., 1911).

We see from this that the anal trachea is more primitive in the *Gomphinæ* than in the groups already discussed, in so far as

A_1 does not at any point reach Cu_2 or fuse with it. Hence no anal loop comparable to that in the *Æschninæ* or *Libellulidæ* can be formed. In this connection, it is to be hoped that the anal tracheation of such forms as *Hagenius* (Fig.19) will be worked out by those who have access to them. The small loop there formed may quite probably be enclosed between $A_{1\cdot 2}$ as the upper part of its basal side, A_1 as the lower part of its basal side, Cu_2 as the upper part of its distal side, and the small branch-trachea from Cu_2 (shown in *A. heteroclitus*) completing its distal side lower down and joining A_1. In that case, the correct notation for the wing-veins will be that given in Fig.19. The "anal loop" of *Hagenius*, under these circumstances, is not homologous, in any sense, with the anal loops of the other groups, but is more of the nature of a subtriangle. The point cannot, however, be settled without a study of the larval wing-tracheation.

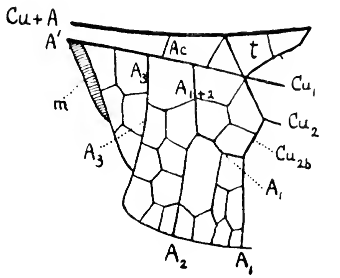

Fig.19.

Fig. 19.—*Hagenius brevistylus* Selys, ♂. Portion of imaginal hindwing-venation, with suggested notation for the descending branches of the anal vein (not yet confirmed by analysis of nymphal wing). From a specimen sent by E. B. Williamson, Bluffton, Indiana, U.S.A.

If my interpretation of the branchings of A in the *Gomphinæ* be correct, Needham's notation for that subfamily will need altering. In his figure for *Gomphus descriptus* (*loc. cit.*, p.708), A_3 and A_2 remain as indicated, but the vein labelled A_1 must be altered to Cu_{2b} (= proximal branching of Cu_2). His figure on p.707 also shows that this is so. Probably A_1 forms the greater part of the weak zigzag vein descending between A_2 and Cu_{2b}, and arising from A_2 one cell below the subtriangle.

It is very necessary that other genera of *Gomphinæ* should be studied in this manner. A satisfactory classification of this subfamily has not yet been attained, but a study of the larval wing-tracheation would go far towards establishing it, and would, in any case, reveal any hidden convergences which may be lurking to catch the systematist who pins his faith to imaginal wing-venation only. That such may be reasonably expected to occur, will be seen by perusing Section B of this part, in which a most unexpected and extraordinarily well hidden convergence is brought to light in the *Agrionidæ*.

To return to *Austrogomphus*, it is now necessary to propose a subdivision of this genus into two, as follows :—

(1.) Distal side of anal triangle in the male descending perpendicularly from Ac (Fig.17). Larva with flattened abdomen, four-jointed antennæ only moderately swollen, and rectal tracheal gills without papillæ. Larva lives in trash in running streams.

Genus AUSTROGOMPHUS.

Type, *Austrogomphus guérini* Ramb.

This genus includes, most probably, all the species at present grouped under the name *Austrogomphus*, except the three separated out below.

(2.) Distal side of anal triangle in the male descending from A′ before the level of Ac, and running in a slanting curve away from it (Fig.18). Larva with rounded abdomen, four-jointed antennæ (in which the third joint is greatly swollen and rounded, while the fourth joint is practically obsolete), and rectal tracheal gills with numerous papillæ. Larva lives completely buried in clean sand in running streams.

Genus HEMIGOMPHUS Selys (re-defined*).

Type, *Austrogomphus heteroclitus* Selys.

This genus, which corresponds to the second division of de Selys' suppressed genus *Hemigomphus*, includes only three species, viz., *A. heteroclitus* Selys, *A. comitatus* Tillyard, and *A. armiger* Tillyard.

Hemigomphus is, almost certainly, an offshoot from the Palæarctic *Onychogomphus*-group, with which it agrees in the form of its larval antennæ and rectal gills. It has, however, suffered

* The generic name *Hemigomphus* was introduced by de Selys (type *H. heteroclitus*), but suppressed by R. Martin owing to the very slight differences between it and *Austrogomphus*. The new definition of the genus here given, however, establishes it on a firm footing.

considerable reduction during its migration eastwards. It may, in fact, be considered as very probably a specialised offshoot from the Oriental genus *Burmagomphus*, and its arrival in Australia is almost certainly much more recent than that of *Austrogomphus*, s.str. As for the latter, its origin seems lost in the mists of antiquity, since no other *Gomphinæ* are, so far, known in which the larval rectal gills have not developed papillæ. Both genera must have entered Australia from the North-West by way of Timor, since no *Gomphinæ* occur in the Papuan subregion.

Needham's supposition, that A_1 may possibly be aborted in the *Gomphinæ*, seems to me to be unlikely. For, in the more primitive forms, it is just this particular branch of A which shows the greatest development. It seems rather that we have to do with forms in which A_2 is very poorly developed, this being due to the fact that the failure of A_1 to reach Cu_2 left only a very small area between A_3 and A_1, for A_2 to supply.

Having now followed the development of the anal trachea in both fore and hind wings through all its phylogenetic stages, we may conclude this section by giving a table of the principal differences between the Comstock-Needham notation and the new notation here adopted :—

	Comstock-Needham Notation.	New Notation.
Main longitudinal veins at base of wing :—		
First	C	C
Second	Sc	Sc
Third....................	R + M	R + M
Fourth	Cu	Cu + A
Fifth	A	A′
First cubito-anal cross-vein (= Anal-crossing)	Cuq(Ris)	Ac
Anal loop of *Æschninæ* :—		
Basal side	A_2	A_2
Distal side	A_1	A_1
Italian loop of *Libellulidæ* :—		
Basal side	A_3(Ris)	A_2
Midrib	A_2(Ris)	Cuspl
Distal side	A_1(Ris)	Cu_2
Sole of foot....................	?	Cu_{2b}

Note on the so-called "First Postcubital." In Plate xi., fig.3, I have shown the tracheation of the hindwing of the nymph of

Dendroæschna conspersa Tillyard, the only nymph so far studied of an *Æschnine* with reticulated basilar space. This shows the interesting fact that the anal-crossing Ac is *not* the first postcubital cross-vein, but the *second*, since there is one cross-vein developed between it and the base. In the imaginal wing, at first sight, the whole series of four (sometimes five) postcubitals appears very similar, except that the last is placed slantwise to form a weak subtriangle. But a little examination shows us that the second postcubital is also slightly bent, and very slightly thicker than the others. The reduction in strength from the strong trachea Ac to the weak cross-vein is, of course, exactly on a level with the formation of the "oblique vein" treated of in the next section of this paper. But here, the obliquity of the trachea was never very great, and is practically lost in the imaginal cross-vein.

We see from this how very inconvenient, and even incorrect, the term "first cubito-anal cross-vein" may become. It should certainly be done away with once and for all, and the term "anal-crossing" (Ac) be substituted. In the closely veined species of *Æschninæ*, there should never be any difficulty in picking Ac out, since it is always the cross-vein lying slightly distad from the distal side of the anal triangle of the male. Hence, in *Basiæschna* and *Boyeria*, for instance, it is actually the *first* cross-vein, in spite of their archaic reticulation.

Section B.—*The occurrence of a bridge-vein in Zygoptera.*

Needham states that a true bridge-vein is not formed in any of the *Zygoptera* except the *Lestinæ*. In that subfamily (Plate xii., figs.3-4), it is very easily discovered in the nymphal wing, and agrees entirely in its form with the bridge-vein of *Anisoptera*, except for its greater length. In the imaginal wing (Plate xii., fig.4), it carries Rs backwards in a straight line, to attach to $M_{1\text{-}2}$ very slightly distad from the origin of M_3.

The occurrence of this bridge-vein in the *Lestinæ* must be of very great phylogenetic importance, since it almost certainly indicates a separate line of descent for that subfamily, as compared with the non-bridgeveined *Zygoptera*. We should, therefore, search carefully for any evidence still existing as to what this line of descent was like, and also try to discover whether any other *Zygoptera* exhibit a bridge-vein.

Now in the very remarkable dragonfly, *Epiophlebia superstes* Selys, whose wings are figured by Needham (*loc. cit.*, Plate xli., fig.3), a typically *Lestine* bridge, with clearly indicated oblique vein, can easily be made out; and will, I feel sure, readily be recognised and accepted by all students of *Odonata* without requiring corroborative evidence from the larval wing, which will probably never be found, even if the dragonfly be not already extinct. The remarkable and isolated wing-type shown by *Epiophlebia* has so many points of *Lestine* affinity, that it may well be claimed to lie on the direct line of descent of that genus. The chief difference lies in the much greater reduction of the *Lestine* wing, and the departure of M_2 from M_1 far distad from the subnodus. The latter is, however, a characteristic of all highly reduced *Zygopterid* wings, and must be considered as a specialisation brought about by the shifting of the nodus basad. The trachea M_2 need not follow the subnodus towards the base, since it is not really connected in any way whatever with either Sc or R, and its function is to supply the middle portion of the apical part of the developing wing. The genus *Archilestes* shows an intermediate position of M_2.

In quite another direction, *Epiophlebia* shows strong relationship to the *Anisoptera*, particularly to the *Gomphinæ*. In the larger *Gomphinæ*, the oblique vein is placed about as far distad from the subnodus as it is in *Epiophlebia*, and the bridge itself is almost, if not quite, as long. Furthermore, in both, M_2 descends from the subnodus, and there are two thickened anastomosing antenodals of flat triangular form. Finally, apart from its wing-venation, *Epiophlebia* is characteristically *Gomphine* in the short build of its body-parts, in the large size and closeness of the eyes in the male, and its archaic bicolorous (*hylochrome*) colour-pattern.

We stand here, in fact, almost on the verge of the first dichotomy between *Anisopterid* and *Zygopterid* forms. It needs but a single cross-vein inserted into the quadrilateral of the hindwing of *Epiophlebia* to turn that cell into a weak "supertriangle +

triangle" of early *Anisopterid* type. The greater breadth of the hindwing is, in itself, evidence of a descent from *Anisopterous* ancestors; while the fact, that the forewing-quadrilateral is already of *Lestine* form, strongly suggests that the latter group are highly reduced descendants of an originally weakly-triangled *Anisopterous* stock. In that case, the sharply acute distal angle of the quadrilateral is the last remaining piece of evidence of the originally present triangle. It does not follow, of course, that any of the *Zygoptera* which possess fairly regular quadrilaterals were descended from similar ancestors; in fact, the regularity of the quadrilateral is an almost certain sign that all these forms branched off as reduced members from the main stock long before the first beginnings of the formation of the *Anisopterid* triangle. On this view, the *Calopterygidæ* and their more highly reduced descendants, such as the *Podagrionini*, are a far more archaic stock than the *Epiophlebia-Lestes* line, which has a truly *Anisopterous* ancestry. As regards the acutely-angled quadrilateral of the *Agrionini*, we should hesitate to describe that also as the result of a reduction from an early *Anisopterous* form, since we have, at present, no other evidence in favour of that view, and a good deal against it. It is probably much more truly a specialisation of an originally regular quadrilateral.

To turn now to our second point – can we indicate any other *Zygopterous* forms which possess a bridge and oblique vein? A search through the whole series of known imaginal wings will not reveal a single case with certainty; hence we must turn to the study of the larval wing. Now there is, in Australia, a genus (*Synlestes*) which is usually placed in the *Podagrionini* with *Argiolestes* and its allies. I have, for years, been struck by the similarity in habits, appearance, and, in particular, larval form, between *Synlestes* and *Lestes*, and also by the wide divergence in all points (except wing-venation) between *Synlestes* and *Argiolestes*. I, therefore, expected that the similarity in wing-venation between these two latter genera must be due to convergence. This year, I obtained nearly full-fed larvæ of *Synlestes weyersi*, *Argiolestes griseus*, and *A. icteromelas*, and photographed the larval wings. The result was even more astonishing than I had expected, as will be seen by comparing Plate xii., figs.5-8, also Plate xiii., figs.2-3. While *Argiolestes* shows a typical *Zygopterid* tracheation, with no sign whatever of either bridge or oblique vein, *Synlestes* exhibits a very long bridge, which would have appeared as of typical *Lestine* form, had it not become very cleverly masked, in the imago, by becoming hitched on to M_3 close to its origin, instead of joining up to M_{1-2} in the usual manner. Also, it is very remarkable to see that, in spite of the excessive obliquity of trachea Rs at its crossing from M_2, the corresponding cross-vein in the imago is so little oblique in direction (Plate xii., fig.6,*o*) that nobody would notice it at all unless he had the larval wing to guide him. In fact, from my long series of *Synlestes weyersi*, I can select a fair number of specimens in which the obliquity of this vein is *completely lost.* To such unprecedented lengths, then, can convergences go, in the formation of apparently similar and closely allied types of imaginal wing-venation, that we can now lay down only one safe rule for the study of the phylogeny of the *Zygoptera*; that is—*Never be sure of the homologies of the parts, in any genus of Zygoptera, until you have studied the tracheation of the larval wing.*

Having thus shown that *Synlestes* has no real affinity to the *Podagrionini*, towards which group it is a pure and very cleverly masked convergence, we must next enquire whether any other genera, now included in that tribe, ought to be taken out and placed with *Synlestes*. To this, bearing in mind the rule I have just laid down, we must give a very guarded reply. Without having seen even the insect itself, and simply from the photographs of wing-venation sent to me by my friend, Dr. F. Ris, I am able to state my very strong conviction that the genus *Chlorolestes* will be found, when its larval wings are examined, to possess a bridge and oblique vein of exactly similar form to those of *Synlestes*. In the imaginal wing, the oblique vein can be detected some four to six cells distad from the bifurcation of M_2 from M_1, much more clearly than it can be usually seen in *Synlestes* itself. *Chlorolestes*, like *Synlestes*, has the distal angle of its quadrilateral very acute, and Cu_1 in both genera arches strongly upward away from Cu_2.

In the fossil genus, *Heterophlebia*, about which unfortunately very little is known, there is an attachment of what is probably a long bridge-vein to M_3 in the manner of *Synlestes*. It is quite probable that this fossil stands in somewhat the same relationship to *Synlestes* that *Epiophlebia* does to *Lestes*. A careful study of the hindwing-quadrilateral of *Heterophlebia* should go far towards completing the proof of the *Anisopterous* ancestry of this group.

It will be seen that the above study affords us a very satisfactory point from which to start on an entirely new classification of the *Zygoptera*. This will be somewhat more fully dealt with in the next section.

Section C.—*The general tracheation of the larval wing in Zygoptera, and its homologies with that of the Anisoptera.*

I have already indicated that my study of the general tracheation in *Zygoptera* is necessarily incomplete, since it is confined to the *Agrionidæ*. However, in that family I have been able to obtain and study a large number of different genera, a list of which is here given :—

Tribe.	Genus.	Species.
Synlestini	*Synlestes*	*S. weyersi* Selys.
Lestini	*Austrolestes*	*A. cingulatus* Burm
		A. psyche Selys.
		A. leda Selys.
Podagrionini	*Argiolestes*	*A. icteromelas* Selys.
		A. griseus Selys.
Protoneurini	*Neosticta*	*N. canescens* Tillyard.
	Isosticta	*I. simplex* Martin.
Agrionini	*Ischnura*	*I. heterosticta* Burm.
		I. aurora Br.
	Argiocnemis	*A. rubescens* Selys.
	Caliagrion	*C. billinghursti* Martin.
	Austroagrion	*A. cyane* Selys.

The list thus comprises nine genera, selected fram five tribes, and represents practically all the *Agrionid* larvæ obtainable within one hundred miles of Sydney. Several of them, indeed, are very rare, and only to be obtained by thorough searching of special localities.

In carrying out this research, one of the principal difficulties was found to be the extreme thinness of the wing-cases, through which the slightest pressure served to disarrange the tracheæ. Many specimens were spoilt through this. The plan which I finally adopted was to dissect off the two wings of one side together, under water, with a fairly large portion of the pleural attachment; then, to separate the two wings by a sharp cut *in the plane of the wing-case*, not transverse to it, so as to cut the attachment in halves without exerting any pressure on the wing-cases themselves; and, finally, to float each wing out separately on to a slide with plenty of water, let down a cover-glass gently on to it, and photograph it while still in the water. If desired, the attachment can be cut completely away in order to obtain a planer surface for focussing; but as this usually pulls the delicate anal trachea away from its attachment to Cu, it should only be done for enlarged studies of other parts of the tracheation, as for instance, the studies of the bridge (Section B, above).

Another great difficulty is the fact that some larvæ have very hairy wing-cases, while many have them very deeply pigmented. The wing-cases of *Argiolestes* are very hairy and rather thick; those of *Isosticta* nearly always jet black. Some ingenuity is required in manipulating these insects. Remembering that the dark colour of these larvæ is mainly due to their being bottom-dwellers, I placed some *Argiolestes* and *Isosticta* larvæ in a jar with a mass of water-weed alone, no sandy bottom being supplied. After wandering round the glass bottom for some time, most of the larvæ took to the water-weed, on which they rested clumsily with outspread legs (showing their inability to cling closely in the way that habitual weed-dwellers do). One *Argiolestes* and several *Isosticta* larvæ went through an ecdysis in this position; and instead of rapidly darkening, as they usually do, remained pale brownish for many days, showing even a tinge of green also. This was what I expected. From these larvæ, I obtained very fair photographic results, from which the diagrams (Plate xii., figs.7, 11) have been taken. I also obtained a photograph of an *Isosticta* larval wing soon after ecdysis, and was interested to notice that all the imaginal wing-venation showed up white and unpigmented, with large patches of black pigment in each separate cell.

For our general study, I will now select the largest as well as the palest of all the larvæ examined, that of *Caliagrion billinghursti* Martin. This very beautiful larva is of a bright green colour, and its wings are pigmented uniformly and lightly all over. I was, unfortunately, unable to study any of the earlier stages of this or any other larva, owing to the lateness of the season when I first started (September). A complete study of the *Caliagrion* nymph will, I hope, be undertaken next season, with a view to determining the ontogenetic development of Rs.

A very clear photograph of the complete *hindwing* is given in Plate xi., fig.14, while Fig.1 of Plate xiii., gives a much more highly magnified photograph of the most important parts. From these and from the diagram in Plate xii., fig.1, it will be seen that, in *Caliagrion*, as in all the *Anisoptera*, trachea A fuses with Cu as far as the anal crossing (Ac). This can also be seen very clearly in *Austrolestes*, less clearly in *Synlestes*; while, in the smaller species, it is often very difficult to detect any trace of A at all. This is especially the case with the *Protoneurini*, *Neosticta*, and *Isosticta*, in which the whole anal trachea seems to be quite aborted, except that, in one or two specimens, I have detected a very fine and short basal portion which fails to reach Cu. However, in all cases Ac can be detected, though not without careful searching in the case of the most reduced forms.

From this, we must conclude that the anal trachea of the *Zygopterid* nymphal wing behaves in the same manner as the corresponding trachea in *Anisoptera*. Hence, as far as A′ and Ac are concerned, the new notation applies to all *Odonata*.

The next point is a very startling one, viz., that, in *Caliagrion*, the anal trachea at the distal end of Ac becomes four-branched, just as it does in *Anisoptera* (Plate xii., fig.1). The branch A_1 runs basad for a short distance, and along and beyond its course the future secondary anal vein A′ of the imaginal wing is clearly marked out as a pale band. A_3 and A_2 arise close together under Ac, and run slightly divergingly downwards *to supply a quite fairly large anal area below.* At metamorphosis, these two tracheæ, and the area which they supply, are completely lost, the petiolation of the imaginal wing cutting out all the area below Ac, and making A′ itself form the hind border of the wing from the base up to Ac. Finally, A_1 runs distad as a fine trachea towards Cu_2, but fails to reach more than half-way towards it. It is then continued, in the imaginal venation, by a white band (Ab), which runs on to join the first small descending trachea from $Cu_2(Cu_{2b})$. The vein developed from this white band may be conveniently termed the *anal bridge* (Ab).

There is only one interpretation to be given to all this, viz., that *Caliagrion* is a reduced descendant from an original ancestor *which had a fairly broad anal area supplied by a well developed four-branched anal trachea.* Also, since a difference in the width of this anal area, and the amount of development of the four branches of A, is still easily to be detected in the fore and hind wings of the *Caliagrion* nymph, we must go further, and state that this ancestor was of an *Anisopterous* type; not, of course, necessarily with triangles developed, but most certainly with hindwings broader than forewings.

Further proof of this interesting point can be obtained by studying the formation of the imaginal venation in the nymph of *Caliagrion*. The original posterior border of the wing is formed at first, in the usual manner, as a pale band running far posteriorly to Ac, towards which the remnants of two descending veins can still be seen developing as thin white bands along A_2 and A_3 respectively. Further, the white bands which descend from Cu_2 to the posterior border, are not only strong and clearly to be seen, but they are of great length compared with their remnants in the imago. In fact, the whole of this portion of the wing is constrained to pass through, in its ontogenetic development, the past phylogenetic stages of its ancestry, before arriving at its present highly specialised petiolate form. Just in this case, the application of the Biogenetic Law of Haeckel seems very complete and exact.

As metamorphosis approaches, the wing-rudiment becomes drawn away, along its posterior margin, from the edge of the wing-case; it shrinks in rapidly, but more especially towards the base, where it finally coalesces with A′ from the base to Ac. Beyond Ac, it takes a slanting direction from Ac towards Cu_{2b}, which is now only about half its original length; all the other subcubital cross-veins becoming similarly shortened. A similar, but less intense narrowing also takes place along the costal border. As a result, the base of the wing becomes quickly narrowed to less than half its former width, and, in this shape, it is withdrawn from the wing-case at metamorphosis. The expansion which follows mainly affects the "blade" of the wing, the petiolate stalk undergoing a comparatively small lengthening.

A further point of interest in *Zygopterid* wings is the development of Cu. In all *Zygopterid* wings, there is very little curving of this trachea. In some cases (as in *Caliagrion*), Cu_2 continues the line of $Cu_{1\text{-}2}$, while, in others, it is about as much curved as Cu_1, but, of course, in an opposite direction (see *Synlestes*, Plate xii., fig.5). In every case, Cu_2 is less strongly developed than Cu_1, the latter being a very strong and almost straight trachea. In the *Protoneurini*, Cu_1 undergoes a gradual reduction, until, in the most asthenogenetic forms (Plate xii., figs.9-12), it is seen to be only a very short trachea terminating somewhere about the level of the origin of M_3 from $M_{1\text{-}2}$. Its length varies very much in the different genera. In many genera, Cu_2 is completely suppressed, and Cu then appears as a short, unforked trachea, slightly bent downwards under the arculus. In such forms, it is not surprising to observe the complete disappearance of trachea A, except perhaps for a minute basal portion not easily observed; since the asthenogenetic tendency *must* affect A before it can touch Cu.

These highly specialised *Protoneurini* are, without doubt, from the point of view of the reduction of their tracheal system, the most advanced members of that very prolific and successful phylogenetic line, which probably includes, in the form of numerous more or less successful side-branches, the whole mass of the *Calopterygidæ*, and also all the *Agrionidæ* possessing *regular* quadrilaterals.

Let us now pass to the question of the origion of Rs in *Zygoptera*. In all except one of the forms so far examined, no connection can be detected between Rs and R, but Rs in all these cases appears as a branch of M. It can generally be detected by its peculiar method of parting from M, which is at a considerably greater angle than that made by a true branch of M, such as M_3 (Plate xii., fig.1). This distinct curve in Rs, on leaving M, is most probably due to the original manner in which it cut across and under M_1 and M_2, before it became permanently hitched on to $M_{1\text{-}2}$. As Needham has justly observed, there can be no difficulty in understanding this cutting-off of Rs from R, and its subsequent permanent attachment to M. For with the setting-in of the asthenogenetic process, and the consequent narrowing of the wing-rudiment in width, any difference of level which originally existed between M and R (and the fact that Rs still passes *under* $M_{1\text{-}2}$ in *Anisoptera* shows that there *was* once a difference in the level) must inevitably become lessened. Thus the trachea Rs must gradually become pressed near its base by the stronger overlying $M_{1\text{-}2}$, and if it could not effect a union with the latter by the abortion of its original base, it would inevitably perish for lack of oxygen.

Let us now examine the condition seen in the *Protoneurini*. The arrangement of tracheæ in the region below the nodus seems to be the same in *Isosticta* (Plate xii., figs.11-12) as it is in *Caliagrion*. Two tracheæ branch off from $M_{1\text{-}2}$ close together. One would naturally suppose that the more proximal of these is M_3, and the more distal is Rs, as labelled in the plate (with a query). But if we turn to the closely allied genus *Neosticta* (Plate xii., figs.9-10), we find Rs actually descending from R below the nodus, and crossing both $M_{1\text{-}2}$ and M_3. Having done so, it runs along only for a very short distance, and then ends up; so that the rest of the imaginal vein Rs is not found about a trachea at all.

It seems very probable that we have, in *Neosticta*, the condition described above, viz., that Rs has failed to connect basally on to M, and is in process of perishing for lack of oxygen, owing to pressure from the overlying branches of M. If this is really so, then we might well consider that *Isosticta* shows the next step in advance, viz., that Rs has attained a basal fusion with M, and hence gets a plentiful supply of oxygen, and grows to its full length. In that case, we must transpose the lettering in the plate, and name the more proximal trachea Rs.

If we accept the above solution, the *Protoneurini* (so far as known) will differ from all other *Agrionidæ* in having Rs crossed under *three* branches of the nodus instead of two. The question, however, should not be regarded as finally settled, since it is only fair to point out that the wing of *Neosticta* is so highly pigmented, and the trachea Rs so faintly indicated, that I may have made a mistake in my interpretation of its course. In Plate xiii., fig.4, I give the actual photograph itself, but I may add that the wing itself, when first examined, was somewhat clearer than the photograph, and gave me a distinct impression of Rs crossing under M_3 as well as $M_{1\text{-}2}$. The point can only be finally settled by further investigations, if possible on larvæ fresh from an ecdysis, at a time when pigmentation is less dense.

Concerning the rest of the *Zygopterid* nymphal wing, there is very little of interest. The arculus is formed exactly as in *Anisoptera* by M descending from R, but the supporting vein formed underneath it, and completing it, also forms, of course, the basal or proximal side of the quadrilateral. The distal side of this latter is another cross-vein connecting M_4 with Cu at its point of bifurcation. The subcosta is a very weak trachea, and takes very little part in forming the nodus, which is here constructed from a small thick trachea arising from R, but principally by a simple vein, devoid of tracheæ, and blocked off by a huge mass of pigment proximally. This formation is an asthenogenetic specialisation derived from the older method shown in *Anisoptera* (where Sc plays the principal part), and is due to the weakening of Sc, caused by the narrowing of the wing.

All the wings studied under the tribe *Agrionini* agree with *Caliagrion* in all essential particulars, except that Ac and its branches are not so clearly to be seen as in the larger larva. The distribution of tracheæ in *Argiolestes* is also essentially similar to that in *Caliagrion*, the chief difference being that, in the latter, all tracheæ run nearly parallel or slightly converging, while in the former, the wing being broader apically, they tend to diverge and allow of the introduction of short supplementary sectors (Plate xii., fig.7). As in *Anisoptera*, forewings can be distinguished from hindwings easily by the fact that they are only heavily pigmented from the costal border to M_1. All the rest of the wing, being covered by the hindwing, is pale and very little pigmented. The erect position of the wing-cases, seen in adult *Zygopterid* larvæ, is only assumed after the last ecdysis, at a period shortly before the final metamorphosis. *Anisoptera* behave in the same way, but the change is perhaps not so noticeable.

For general study, forewings may be preferred to hindwings, since they yield much clearer photographs. But for the study of the anal trachea, the hindwing should be selected, since it is broader at the base, and shows the four-branched condition much more clearly.

Much more remains to be done in the study of the nymphal wings of this interesting Suborder. The present research is only a bare beginning, on which, it is to be hoped, other investigators will be able to build. Particularly in the *Calopterygidæ* must careful study be made of all possible nymphal wings; for it is just amongst these archaic end-twigs that we may expect to find the missing steps in the development of Rs across M_1 and M_2, and in the reduction of the anal trachea.

We may profitably conclude this section by a short discussion on the question of the classification of the Suborder *Zygoptera*.

It becomes now more than ever apparent that the Selysian division into *Calopterygidæ* and *Agrionidæ* is quite untenable as a natural dichotomy. More than this, it is pretty clear also that the *Zygoptera* are not, like the *Anisoptera*, derived from any original pure line of descent. Triangle-formation most certainly only started once; and, however far back new fossil discoveries may take us as regards the first formation of the triangle, there can be no doubt about the origin of all *Anisoptera* from that single line of descent, which Palæontology already places as far back as the Trias, and which probably began in the Permian period. Most of the *Zygoptera* (certainly all those with regular quadrilaterals) must have branched away from the *Anisoptera*-line before this. But who can tell how many separate branchings took place, even amongst this one portion of the Suborder? The origin of the tribe *Agrionini* is doubtful, for their acute quadrilateral might yet be proved to be the reduced remnant of an originally weak *Anisopterid* triangle-formation. Finally, standing out clearly from all the rest as the most recent offshoot from the *Anisopterid* line, we see the *Epiophlebia-Synlestes-Lestes* line of descent, which branched off from that line *not very far from* the beginnings of the *Gomphinæ*, and whose sharply angulated quadrilateral is almost certainly an *Anisopterid* remnant.

Were it not for the problematical position of the *Agrionini*, which form the greater number of the *Zygoptera*, and must, therefore, be satisfactorily placed in any classification that is to be of any use, we might see the dividing line in the form of the quadrilateral. Our two main groups would then be the *Zygoptera Rectangularia*, with more or less regular quadrilateral, and the *Zygoptera Acuta* with the distal angle of the quadrilatera sharply acute. But this division is most probably scarcely less unnatural than the Selysian. It would, therefore, be unwise to press for its recognition as a natural basis for classification. On the other hand, just as the terms *Calopterygidæ* and *Agrionidæ*, though indicating admittedly unnatural groups, *do* carry a certain value as the names of groups possessing a single character common to every member of each (at least, with few exceptions)—and are, therefore, of great value to students not very familiar with the intricacies of *Odonate* wing-venation—so also, I would urge a loose acceptance of the terms proposed, on the ground that they may prove of very great benefit in subsequent phylogenetic discussions. If that be recognised, then, for instance, whenever we mention the term *Zygoptera Acuta*, everyone will recognise that it refers to *all Zygoptera* with acute-angled quadrilaterals; and similarly for *Zygoptera Rectangularia*.

The time is not yet ripe for making more than a beginning at the difficult problem in hand. That beginning I now make by selecting the *Epiophlebia-Synlestes-Lestes* line of descent as a single pure line, descending from the main *Anisopterid* stock at a later period than any of the other *Zygoptera*. These, I consider to be worthy of family-rank at least; hence I propose, for them, the family-name *Lestidæ*, with the following definition and subdivisions :—

Family Lestidæ.

Quadrilaterals of all four wings, but especially of forewings, with their distal angle very acute. Rs leaving M_2 considerably distad from subnodus. A long bridge-vein developed backwards from Rs towards the bifurcation of $M_{1\text{-}2}$ from M_3.

Excluding fossil forms, three subfamilies may now be proposed under the above heading :—

{ Bridge connecting with $M_{1\text{-}2}$ .... 1.
{ Bridge connecting with M_3 .... 2.

1. { More than two antenodals, of which two are thickened. M_2 departing from subnodus. Quadrilateral of hindwing much less acute than that of forewing. General facies of insect distinctly *Gomphine* in appearance............... ....Subfamily 1. *Epiophlebiinæ*.
{ Only two antenodals (rarely three). Slender petiolate wings. M_3 departing more or less distad from nodus. General facies of normal *Zygopterid* form...............Subfamily 2. *Lestinæ*.

2. { Only two antenodals (rarely three). Slender petiolate wings. M_2 departing far distad from subnodus.........Subfamily 3. *Synlestinæ*.
{ More robust forms with many antenodals........................ .... [Fossils only. Subfamily *Heterophlebiinæ*].

Of these, the subfamily *Epiophlebiinæ* contains the single genus *Epiophlebia* Calvert (= *Palæophlebia* of Selys). The subfamily *Heterophlebiinæ* contains only the single fossil genus *Heterophlebia*, which has not yet been fully studied. The subfamily *Synlestinæ* contains the genus *Synlestes*, *Chlorolestes*, and possibly other additions from the ranks of our present tribe *Podagrionini*. The subfamily *Lestinæ* remains exactly as at present recognised, with *Archilestes* as its most archaic genus (M_2 fairly close to subnodus) and *Austrolestes* as its most reduced, and probably most cænogenetic development.

There can be little doubt that the tangle of forms left over, after the extraction of the homogeneous *Lestidæ*, will eventually be unravelled by scientific treatment. But the problem calls for not months but years of research. The point of division must be looked for still in the behaviour of Rs, since there are probably, in the *Calopterygidæ*, a number of archaic forms in which

Rs never succeeded in getting under more than the first branch (M_1) of the median trachea. Forms like *Diphlebia*, which show a peculiar oblique vein under M_1 far distal from the subnodus, need also a thorough investigation; since in such cases the vein, at present taken to be M_2, may eventually prove to be none other than Rs itself. There, for the present, we must be content to stop, resting in the certainty that the many forms of *Calopterygid* larval wings will one day yield a wonderful harvest to the fortunate student who has a chance of investigating them.

Part ii.

The study of the source of the Oxygen-supply of the Wing-tracheæ.

Section A.—*Description of the tracheal system of the thorax.* The tracheal system of the thorax can only be studied in *Anisoptera* by means of very careful dissections, or by serial sections. Dissection is difficult, owing to the great thickness of the pleural ridges and their underlying muscles, in which it is very difficult to follow the course of the alar trunk. Eight larvæ of *Æschnidæ* were dissected, but the complete result was obtained only by piecing together the separate points made out in different larvæ.

The most satisfactory method of study is to select a *Zygopterid* larva immediately after its final larval ecdysis, and study it directly, under a low power of the microscope. If a green or yellow transparent larva be chosen (*Lestes*, *Ischnura*, or *Caliagrion*) and submitted to strong transmitted light, the whole tracheal system stands up clearly in black, against a background of transparent pale greenish or yellowish.

The following description embodies the general results obtained for both *Anisoptera* and *Zygoptera*.

In all the specimens examined, the great dorsal trunks pass into the thorax from the abdomen with an upward curving, and also distinctly converging towards one another. Thus they come to lie very close under the pleural ridges, and pass forwards and upwards to a point very nearly vertically above the second coxæ, where they attain their maximum convergence, and are connected by the short stout *thoracic anastomosis* (TA) (a very short connecting trachea from which two small diverging branches pass to the region of the closed posterior stigmata). Beyond this, they diverge slightly, and pass close under, and a little to the inside of, the pair of larger and open anterior stigmata (St_1) which lie hidden in the fold between thorax and prothorax.

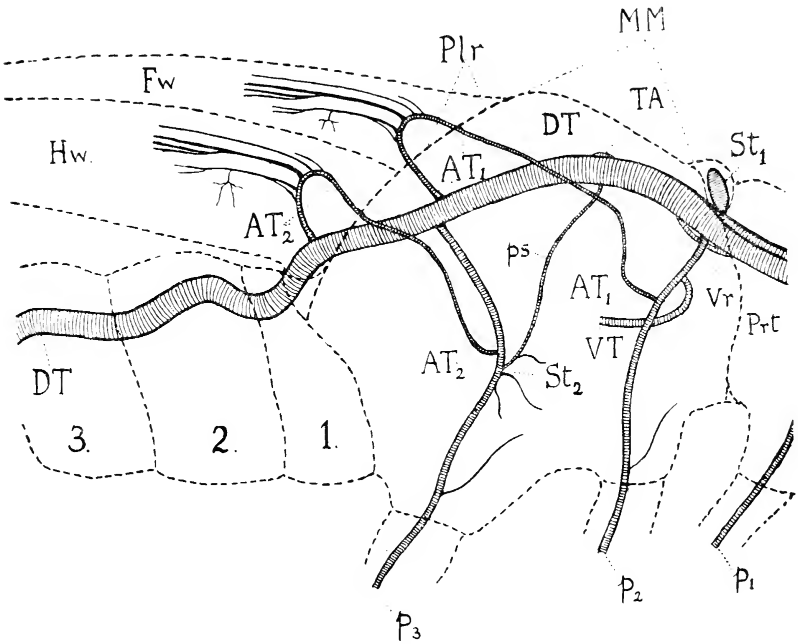

Fig.20.

Fig.20.—*Austrolestes leda* Selys, ♀. Diagram of tracheal system of thorax in full-grown nymph, viewed from right side. The left visceral trunk (VT) crosses over to become hitched on to the right second pedal trachea (p_2), and a remnant (Vr) forms a small loop attached to the dorsal trunk (DT). The alar trunks (AT_1, AT_2) arise from DT (anally), and end (costally) on the second and third pedal tracheæ (p_2, p_3) respectively. The posterior stigma (St_2) is aborted, but its position is marked by tracheal branchlets. The two dorsal trunks (DT) are connected by a short transverse anastomosis (TA). For other letterings, see p.214.

At a point not far removed from the thoracic anastomosis (slightly behind it in *Æschnidæ*, in front of it in *Agrionidæ*), each dorsal trachea gives off a strong branch to the second leg, the *second pedal trachea* (p_2). This important trachea receives, very close to its origin, the anterior termination of the visceral trunk from the *opposite* side of the body. That is to say, the two visceral trunks cross one another under the œsophagus, the right one passing *over* the left, and each connects with the second pedal trunk of the opposite side. These visceral tracheæ lie well below the dorsal tracheæ, and play no part in the development of the wings.

At a point directly under the posterior part of the pleural ridge, not far from the point where the abdomen joins the thorax, each dorsal trunk gives off a short stout trachea, which enters the base of the corresponding hindwing-case *at its anal end.* This is the *alar trunk* of the hindwing. From it arise, in order, the anal, cubital, median, radial, subcostal, and costal tracheæ of the wing-rudiment. This alar trunk is of greatest diameter at its point of origin from the dorsal trunk. As it proceeds costad, its diameter decreases. After giving off the six tracheæ of the wing, it becomes a narrow, thread-like trachea. Its course through the wing-base is roughly semicircular. On leaving the wing, it runs downward and slightly forward, and finally enters the *third pedal trachea* (p_3), at a point very close to the posterior stigma (St_2). This third pedal trachea is itself an offshoot ventrally from the great dorsal trunk, and arises, in the *Æschnidæ*, not far from the alar trunk of the hindwing, which may be termed the *second alar trunk.* In the *Agrionidæ*, owing to the greater obliquity of the thorax, it comes to lie very close under the origin of the *first alar trunk.*

The *first alar trunk* arises similarly to the second, from the main dorsal trunk. In the *Æschnidæ*, and probably in all *Anisoptera*, this alar trunk lies very close to, and a little in front of, the second alar trunk. In the *Agrionidæ*, it is separated from the latter by a greater space, and arises, as just mentioned, very nearly directly over the third pedal trachea (p_3). In the *Anisoptera*, it is of somewhat smaller diameter anally than the second alar trunk; in the *Zygoptera*, almost of the same size as the latter. It passes into the forewing-base at its anal end, gives off the six main wing-tracheæ in the order already named for the second alar trunk, makes a semicircular loop, gradually decreases in diameter, and finally leaves the wing-base on its costal side as a fine thread-like trachea. It then runs downward and forward to join the *second pedal trachea*(p_2) somewhat below the point where the visceral trunk enters it.

In all *Odonata*, the distance from the origin of the alar trunk to the point at which it gives off the anal wing-trachea (A) is very short; while the distance from the point at which the costal wing-trachea (C) is given off, to the point where the alar trunk ends on the pedal trachea, is much longer, especially in *Agrionidæ*. The diameter of each alar trunk is *very much smaller* at its ending on the pedal trachea than it is at its origin from the dorsal trunk.

It seems, therefore, very evident that *the oxygen-supply of the developing wing in Odonata is derived from the anal end of the alar trunk*, being drawn from the main dorsal trunk, which receives its supply from the branchial basket in *Anisoptera*, or from the caudal gills in *Zygoptera*. This fact is, in my opinion, the cause of all the chief peculiarities of the *Odonate* wing, as will be shown in Section B of this part.

The diagram in Fig.20 shows a lateral view of the tracheation of the thorax in a larva of *Austrolestes leda* Selys, directly after the last larval ecdysis. The drawing was made under the camera-lucida by means of strong, artificial, transmitted light, in which all the tracheæ appeared almost black on a pale yellowish-green ground. Making allowances for the greater obliquity of the thorax in the *Zygoptera*, the results of my dissections of *Æschnid* larvæ agree very fairly closely with this diagram. I thought it advisable to publish the diagram of *Austrolestes* rather than of *Æschna*, because the former can be much more easily studied, and the complete result verified; while, in the latter, only repeated dissections enable one to piece the whole scheme together, and thereby invite the unwitting introduction of error.

Section B.—*General theory of the unique development of the Odonate wing-venation.*

We are now in a position to enunciate a theory concerning the unique peculiarities of the wing-venation of *Odonata*, in the following words.

The peculiarities shown by the wing-venation of Odonata, as contrasted with that of other insects, are due primarily to the aquatic habits of the larvæ; whereby, through the development of rectal or caudal breathing, the oxygen-supply of the developing wing is carried from the posterior end of the body, and enters the wing-base at its anal end.

The effects of the peculiar formation of the alar trunk may be stated as follows. (1) The costal trachea (C) is in the *most unfavourable* position for receiving oxygen. As a matter of fact, it receives scarcely any, dwindles rapidly in size, and becomes a mere rudiment in the fully developed nymphal wing.

(2) Next to C, the subcostal trachea (Sc) lies in the next most unfavourable position. It receives a certain amount of oxygen, but its development is weakened and curtailed, so that it only develops about half-way along the wing-rudiment. This fact, originally a source of weakness to the wing, has been seized upon by natural selection, and has been made a source of strength to the wing by the development of the unique formation known as the *nodus* at the end of Sc.

(3) The radius (R) was originally the largest and longest trachea of the wing (as may be seen by comparing the *Odonate* wing with that of an *Ascalaphid*, an insect undoubtedly derived from the same stock as *Odonata*, before the larvæ of the latter adopted an aquatic mode of life). Originally R arose at the extreme bend of the alar trunk at some distance away from M, and thus held an excellent position for receiving the flow of gas from either costal or anal ends of AT. At first, it tends to develop ahead of the media (M), and at the ontogenetic period when both R and M appear as fair-sized bifurcated tracheæ, R is still greater than M.

(4) At this stage, M begins to gain on R, owing to its ability to intercept oxygen coming from the anal end of AT. Arising a little before the extreme bend of AT, M is in an exceptionally favourable position for competing with R for the flow of gas. As the wing develops, M begins to gain upon R, and finally moves up close to it, thus sharing with R the ideal position at the bend of AT, and receiving more oxygen than any other trachea in the

wing. Thus it develops into a four-branched trachea supplying a greater area of wing-rudiment than is supplied by any other trachea.

It might here be accepted as sufficient explanation of the ultimate fusion of R and M in the imago, that it was the direct outcome of the struggle for precedence between these two leading tracheæ of the wing. Certainly this played no inconsiderable part in the result. But there can be little doubt that another factor, viz , the gradual tendency towards the production of a narrower *flying-wing* from an originally broader *planing-area*, helped to drive these two tracheæ close together. The same tendency also most certainly played a part in the invasion of territory originally served by R, by one or more branches of M. Partly because of this gradual wing-narrowing, partly also because of the gain in development by M at the expense of R, we find the former throwing two of its four branches over Rs, so as to invade and supply the area between R_1 and Rs.

(5) The cubitus(Cu) was originally a much smaller trachea than either M or R. In a wing with a symmetrical oxygen-supply (*i.e.*, a supply received equally from costal and anal ends of AT), Cu would develop about equally with Sc, its analogue on the costal side of the wing. But it lies in a more favourable position, in the *Odonate* wing, since it is closer to the anal oxygen-supply than any trachea except A itself. Hence it develops into a strong two-branched trachea of greater importance than any except R and M.

The weaker development of Cu (and A also) in the forewing is easily explained by the fact that the hind wing-case completely covers over this portion of the forewing. Thus, both Cu and A in the forewing are deprived of the light so necessary to the formation of strong pigmentation: and this must, in the end, have a deleterious effect on the development of this portion of the forewing.

(6) The anal trachea (A) is only a small trachea, which could develop but little, were it not for its extremely favourable position, enabling it to take first toll on the available oxygen-supply,

and thus to develop much more freely than its analogue (C) on the costal side of the wing. Hence, in the *Odonate* wing, it is enabled to become a four-branched trachea of considerable importance, particularly in the overlying hindwing. Also, it competes with Cu in the same manner that M competes with R; and hence arises the fusion of Cu and A already described in the imaginal wing. Of course, as in the case of R and M, the tendency towards narrowing also aids this result.

This theory, then, founded on the facts now known concerning the origin of the alar trunk, is sufficient to account for all the peculiarities of the *Odonate* wing, provided we accept also the theory, already advanced by Handlirsch,* of the development of the present-day insect-wing from an original broad *planing-area*, only useful for accomplishing long downward "*vols planés*," and not for active flight. Probably nobody will now refuse to accept Handlirsch's theory, since it appears to be the only possible explanation of the development of any form of wing in Nature. It is not, however, the object of this Section to discuss Handlirsch's theory. We may safely claim it as a contributory cause to the peculiar development of the *Odonate* wing-venation, while, at the same time, indicating the anal oxygen-supply as the primary cause of all those peculiarities.

Let us now go back a little further, and inquire what evidence there is, either in Ontogeny or Palæontology, for the belief that the larvæ of *Odonata* were not *originally* but only *secondarily* aquatic in their mode of life. The evidence for this seems to me to be overwhelming, but there are some important points that bear more closely on the question at issue.

First of all, if the *Odonata* larvæ took to fresh water from the sea, without the intervention of a land-living period, we should naturally expect to find them still breathing by those archaic adaptations of segmental processes which, we have every reason to believe, were employed by *Trilobites* and their nearest allies. The fact that the larvæ of both *Anisoptera* and *Zygoptera* exhibit

* Fossilen Insekten, pp. 1316 et seq., 1908.

breathing-organs utterly unlike those of any other aquatic animal, speaks very strongly in favour of a special development of these organs in larvæ which, having lost their original marine mode of respiration by taking to the land, again took to the water and developed organs peculiar to themselves.

Secondly, the persistence of thoracic spiracles, in spite of their uselessness during the greater period of growth, is a strong argument for the existence of an open tracheal system in the larvæ as well as the imagines of the ancestors of our present-day *Odonata.*

Thirdly, a careful study of the peculiar connections of the leg- and wing-tracheæ in the larvæ of *Odonata* must go far to convince us of the same truth. Let us examine these in detail.

The anterior spiracle (St_1) in the larva is still open, and partly functional. Now p_1 arises from St_1, and a branch lb passes off from it to supply the labium. On the other hand, p_2 arises directly from DT, and receives only a small branch from St_1.* This can be understood, if we suppose that this small branch was the original p_2, and that, later on, a new attachment was developed on to DT, to intercept the oxygen coming from the anal end of the body.

Again, p_3 arises directly from DT, but it gives off one or more small tracheæ to the region of the closed posterior stigma(St_2). The same explanation would, therefore, hold here, viz., that these small branches represent the remains of the original trunk of p_3 (now almost aborted by the complete closing of the stigma), while a new attachment was formed on the dorsal trunk (DT) when the larva took to breathing from its anal end.

Let us now see whether the other tracheæ of the thorax support this explanation.

Firstly, the visceral longitudinal tracheæ (VT) cross one another in a peculiar manner, and terminate each on p_2 of the opposite side, not far below the stigma. This is an extraordinary arrange-

* This is the arrangement in the *Anisoptera*. In the *Zygoptera*, p_1 arises from DT in front of St_1, while p_2 connects up to St_1 (Fig. 20). Either of these arrangements is clearly of a secondary nature.

ment. It can scarcely be doubted that these visceral trunks were originally developed from St_1 for direct air-breathing, and that the present crossing and hitching on to p_2 is a secondary arrangement developed when the larva took to an aquatic mode of life.

Secondly, the alar trunks, by their peculiar arrangement, support the theory of an original air-breathing larva for *Odonata*. Each ends by a slender attachment to its corresponding pedal trachea (p_2 or p_3) not very far from the stigma. These slender endings are at present of no value to the developing wing, since it is quite clear, from the gradual decrease in diameter, that the oxygen-supply now comes altogether from the anal end. What then can they be, but the reduced remnants of the original alar trunks, which arose either directly from the spiracles, or, more probably, from the pedal tracheæ close up to the spiracles? In that case, there must have been *originally*, in the air-breathing larva, a supply of oxygen to the costal side of the wing-base, such as is found in the larvæ of all present-day insects except the *Odonata*. Whether this supply arose directly from the stigma or from the pedal trachea, or even originally from the main visceral or ventral trunk, it is scarcely necessary to enquire. The point is that the *Protodonate* wing was developed along *normal lines*, by means of an oxygen-supply to the costal side of the wing (probably also, as in *Plecoptera*, with a *smaller* supply to the anal side), and that this normal method of supply was destroyed when the larva took to fresh water. *From that point onwards*, we must expect to see the gradual development of those peculiar characteristics which make the *Odonate* wing unique.

One more point of interest in this question can be brought forward. It is well known that the whole dorsal tracheal system in *Odonata* is of a peculiar reddish-purple or bright coppery colour, while the visceral system is silvery-white.* Now, just where the main dorsal trunk passes close to the anterior stigma

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* The remarks in this paragraph apply, as regards *colouration*, specially to the *Anisoptera*. In the *Zygoptera*, the arrangement of the trachea is similar, but the differences of colouration are not so marked.

(St_1) it divides into two parallel, main trunks supplying the head (Fig.20). The outer of these seems to represent the original dorsal trunk, while the inner probably represents an originally separate tracheal system for the head, which became hitched on to the dorsal trunk when its original air-supply was cut off by the more or less complete functional atrophy of St_1. (The short branch to St_1 is still to be seen). Now (Fig.20) whereas all these tracheæ are either purplish-red or coppery colour, and hence belong to the dorsal system, there can be easily detected, lying just inside DT, a very short trachea (Vr) of silvery-white colour, arising from the inner of the two divisions of DT close to the point where it divides into two, and running back only a very short way to enter again the dorsal trunk itself. What then can this useless rudiment be, but the original spiracular ending of VT, the rest of which is now broken off and hitched on to p_2? Surely its silvery colour admits of no other interpretation, since at the present time it is completely attached to the dark coloured dorsal system!

Let us now turn to Palæontology for support. If our theory be correct, the ancestors of our *Odonata* should show a stronger development of the tracheæ on the costal side of the wing than they do to-day. Also, *no water-dwelling larvæ* should be found in those deposits whence we have obtained such ancestors. Now this is exactly the case with our *Protodonata*. Fossil *Ephemerid* larvæ are recorded far back, almost into Palæozoic times; but no fossil larvæ referable to an *Odonate* type have yet been found with them. Moreover, in the *Protodonata*, Sc runs either to the wing-tip or nearly as far, while the crossing of one or more branches of M over R is not accomplished, nor are M and R fused in the imago. Further than this, the *Protodonata* exhibit extraordinary differences, in many cases, between the venation of fore and hindwings—differences that seem to defy explanation, unless we assume that these insects are misnamed, and do not lie anywhere near the direct line of *Odonate* ancestry. Might not an application of this new theory help to solve some of these very difficult problems, on the assumption that the tracheal shiftings took place *not only gradually but also unequally* in fore and hindwings, thus producing differences in the venation? Such an application, though beyond the scope of the present paper, would be well worth making by some student more intimate with the vagaries of *Protodonate* wing-venation than myself.

There remains now to be carried out a thorough study of the embryonic and early post-embryonic development of the tracheal system in *Odonata*. Such a study will almost certainly reveal the true phylogenetic stages of *Odonate* larval history, and I hope to be able to give a full account of them in a future paper. If it should be proved to bear out the theory offered in this Section, we shall have, in the *Odonata*, a double tracheal metamorphosis—first from spiracular to anal breathing in the young larva, and secondly from anal breathing back to spiracular breathing at metamorphosis—which will be more wonderful even than the remarkable changes, now known to every biologist, which took place in the blood-system of the *Vertebrata* when they began to desert the sea and make their homes on dry land —changes which to-day are being repeated in the ontogeny of every air-breathing Vertebrate.

REFERENCE LETTERS.

A, anal trachea or vein: A_1, A_2, A_3, A_4, its four branches—A' secondary anal vein—Ab, anal bridge—Ac, anal crossing (= "first cubito-anal cross-vein"—Al, anal loop—Al', secondary anal loop (of *Æschna*)—arc, arculus—At, anal triangle—AT_1, AT_2, alar trunks of fore and hindwings —Br, bridge-vein—C, costal trachea or vein—Cu, cubital trachea or vein; Cu_1, Cu_2, its two branches,; Cu_{2a}, Cu_{2b}, distal and proximal branches of the latter—Cual, cubito-anal or Italian loop—Cuspl, cubital supplement (=midrib of Italian loop)—DT, dorsal longitudinal tracheal trunk—Fw, forewing—Hd, head—Hw, hindwing—lb, labial trachea—M, median trachea or vein; M_1, M_2, M_3, M_4, its four branches—m, membranule—MM, combined meso- and metathorax—Mspl, median supplement—N, nodus—o, oblique vein—p_1, p_2, p_3, first, second and third pedal tracheæ —Plr, pleural ridge—Prt, prothorax—ps, branch-trachea to region of second stigma—R, radial trachea or vein; R_1, Rs, its two branches [Rs= "radial sector"]—Rspl, radial supplement—Sc, subcostal trachea or vein —st, subtriangle—St_1, St_2, anterior and posterior stigmata, or spiracles— t, triangle—TA, thoracic or posterior tracheal anastomosis—Vr, remnant of visceral trunk—VT, visceral longitudinal tracheal trunk.

EXPLANATION OF PLATES XI.-XIII.

Plate xi. (Microphotographs).

Fig. 1.—*Æschna brevistyla* Ramb., ♂. Basal portion of hindwing of nearly full-grown nymph. (Compare text-figure 2B).

Fig. 2.—*Æschna brevistyla* Ramb., ♂. Basal portion of forewing of same. (Compare text-figure 2A).

Fig. 3.—*Dendroæschna conspersa* Tillyard, ♂. Basal portion of hindwing of full-grown nymph.

Fig. 4.—*Synthemis macrostigma orientalis* Tillyard, ♂. Basal portion of hindwing of nearly full-grown nymph. (Compare text-figure 6B).

Fig. 5.—*Synthemis macrostigma orientalis* Tillyard, ♂. Basal portion of forewing of same. (Compare text-figure 6A).

Fig. 6.—*Austrocordulia refracta* Tillyard, ♂. Basal portion of hindwing of full-grown nymph. (Compare text-figure 9).

Fig. 7.—*Hemicordulia tau* Selys, ♂. Basal portion of hindwing of full-grown nymph. (Compare text-figure 11B).

Fig. 8.—*Hemicordulia tau* Selys, ♂. Basal portion of forewing of same. (Compare text-figure 11A).

Fig. 9.—*Diplacodes hæmatodes* Burm., ♀. Basal portion of hindwing of full-grown nymph.

Fig. 10.—*Cordulephya pygmæa* Selys, ♂. Basal portion of hindwing of full-grown nymph.

Fig. 11.—*Cordulephya pygmæa* Selys, ♂. Same from another specimen, closer to metamorphosis, to show narrowing of imaginal wing-border. (Compare text-figure 13).

Fig. 12.—*Hemigomphus heteroclitus* Selys, ♂. Basal portion of hindwing of full-grown nymph. (Compare text-figure 16).

Fig. 13.—*Cordulephya pygmæa* Selys, ♂. Forewing of full-grown nymph.

Fig. 14.—*Caliagrion billinghursti* Martin, ♀. Hindwing of full-grown nymph.

Fig. 15.—*Caliagrion billinghursti* Martin, ♀. Base of same, lightly printed to show fusion of A with Cu. (Compare Plate xii., fig. 1A).

(Figs. 1-3 and 6-12 × 32, figs. 4-5 × 16, figs. 13-15 × 11.)

Plate xii. (Diagrams).

Fig. 1.—*Caliagrion billinghursti* Martin, ♀. Tracheation of hindwing of full-grown nymph. (Compare Plate xiii., fig. 1).

Fig. 1A.—Base of same, to show fusion of A and Cu. (Compare Plate xi., fig. 15).

Fig. 2.—*Caliagrion billinghursti* Martin, ♀. Corresponding venation in imago.

Fig. 3.—*Austrolestes cingulatus* Burm., ♂. Tracheation of forewing of full-grown nymph.

Fig.4.—*Austrolestes cingulatus* Burm., ♂. Corresponding venation in imago.

Fig.5.—*Synlestes weyersi* Selys, ♂. Tracheation of forewing of nearly full-grown nymph. (Compare Plate xiii., fig.2).

Fig.6.—*Synlestes weyersi* Selys, ♂. Corresponding venation in imago.

Fig.7.—*Argiolestes griseus* Selys, ♀. Tracheation of forewing of full-grown nymph. (Compare Plate xiii., fig.3).

Fig.8.—*Argiolestes griseus* Selys, ♀. Corresponding venation in imago.

Fig.9.—*Neosticta canescens* Tillyard, ♂ Tracheation and imaginal venation of forewing of full-grown nymph. (Compare Plate xiii., fig.4).

Fig.10.—*Neosticta canescens* Tillyard, ♂. Corresponding venation in imago.

Fig.11.—*Isosticta simplex* Martin, ♀. Tracheation of hindwing of nearly full-grown nymph.

Fig.12.—*Isosticta simplex* Martin, ♀. Corresponding venation in imago.

(All figures of nymphal tracheation from microphotographs; × 30. Figures of imaginal venation from camera-lucida drawings; × 5).

Plate xiii. (Microphotographs).

Fig.1.—*Caliagrion billinghursti* Martin, ♀. Tracheation of hindwing of full-grown nymph. (Compare Plate xii., fig.1).

Fig.2.—*Synlestes weyersi* Selys, ♂. Tracheation of forewing of nearly full-grown nymph. (Compare Plate xii., fig.5).

Fig.3.—*Argiolestes griseus* Selys, ♀. Tracheation of forewing of full-grown nymph. (Compare Plate xii., fig.7).

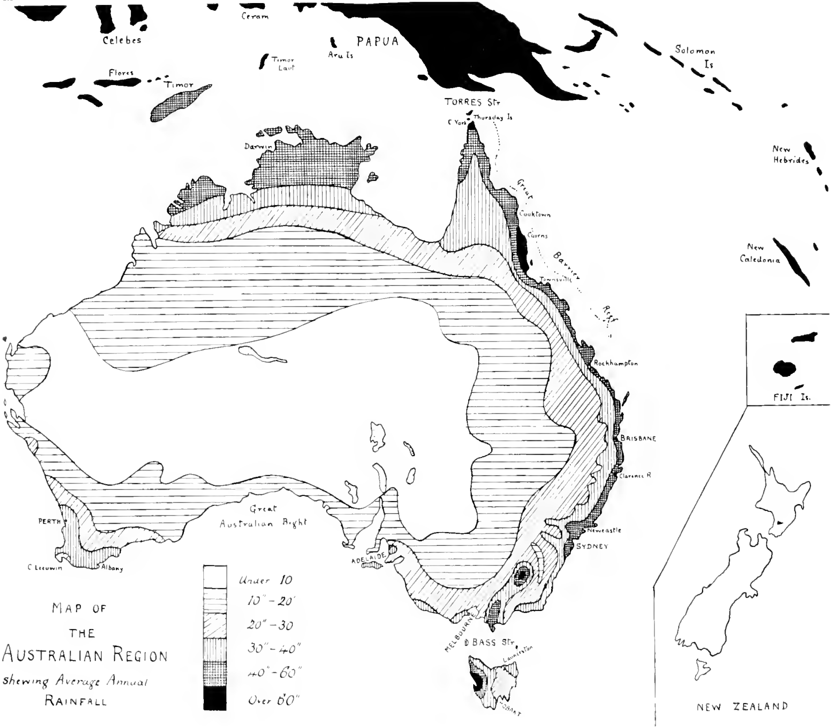
Fig.4.—*Neosticta canescens* Tillyard, ♂. Tracheation of forewing of full grown nymph. (Compare Plate xii., fig.9).

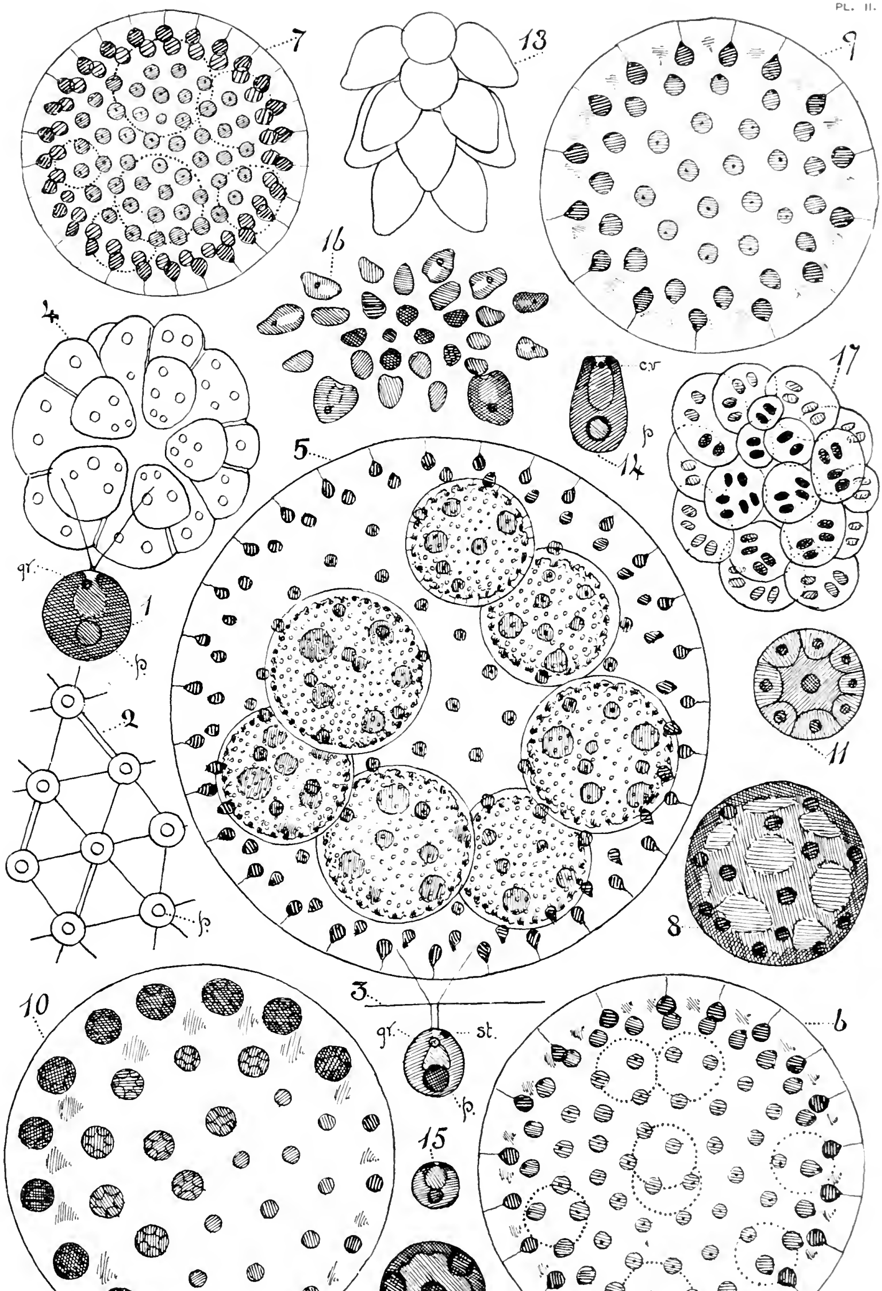
(All figures × 50.)

[Printed off, 13th July, 1914.]

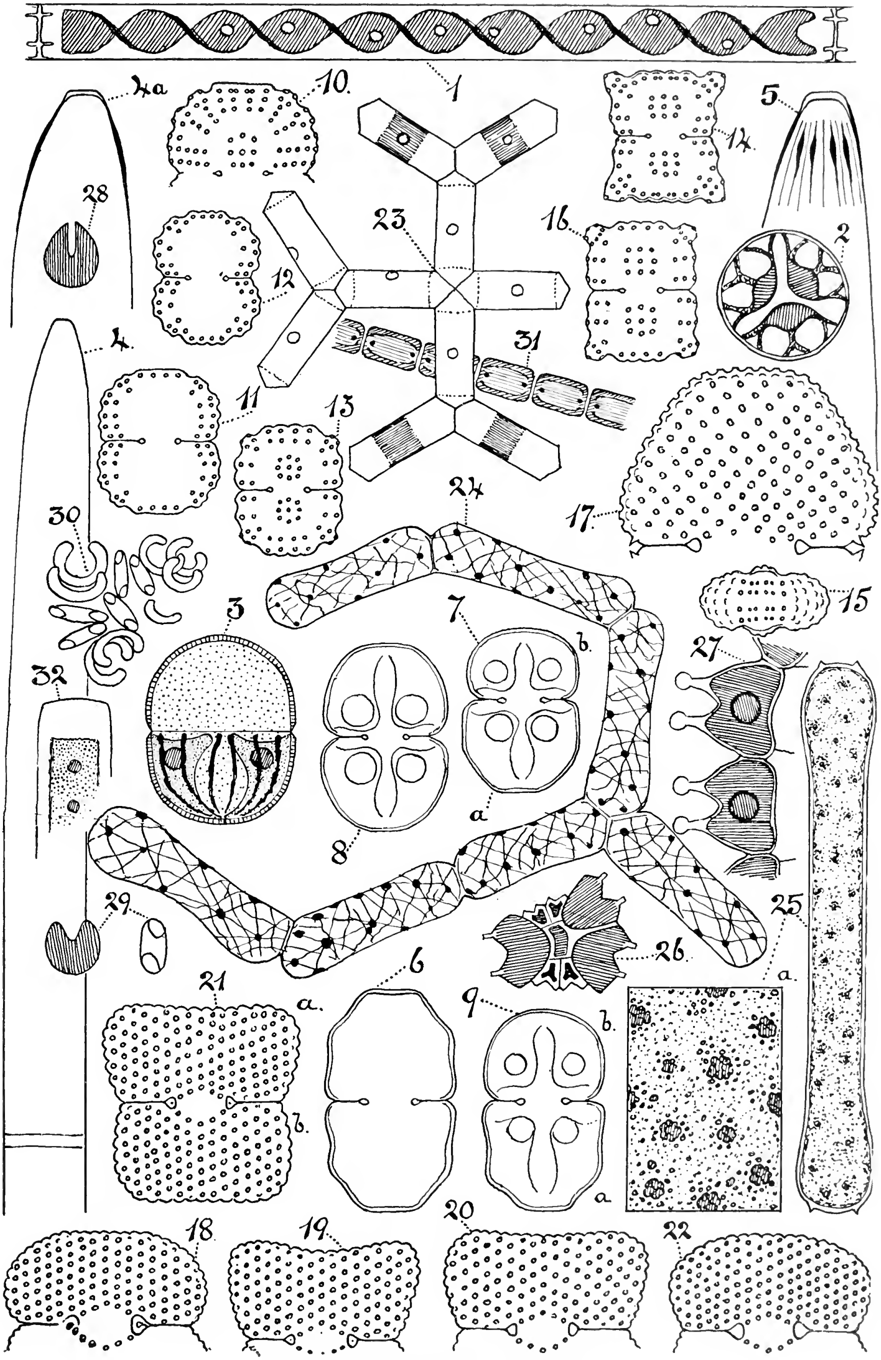
Part of the Specific Contour
for the Subfamily
PETALURINÆ (A PALÆOGENIC)


Transparency 2.
Approximate Specific Contour
for the Group
SYNTHEMINA (ENTOGENIC)

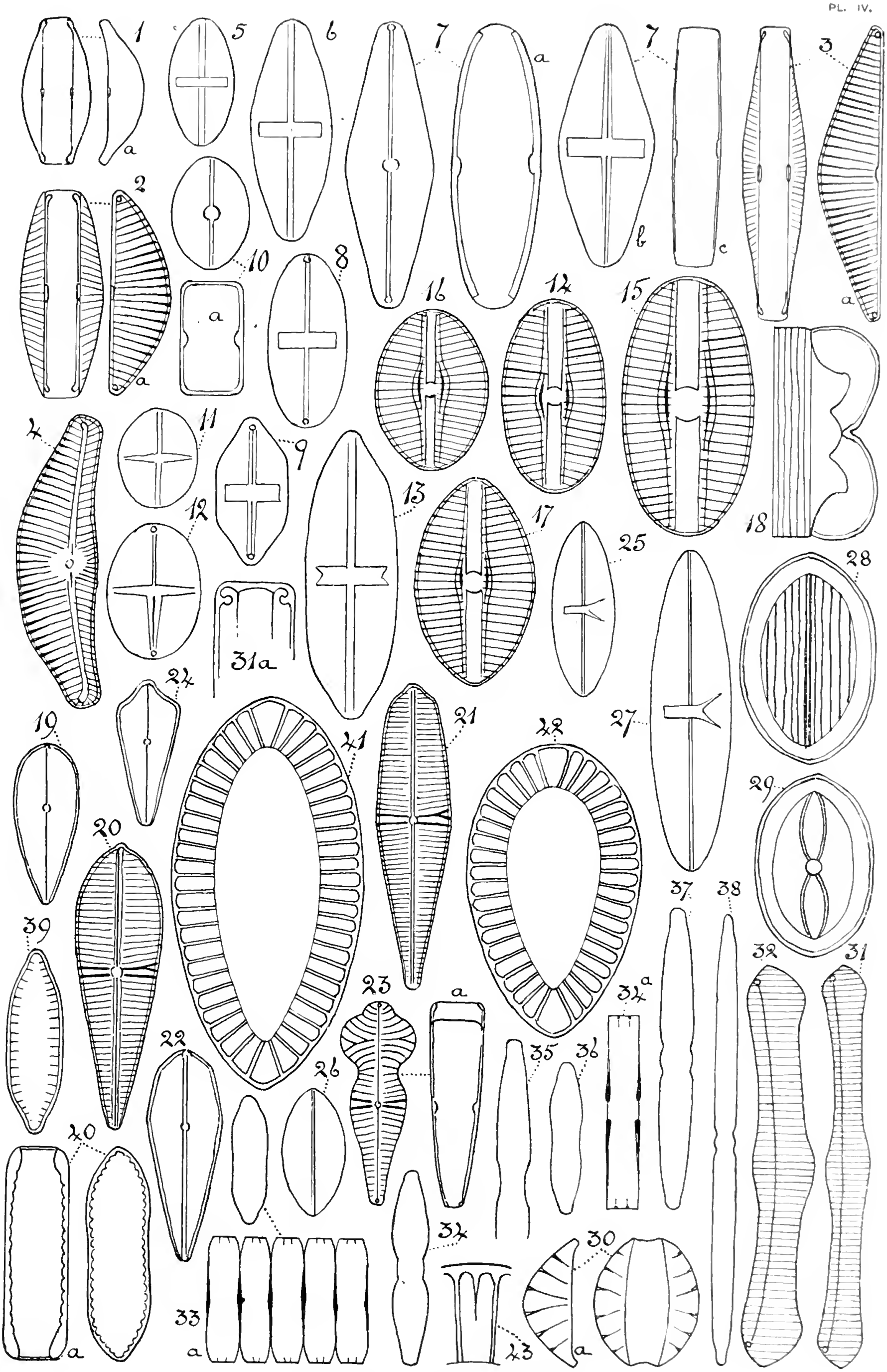

Ceram
Celebes
PAPUA
Aru Is
Timor Laut
Flores
Timor
Solomon Is
TORRES Str
C York
Thursday Is
New Hebrides
Darwin
Great
Cooktown
Cairns
Barrier
Townsville
Reef
New Caledonia
Rockhampton
FIJI Is.
BRISBANE
Clarence R
Newcastle
SYDNEY
Great Australian Bight
PERTH
C Leeuwin
Albany
ADELAIDE
MELBOURNE
BASS Str
Launceston
HOBART
NEW ZEALAND
Under 10
10" - 20"
20" - 30
30" - 40"
40" - 60"
Over 60"
MAP OF THE AUSTRALIAN REGION shewing Average Annual RAINFALL



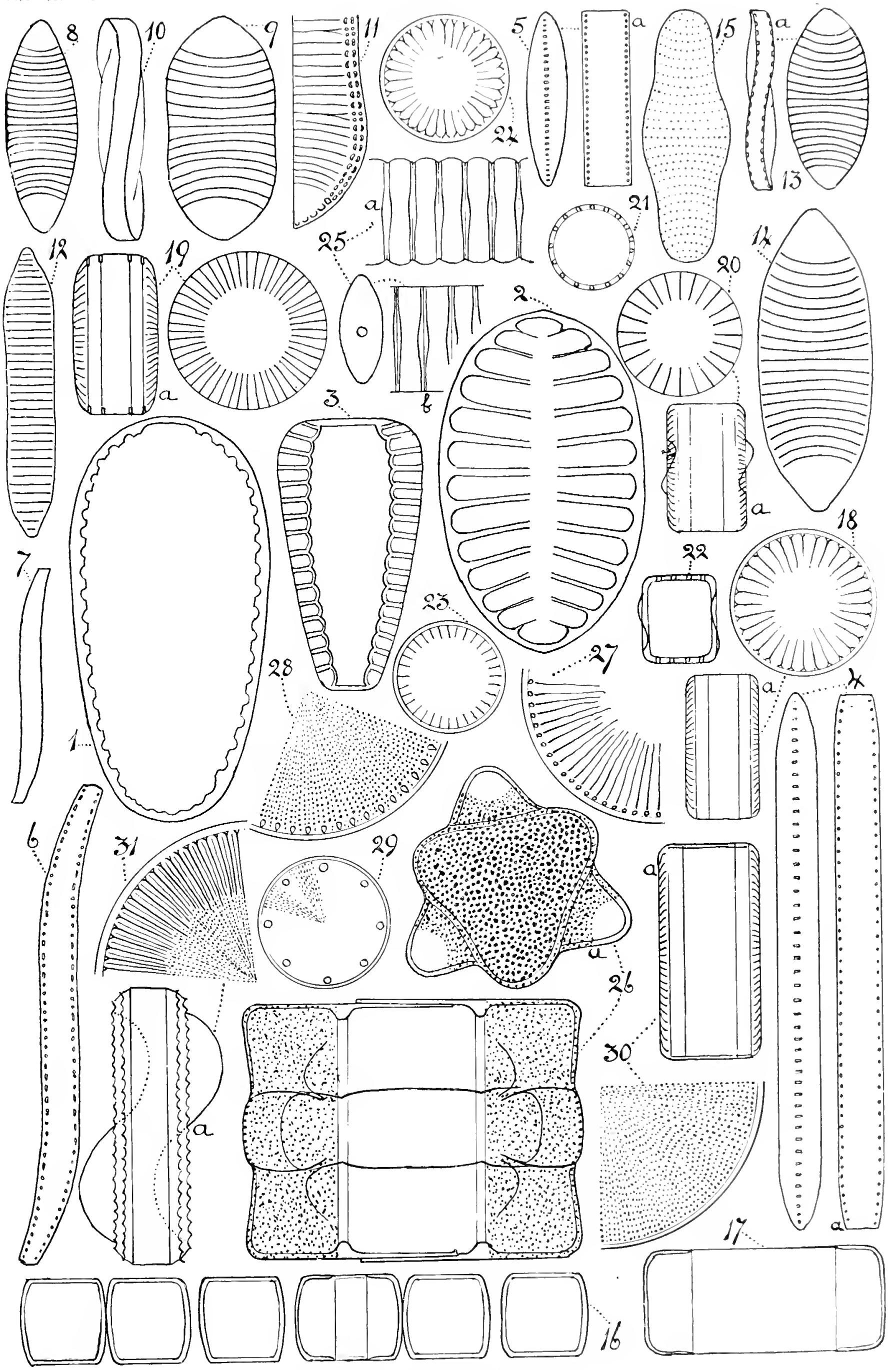
Volvocaceæ of the Richmond River.



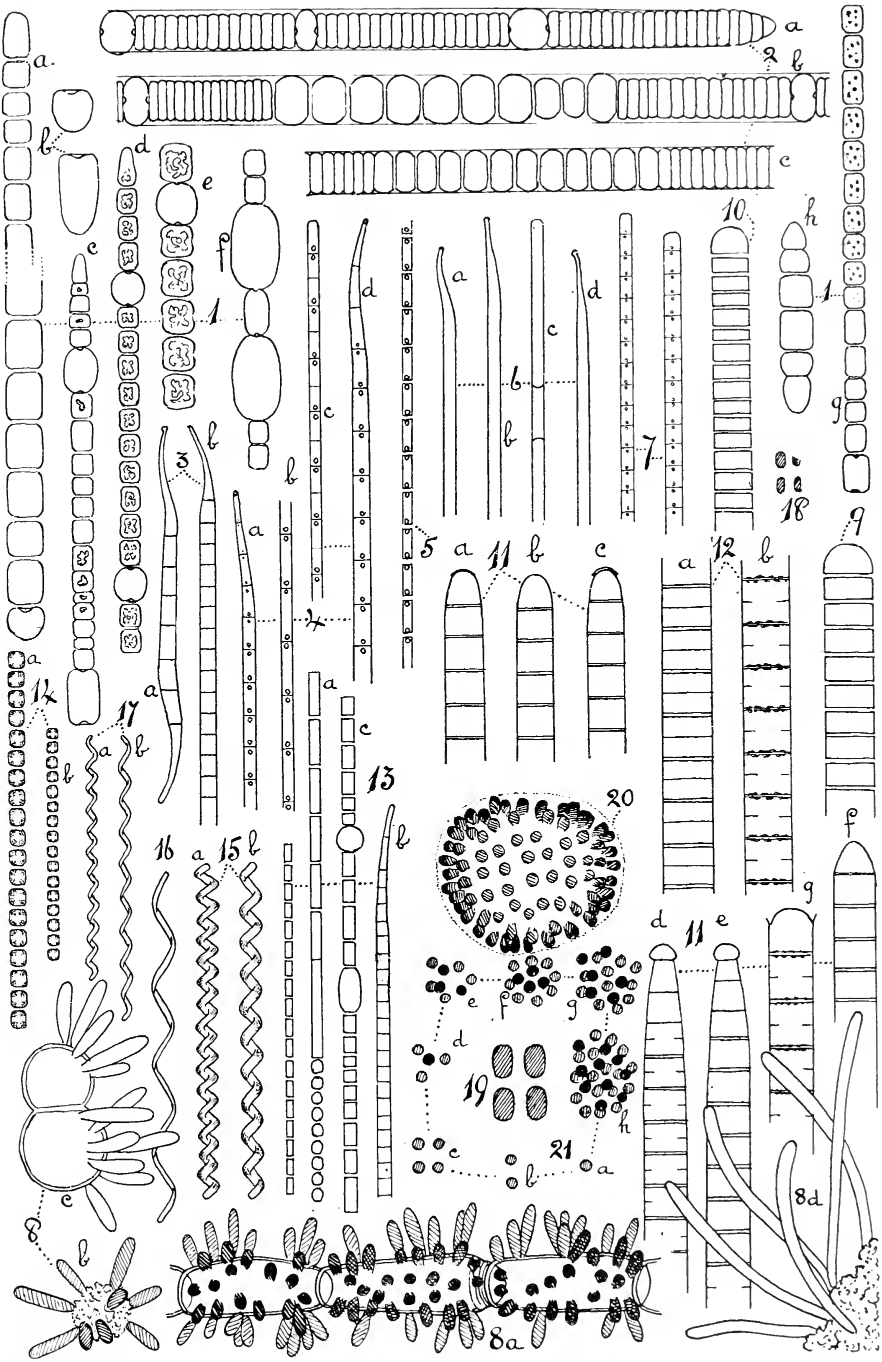
Chlorophyceæ of the Richmond River.



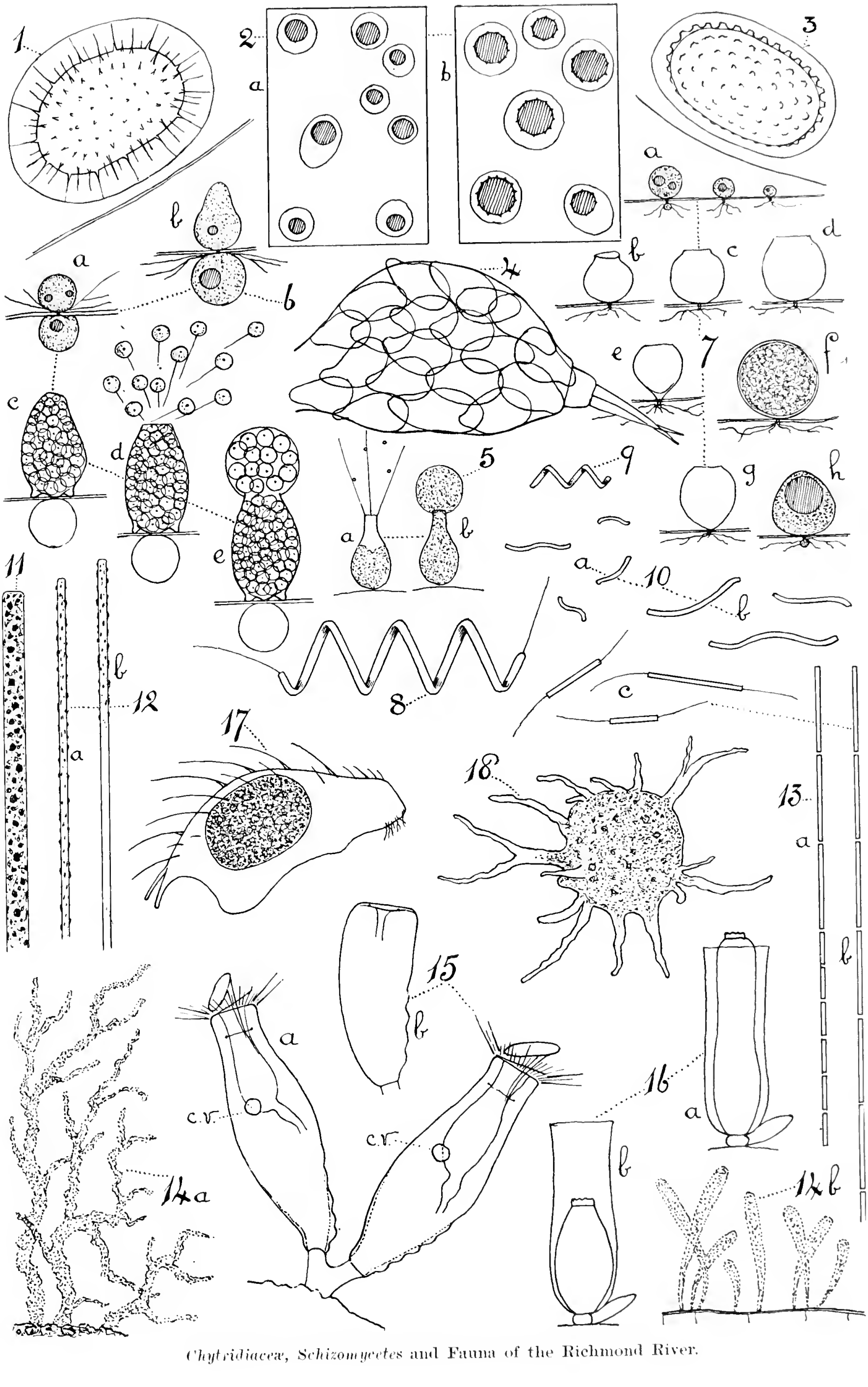
Bacillarieæ of the Richmond River.



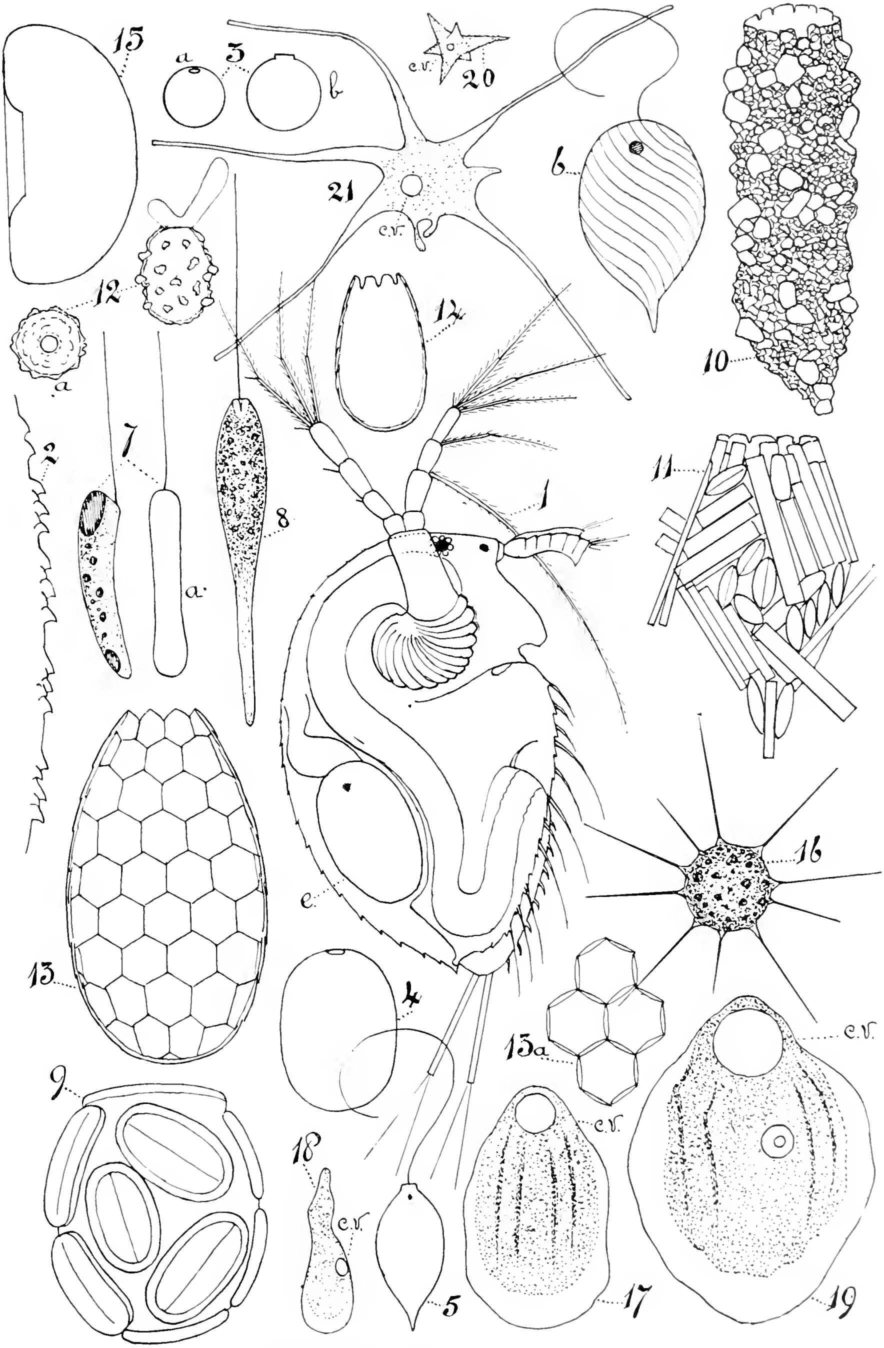
Bacillariæ of the Richmond River.



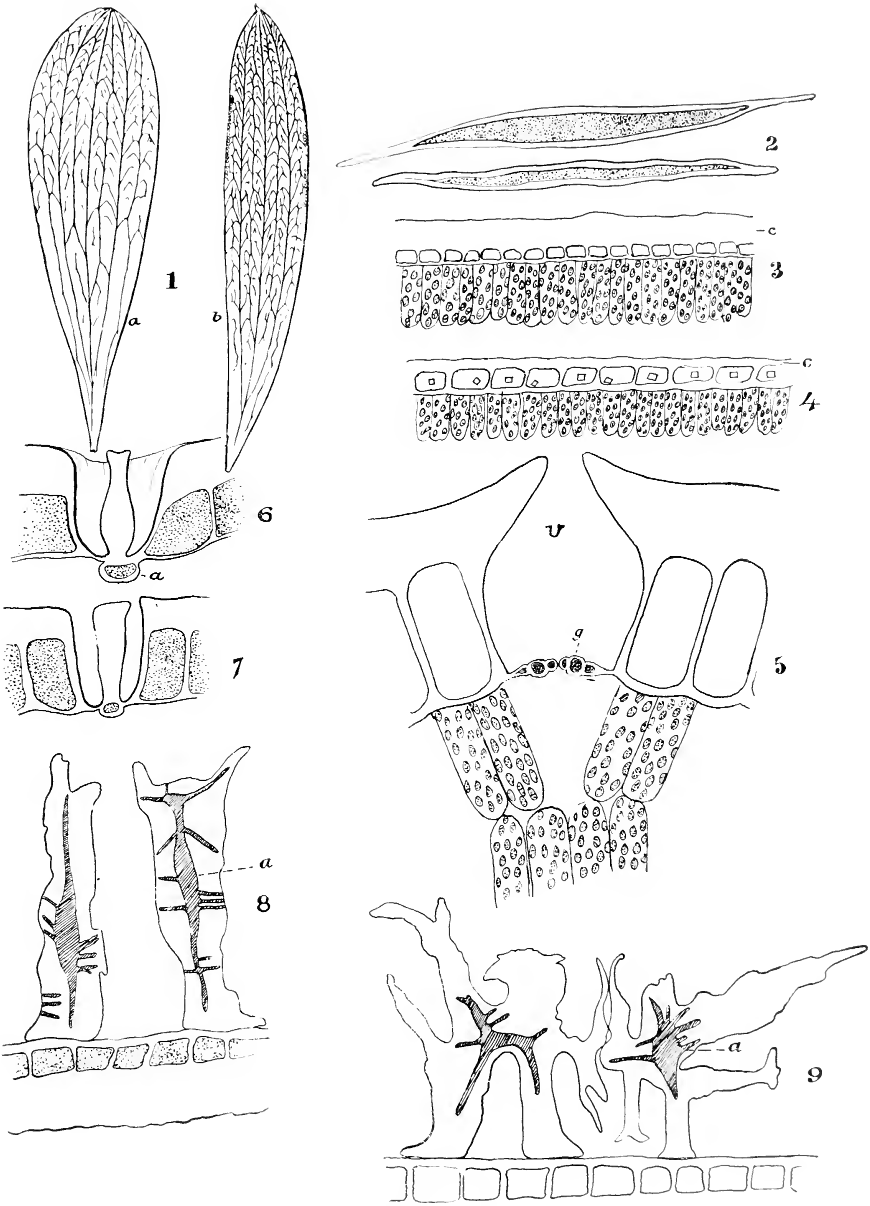
Myxophyceæ of the Richmond River.



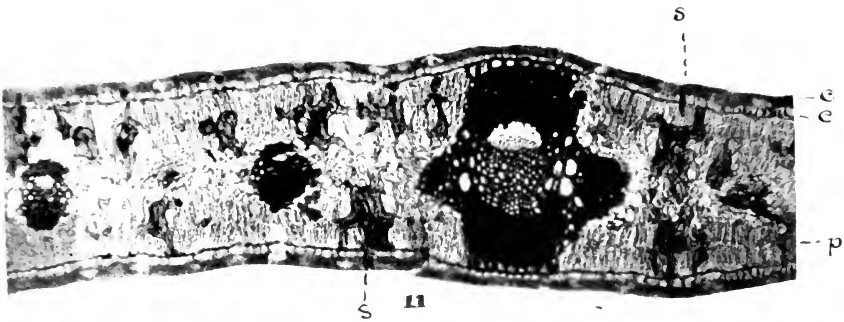
Chytridiaceæ, Schizomycetes and Fauna of the Richmond River.



Microscopic Fauna of the Richmond River.



Xerophilous characters of *Hakea dactyloides* Cav.



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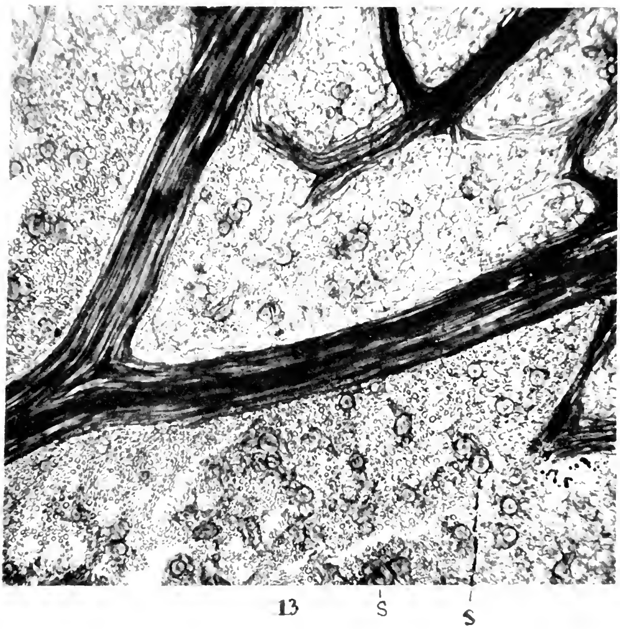

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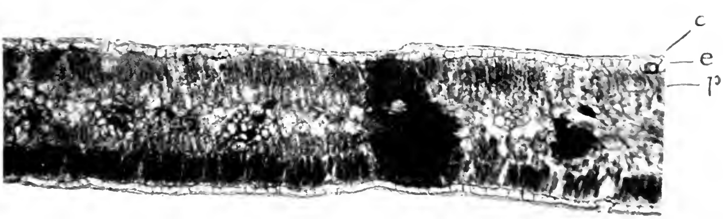

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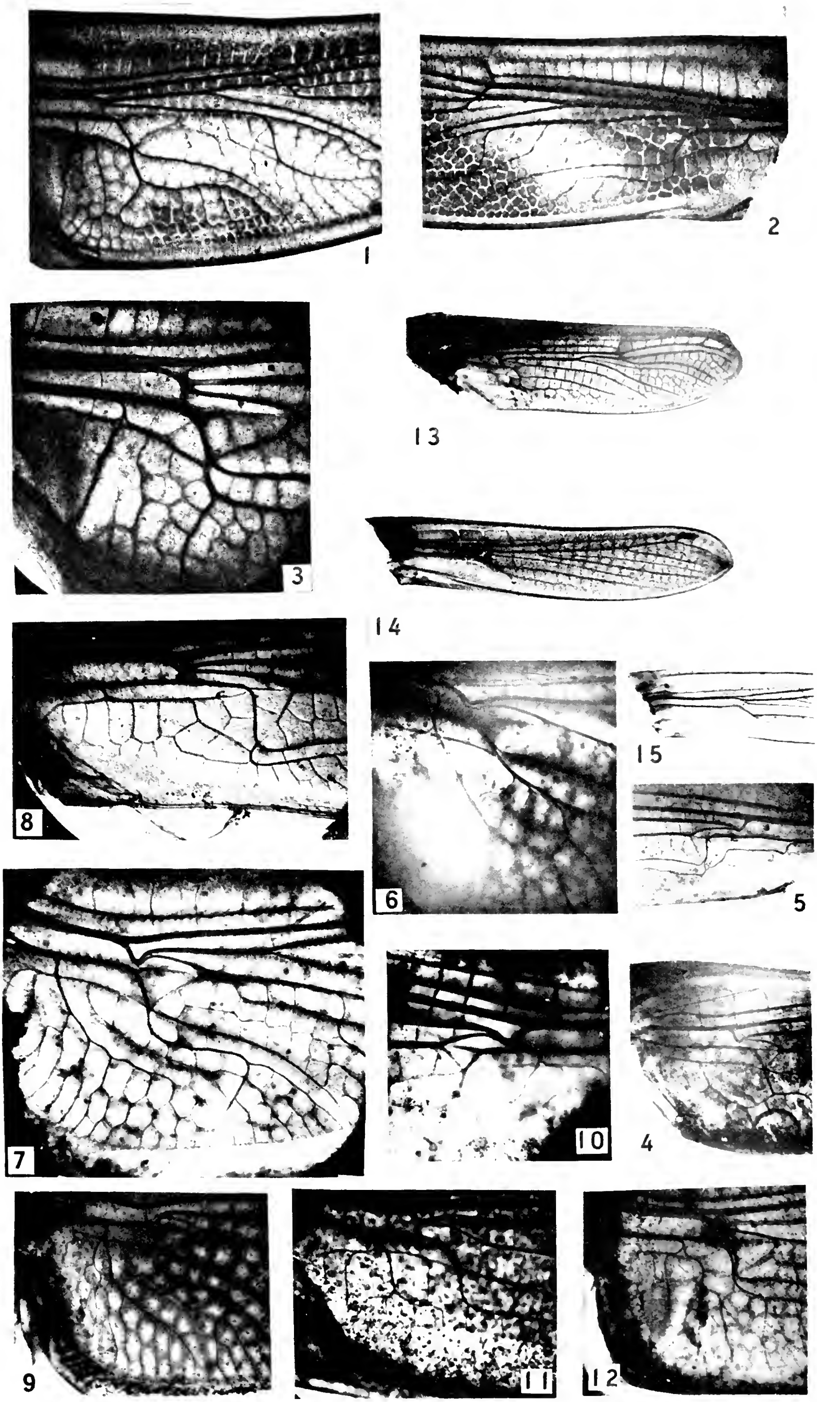
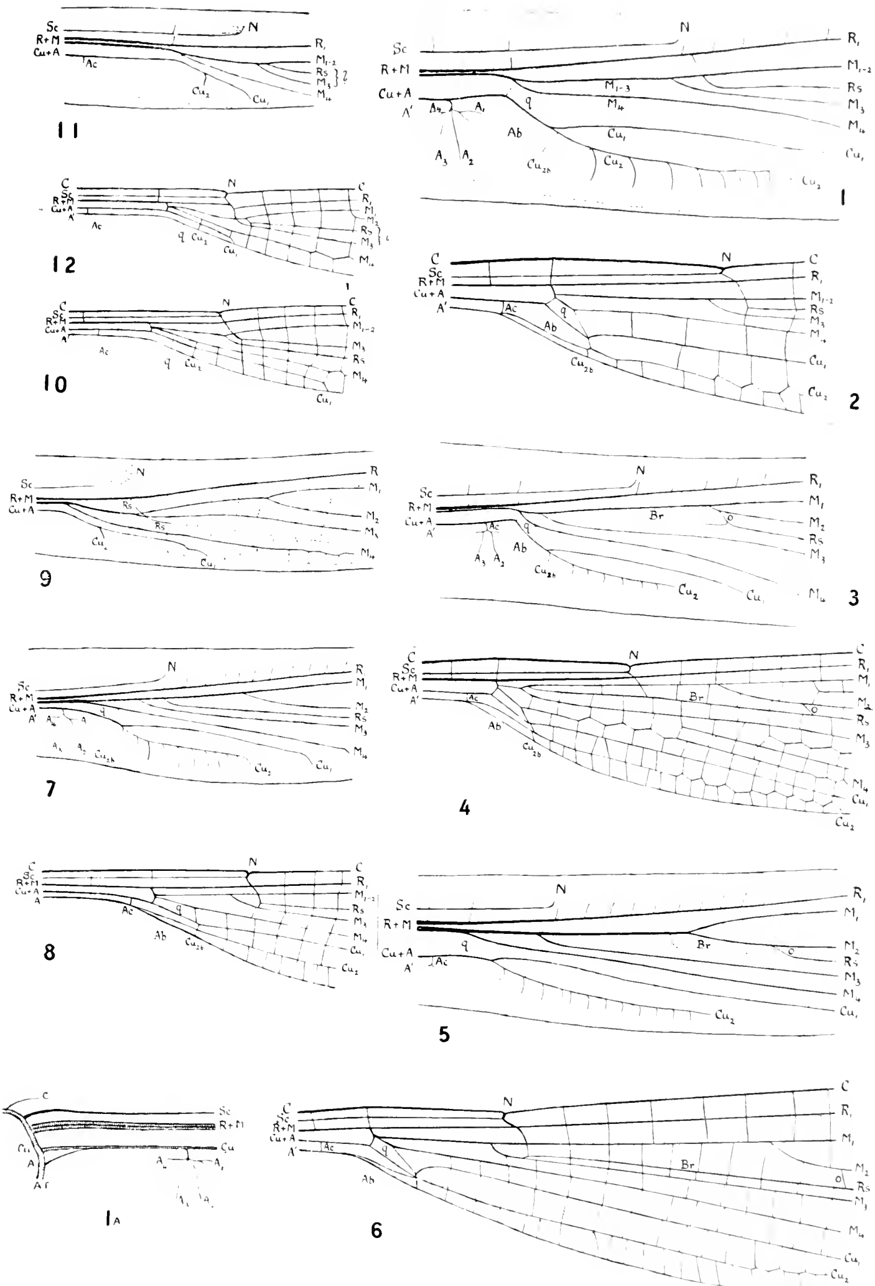
Xerophilous characters of *Hakea dactyloides* Cav.



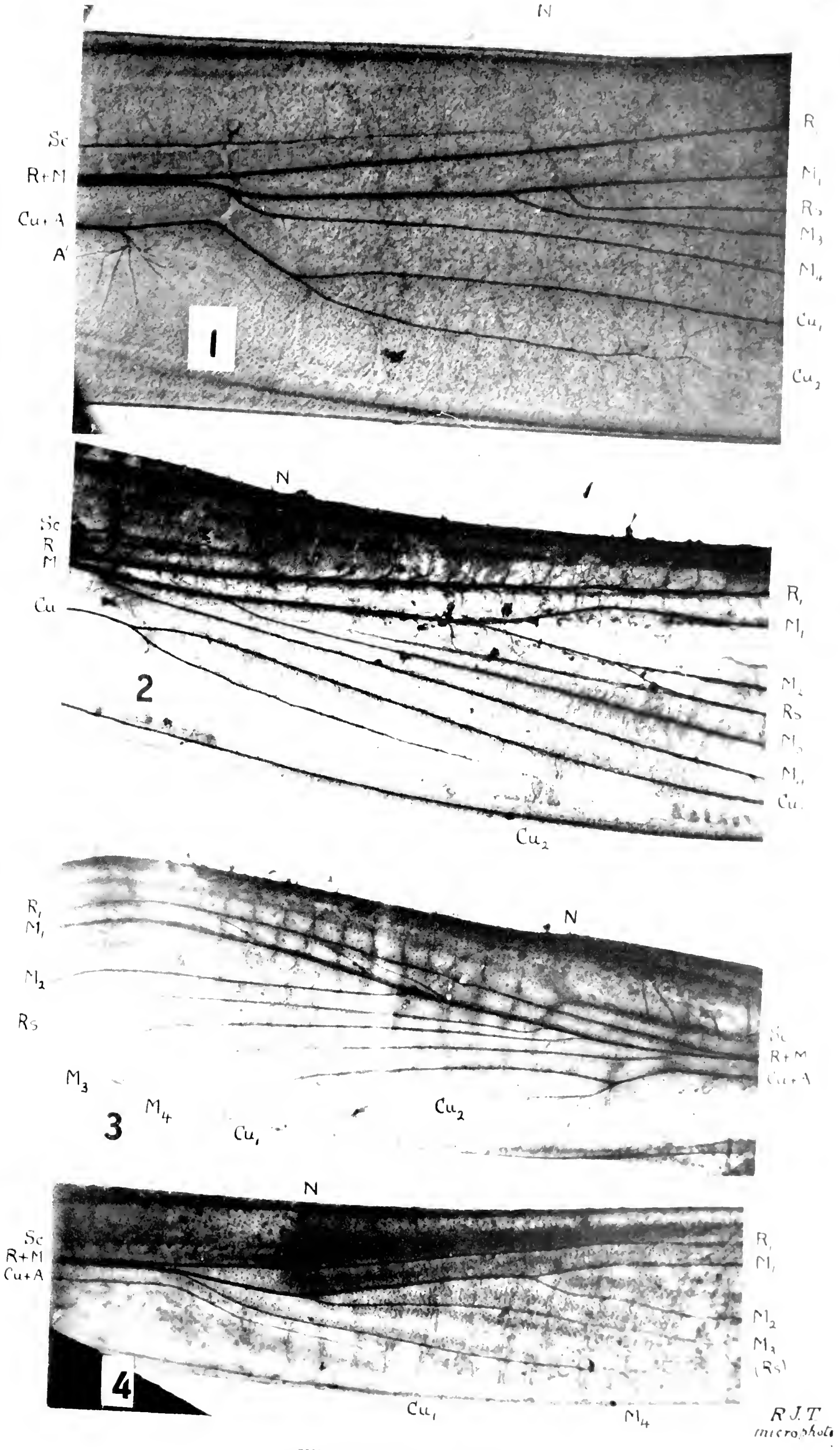
R J T microphoto

Wing-venation of *Odonata.*



R J T del.

Wing-venation of *Odonata*.



Wing-venation of *Odonata*.

REVISION OF THE AMYCTERIDES.

Part iii. *Notonophes*, *Macramycterus*, and genera allied to *Talaurinus*.

By Eustace W. Ferguson, M.B., Ch.M.

(Continued from Vol. xxxviii., p.394.)

(Plate xiv.)

In the present part of my revision of the subfamily, I have brought together a number of the smaller genera, partly for convenience, partly because they are mostly related to *Talaurinus*: *Notonophes*, *Pseudonotonophes* and *Myotrotus*, which show a decided affinity to *Talaurinus*: *Macramycterus*, which should perhaps be considered as forming a distinct group in the subfamily allied both to the *Talaurinus* and to the *Acantholophus* groups of genera; and *Chriotyphus*, which, notwithstanding the long scape, is very doubtfully associated with the long-scaped genera, its affinities appearing to be rather to the "*Euomides*" and to *Alexirhea* in particular.

With the exception of *Myotrotus*, a Central Queensland genus, all the genera described in the present paper are inhabitants of West or North-west Australia, in the case of *Notonophes*, the habitat extending along the north of Australia to the extreme north-east of Queensland.

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*In the first part of this Revision, I indicated that there was some doubt as to the correct assignment of the name *Amycterus*. As will be seen later, this name must sink as a synonym of *Psalidura*, and, according to the present rules of nomenclature, the name of the subfamily, *Amycterides*, should be altered to *Psalidurides*. As the name *Amycterides* has been in use for these insects for so long a time, I do not at present suggest this alteration as advisable.

NOTONOPHES Sloane.

Sloane, Trans. Roy. Soc. S. Australia, xvi., p. 234.

Type of genus, *Cubicorrhynchus cichlodes* Pasc.

The following extract from the generic diagnosis appears to contain the main points of generic importance: "Allied to *Talaurinus*. Form oval, robust. Rostrum broad, flat, not divided from head; a light linear longitudinal impression in middle; external ridges prolonged backwards to eyes, becoming more prominent behind; scrobes widening backwards and reaching eyes." The remainder of the diagnosis contains no feature peculiar to the genus, and is applicable to many forms of *Talaurinus*. Sloane says (*loc. cit.*, p.235), "Except for the head, the species on which this genus is founded has entirely the form of a *Talaurinus*."

To the above combination of features may be added, as a generic characteristic, the supraorbital crest, as, with the single exception of *N. hystricosus* Bohem., which I regard as doubtfully congeneric, it is present, and strongly developed in all the species known to me. The rostrum is always broad, and the external ridges extend back towards the eyes, and end in the supraorbital crests, but though, in general, the plane is flat, in some the median line is further depressed and widened in front, forming a concave, median area which extends anteriorly into the postmarginal sulcus. The external borders of the dorsum of the rostrum are flat, and not definitely ridged; generally, they show an outward divergence towards the base. In some species, the supraorbital crests appear to be the direct continuation backwards of the external ridges; in others, however, the crests arise at a distinct angle from the general line of the ridge. The crest itself is flat, and projects backwards and outwards from the side of the head, above the eye. The internal, rostral ridges are not distinctly marked off from the rest of the dorsum in the type-species; in *N. auriger*, they are present though not conspicuous, and are flattened above; while in *N. angulicollis*, they are small, rounded, and almost nodulose. In the more typical species, the head and rostrum run directly into one another: in *N. angulicollis*, however, they are, to some extent, separated by a transverse, basal sulcus. The prothorax is similar in shape in all, and is not in any way different from that of many species of *Talaurinus.* The elytral sculpture consists of more or less regular rows of shallow foveæ or punctures; the interstices are little raised, and finely granulate, the granules being often obscured by the clothing; in *N. hystricosus,* however, the elytra are spinose.

In addition to *Cubicorrhynchus cichlodes* Pasc., the type of the genus, the following species have also been referred by Lea (Trans. Roy. Soc. S. Australia, 1903, p. 112) to *Notonophes*—*T. dumosus* Macl., *T. pupa* Pasc., *T. lemmus* Pasc., *T. spinosus* Macl., *N. angulicollis* Lea.

I cannot regard the first three as congeneric with *N. cichlodes*, and have, therefore, proposed the genus *Pseudonotonophes* to receive them. *T. spinosus* is synonymous with *T. hystricosus* Bohem., and *T. tenuipes* Pasc.; it differs from *N. cichlodes* in the absence of the supraocular crests, and in the spinose elytra. As it is probably more nearly related to *Notonophes* than to the *typicus*-group of *Talaurinus*, for example, I am content to leave it, for the present, in the former genus. *N. angulicollis* Lea, is a thoroughly distinct species, but I have grave doubts as to whether the form described as a variety, by Lea*, is not entitled to specific rank; at any rate, I have thought it worthy of at least a varietal name. In addition to the above, I have specimens of two new species from West and North-west Australia, and one which I doubtfully regard as another variety of *N. angulicollis* Lea.

Also, I have little doubt, from the description, that *Cubicorrhynchus dilataticeps* Blackburn (Report Horn Exped. Central Australia, ii., 1896, p. 293), also belongs to this genus. As I do not know it in nature, I have not included it in my table.

Geographical Distribution.—The range of this genus differs greatly from that of the other main genera, with the possible exception of *Macramycterus.* Including *N. hystricosus*, the range extends from King George's Sound, through North-west Australia and the Northern Territory to Cape York Peninsula. If *C. dilata-*

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* Mitt. a. d. Zool. Mus. Berlin, 1910, p.181.

ticeps prove to be a *Notonophes*, Central Australia (Charlotte Waters) must be added to the habitat. The region embraced in this range is, or was until lately, almost unexplored entomologically, and probably other new forms await discovery.

Table of Species.

1. Head with supraocular crest, elytra granulate.
  A. Rostrum continuous with head without interruption.
    a. Outer border of crests evenly curved, not angulate.
      b. Elytral granules small but regular and prominent ... ... *N. cichlodes* Pasc.
      bb. Elytral granules smaller, less prominent, and less regular ... ... *N. taurus*, n.sp.
    aa. Outer border of crests markedly angulate beyond point of origin from the head. ... ... *N. auriger*, n.sp.
  AA. Rostrum separated from head by transverse sulcus.
    Elytra with irregular mottled clothing.
      d. Size moderate (14–6 mm.), crest moderately prominent ... ... *N. angulicollis* Lea.
      dd. Size smaller (12–4 mm.), crest little prominent ... ... var. *angustior*, n var.
    Elytra with large dark patches forming a regular pattern ... ... var. *Leai*, n. var.
2. Head without supraocular crest; elytra spinose. *N. hystricosus* Bohem.

NOTONOPHES CICHLODES Pasc.

Cubicorrhynchus cichlodes Pasc., Journ. Linn. Soc., Zool., xii., 1873, p.18; *Notonophes cichlodes* Sloane, Trans. Roy. Soc. S. Australia, xvi., 1893, p. 235.

This species may be easily recognised by its ovate, convex form, with the elytral granules small but conspicuous. I have examined the specimen upon which Sloane founded the genus, and agree with him in assigning it to *C. cichlodes* Pasc. As Mr. Sloane has given a full description of the species, a further one is unnecessary here. It appears to be a common species in the Murchison District of West Australia.

Hab. W. Australia, Murchison District (R. Helms; Elder Expedition; C. French), Geraldton (A. M. Lea), Cue (H. W. Brown).

NOTONOPHES TAURUS, n.sp.

♂. Size moderate, elongate ovate. Black, densely covered with stilaceous and whitish subsetose clothing; head densely clothed, save over median line, with whitish supraocular vittæ; prothorax trivittate, elytra maculate with white, sides of prothorax and elytra with white clothing; beneath sterna sparsely clothed, ventral segments with median maculæ almost continuous, and with smaller lateral ones. Setæ light.

Head and rostrum characteristic of the genus; sublateral sulci shallow, median line rather deeply impressed, external borders of rostrum feebly divergent; supraocular crests arising at nearly a right angle with rostral borders, projecting strongly outwards, the outer edge strongly curved backwards, the inner border less strongly curved, apex pointed, base narrower than in *N. auriger*. Prothorax (3 x 4 mm.) transverse, evenly rounded on sides, apical margin without definite lobes; disc set with small separate setigerous granules, tending to leave sublateral vittæ free; sides granulate above. Elytra (8 x 6 mm.) rather strongly widened, ovate, base gently arcuate, humeral angles noduliform; striate, the striæ with obscure, open, foveiform depressions; interstices rather broad, gently convex transversely, not greatly raised, set with small depressed setigerous granules, more or less obscured by clothing, for the most part in single series, occasionally duplicated; near the sides, the granules show some tendency to unite laterally, forming obscure, transverse rugæ. Beneath glabrous, with scattered, shallow, setigerous punctures, ventral segments feebly flattened in middle, fifth segment very feebly concave in middle, without definite impressions. Legs simple, intermediate tibiæ not notched.

♀. Very similar, but larger, broader, more ovate; undersurface gently convex. *Dimensions*: ♂, 13 x 6 mm.; ♀, 14 x 7 mm.

Hab. West Australia, Lake Austin, "only found in the Lake country under stones" (H. W. Brown).

Both sexes show a feebly transverse impression at base of rostrum, but it is not developed to the same extent as in *N. angui-*

collis Lea. The crests are shaped somewhat as in *N. cichlodes*, but are much stronger and more curved, a fanciful resemblance to horns having suggested the specific name. The femora are practically devoid of clothing (except for a few scattered setæ) on the inner and on the basal two-thirds of the outer side; the knees are also bare; the tibiæ are closely clothed.

Closely allied to *N. cichlodes* Pasc., but, apart from size and the larger crests, it differs in the more obscure granulation of the prothorax and of the elytra; the clothing on the elytra is also differently distributed, lacking the sublateral vitta so conspicuous in *N. cichlodes*.

Notonophes auriger, n.sp.

♂. Elliptical, elongate, convex. Black, granules subnitid, more or less densely clothed with greyish subpubescence, granules not clothed; beneath with scattered setæ, and with whitish setose subpubescence in the middle of each segment, tending to form a feeble, median vitta. Setæ light brown.

Rostrum short and wide, gently convex in profile, forming an even curve with head, not excavate, a feeble transverse impression present at base connecting a median and two sublateral basal foveæ; internal ridges flattened, subobsolete, indicated at base but not at all prominent. Head gently convex above, with large, flat, ear-like crests projecting laterally and directed backwards, the outer border not continuing the direction of the external ridges but arising almost at right angles, then suddenly changing direction backwards and outwards; crests wide across base. Scrobes simple, open posteriorly. Eyes ovate, vertical, overhung by projection of the crests. Prothorax (3·5 × 4 mm.) widest about middle, sides gently narrowed to apex, but rather sharply narrowed before base, apical margin truncate above, ocular lobes absent; disc with a narrow, subapical, transverse impression; set fairly uniformly with rounded, moderately large, non-contiguous granules. Elytra (9 × 6 mm.) elongate, ovate, evenly rounded to apex; base moderately strongly and evenly arcuate, humeral angles marked by a small granule, not produced. Disc foveo-striate, foveæ small, shallow, open, the intervening ridges setigerous, hardly granulate: interstices broader than striæ, gently convex, all equally prominent, set with small, somewhat obsolete, setigerous granules, showing a slight tendency to umbilication, in double series on third and fifth interstices, more prominent on declivity and towards sides. Abdominal segments feebly concave at base, fifth segment without impressions. Tibiæ simple, without subapical notch.

♀. Differs in being relatively more robust, and in the gently convex ventral surface. *Dimensions*: ♂, 14 × 16 mm.; ♀, 14 × 6·5 mm.

Hab.—North-West Australia.

Closely allied to *N. cichlodes* Pasc., but larger and flatter, and with very differently shaped, supraorbital crests. The clothing has been much abraded from the specimen I take to be the male: in the other, the prothorax is feebly trivittate, and the elytra definitely maculate. There appears to be little sexual difference, but, in the specimen I regard as the male, the basal abdominal segments are flattened, hardly concave: while in the other specimen, the whole abdomen is distinctly convex. I am indebted for my specimens to Mr. H. J. Carter, who obtained them from Mr. C. French.

Notonophes angulicollis Lea.

Lea, Mitt. a. d. Zool. Mus. Berlin, 1910, p. 181.

This species was described by Lea, in a paper entitled "Notes on Australian Curculionidæ in the Berlin Museum." It is, for the genus, a comparatively large species, and may be recognised by the prominent angles at the sides of the prothorax. The supraorbital crests are moderately long and prominent.

Hab.—North-West Australia, Behn and Upper Ord Rivers.

N. angulicollis Lea, var. Leai, n.var.

I propose this name for a form which Lea has noted in his paper, and which appears, to me, sufficiently distinct to warrant at least varietal if not specific rank.

♂. Size smaller, narrower. Clothing mostly of a slaty-grey, with a large, subtriangular, dark patch on each side about the middle of each elytron, apex of triangle almost touching suture, and with an apical dark patch on declivity.

♀. More ovate, but with similar clothing. *Dimensions*: ♂, 11 × 4·5 mm.; ♀, 11 × 5 mm.

Hab.—Northern Australia, Port Darwin (A. M. Lea)—North Queensland, Princess Charlotte Bay (C. French).

The head appears to be shorter, and almost nodulose in front, though this is, to a great extent, obscured by the clothing; apart from this, there seems little difference in structure between the two forms. The difference in the clothing is most conspicuous, and the dark patches are constant in all the specimens (4) I have seen of the variety.

Type-male in Coll. Lea; type-female in Coll. Ferguson.

N. ANGULICOLLIS Lea, var. ANGUSTIOR, n.var.

Specimens from North-West Australia appear to represent another variety of this species.

♂. Size smaller, narrower. Clothing mottled with brown as in type, without conspicuous, dark patches. Supraorbital crests much smaller and less prominent. *Dimensions*: ♂, 12 × 4 mm.

Apart from its smaller size and much smaller crests, I can detect no difference between the variety and the type of the species. A specimen which I also refer to this variety, is greatly abraded, and shows small granules on the elytral interstices; these are generally completely obscured by the clothing. In both varieties, the angles at the sides of the prothorax are less marked. Type in Coll. Ferguson.

CUBICORRHYNCHUS DILATATICEPS Blackb.

Blackburn, Report Horn Exped. Central Australia, ii., 1896, p. 293.

I have little doubt that the above species belongs to *Notonophes*. The head is described as "sparsim granulato, supra oculos utrinque cristato, crista rostri planum oblique retrorsum et extrorsum contimanti". Again, Blackburn writes: "Its very short rostrum flattened above (or rather having its entire upper surface gently and evenly concave), transversely quadrate, and as wide as the head is behind the eyes . . . with the crests appearing as prolongations of the rostrum and directed obliquely hindward and outward, and looking like set-back ears of some animal . . . furnishes very unmistakable characters." As the elytra are described as "seriebus alternis e tuberculis sat magnis . . . alternis e tuberculis parvis constantibus," I am confident that I have not seen the species.

Hab.—Central Australia, Charlotte Waters (Horn Expedition).

The above supposition has since received confirmation from Mr. K. G. Blair, of the British Museum, who kindly examined Blackburn's type, at my request. Mr. Blair writes—"*Cub. dilataticeps* Blkb., agrees very well with *Cub. cichlodes* Pasc., as regards form of head and rostrum, but is much more elongate and parallel, and its sculpture has more the general appearance of *Cubicorrhynchus;* a comparison, with members of that genus, makes me think that it is erroneously placed there, and that your supposition is probably correct." In another place in his letter, he states, *C. dilataticeps* Blkb., *is* a *Notonophes.*

Notonophes hystricosus Bohem

Amycterus hystricosus Bohem., Schönh., Gen. Curc. vii., (1), p. 54; *Talaurinus id.*, Macl., Trans. Ent. Soc. N. S. Wales, i., 1865, p. 242; *T. spinosus* Macl., *loc. cit.*, p. 243; *T. tenuipes* Pasc., *loc. cit.*, p.15, t.2, f.2.

Size small; elongate-ovate. Black, clothing variegated, dark portions varying from golden-brown to black, light portions whitish; prothorax trivittate, elytra with a short vitta at each shoulder, and a transverse bar at each side at commencement of declivity, these sometimes continuous across elytra, sides maculate with white; undersurface with light subsetose clothing, on ventral segments forming mesial and lateral maculæ.

Head flattened in front, extending on to rostrum in the same plane, supraocular crests absent. Rostrum short, wide, not separated from head, without excavation, the median area hardly depressed, sublateral sulci narrow, deep, obliquely set, somewhat curved, not quite meeting at base, Head and rostrum set with short, scattered, decumbent setæ. Eyes rather large, set high in head. Prothorax (2 × 3 mm.) transverse, apex with a feeble, postocular sinuation, with a marked, transverse, postapical impression, median and sublateral lines free from tubercles, but hardly impressed; set with small, rather prominent, subconical tubercles, more rounded on the sides. Elytra (7·5 × 5 mm.) rather strongly widened to beyond middle, thence narrowed to apex, which is rather strongly produced and mucronate; base gently arcuate, humeral angles with an out-turned tubercle, disc with rows of shallow, open, punctiform depressions, interstices with small but distinct tubercles, these not present on the declivity; sutural interstice with obscure granules only; second with tubercles, rounded at base, becoming subconical towards declivity; third with a prominent row of rather larger, acutely conical tubercles, becoming larger more posteriorly; fourth with two or three isolated ones; fifth with a row of outwardly projecting, acutely conical tubercles, extending from base to edge of declivity; sixth situated on the side, with much smaller ganules; lateral interstices with the granules obsolete. *Dimensions*: 11 × 5 mm.

Hab.—West Australia, Swan River, King George Sound.

The above description was drawn up from a cotype of *T. spinosus*, received many years ago from Mr. G. Masters. It is probably a female, as the basal, ventral segments are feebly convex; the last segment has a shallow, oval, transverse impression at extreme apex. There are seven specimens before me, but I cannot distinguish any difference in sex. The size is very variable, one specimen in my collection measuring 8 × 5 mm It was on a similar specimen that *T. tenuipes* Pasc., was founded. This specimen was compared with the type of *T. tenuipes* by Mr. K. G. Blair, and it agreed well both in size and also in its lack of clothing, though this is probably due to abrasion. The species agrees in all details with the description of *Amycterus hystricosus*, and I have no doubt that it is correctly identified, though, as mentioned before, I doubt the correctness of its assignment to *Notonophes*.

PSEUDONOTONOPHES, n.g.

Type, *Talaurinus dumosus* Macl.

Rostrum a good deal narrower than head, short, in the same plane above with head; with a median, impressed line, bifurcate at base. Scrobes open posteriorly, with a marked groove extending downwards and backwards to eye. Head plane in front, strongly rounded on sides, also from behind eyes to base of rostrum. Eyes rather large, ovate, set low down in head. Scape of moderate length. Prothorax transverse, granulate. Elytra short, ovate, granulate or tuberculate.

The difference in the relation to each other, of the head and rostrum, at once differentiates this genus from *Notonophes*, to which its species have been referred. In *Notonophes*, the external borders of the rostrum run backwards and outwards above the eyes; whereas in *Pseudonotonophes*, these borders end on the front of the head, and very far from the eyes, which are also situated at a lower level on the side of the head.

To these genus, I would refer *Talaurinus dumosus* Macl., and *T. lemmus* Pasc., placing *T. pupa* Pasc., as a probable variety of *P. dumosus*. The species may be conveniently separated:—

1. Head with distinct though small granules.
   A. Elytra granulate.
      (i.) Prothoracic granules closely set,....... . ...*P. dumosus* Macl.
      (ii.) Prothoracic granules fewer, and more widely separated...*P. pupa*.
   B. Elytra without any trace of granules............*P. Gilesi*, n.sp. or var.
2. Head with granules obsolete.......................... ....*P. lemmus* Pasc.

PSEUDONOTONOPHES DUMOSUS Macleay.

Talaurinus dumosus Macl., *loc. cit.*, p. 243; ? *T. pupa* Pasc., *loc. cit.*, p. 16; *Notonophes id.*, Lea, Trans Roy Soc. S. Australia, 1903, p. 112.

♂. Black, legs and antennæ diluted with red; practically without clothing, save for some white macules on side of elytra, and at commencement of declivity; setæ reddish-yellow.

Head and rostrum as in genus. Head with scattered, umbilicate granules; forehead with a V-shaped depression continuous with the median rostral groove. Prothorax (2 × 2 mm.) rounded on sides, without ocular lobes, median line free from granules, elsewhere with regular, rounded, umbilicate granules closely set. Elytra (4·5 × 3 mm.) short, much wider than prothorax; apex moderately produced, emarginate at suture; base subtruncate, humeral angles marked by a small nodule. Disc with striæ moderately deep, the foveæ hardly traceable save by the interfoveal granules; interstices with prominent, rounded granules becoming conical and tuberculiform posteriorly, on the third and fifth interstice extending halfway down declivity. Sides with rows of regular foveæ, interstices not granulate. Metasternum and first abdominal segment concave, somewhat rugosely punctured; the other ventral segments feebly convex, almost lævigate; fifth with a deep impression at apex.

♀. Similar but broader, beneath strongly convex, lævigate without an apical impression. *Dimensions:* ♂, 7 × 3: ♀, 9 × 5 mm,

Hab.—West Australia, King George Sound.

The above description was drawn up from the type-specimens in the Macleay Museum. In the same collection are cotypes of *T. pupa* and *T. lemmus*. From an examination of the specimen of *T. pupa*, I am of the opinion that it probably should be referred to *P. dumosus;* the specimen, however, is a female, and presents certain differences, of the specific value of which, I am uncertain. The prothoracic granules are fewer, less umbilicate, less closely set, leaving three spaces free from granules; the elytra are similar, but the intrastrial granules are hardly traceable. Also the setæ are of a brown colour, considerably darker than in *P. dumosus*. I have had a chance of examining a number of specimens of this species; all possessed dark-coloured setæ, but the prothoracic granules showed considerable variation; the head also shows some variation in width. Possibly *P. pupa* is distinct from *P. dumosus,* but I am unable to suggest constant characters for their differentiation; the examination of a long series of both sexes, and from different parts of West Australia, would probably solve the difficulty.

A female recently received from the British Museum, for examination, and labelled *Talaurinus pupa* Pascoe, does not differ materially from *P. dumosus.*

PSEUDONOTONOPHES LEMMUS Pasc.

Talaurinus lemmus Pasc., *loc. cit.*, p. 16; *Notonophes id.* Lea. *loc. cit.*, p. 112.

♀, Small, ovate. Black; densely clothed with brown, prothorax trivittate with white, elytra with a short vitta at each shoulder and an irregular transverse bar at each side about commencement of declivity; sides maculate.

Head and rostrum as in genus. Head with scattered setæ on forehead, arising from punctures not from definite granules, slight traces of granules towards sides. Prothorax (2 × 2·5 mm.), with a subapical, transverse impression, and rather feebly impressed median line; set with separate, round granules, absent over mesial and sublateral vittæ, and obsolete on the sides. Elytra (5 × 3·5) with rows of fairly regular, small, open foveæ; interstices granulate, the granules small and obsolete near base, becoming more prominent and subconical near declivity, most conspicuous on the second, barely traceable on the more lateral interstices. Beneath convex, without impressions. *Dimensions*: ♀, 8 × 3·5 mm.

The above description is of a female from Geraldton, in my own collection. I think I am right in referring it to *P. lemmus*. It agrees with the cotype of *T. lemmus* Pasc., in the Macleay Museum, on which specimen I have the following notes, made in comparison with *P. dumosus*. More densely clothed, head with granules not traceable, elytra with granules obsolete anteriorly, less prominent posteriorly, foveæ more transverse, no interfoveal granules.

A male(7 × 3mm.) in the South Australian Museum also belongs to this species; compared with my specimen(♀), it has the granules rather larger and more evident, beneath it is more flattened, with the intermediates shorter, and the fifth segment large, and without a definite excavation, the apical third being only very feebly depressed.

Apart from differences in clothing, which may conceivably be due to abrasion, *P. lemmus* is sufficiently differentiated from *P. dumosus* by the non-granulate head, the slightly more transversely foveate, less tuberculate, elytral sculpture; as well as by the non-excavate fifth ventral segment of the male.

Since the above description was written, I have had, under examination, a specimen (♂), labelled *Talaurinus lemmus* Pasc. It is densely clothed and strongly maculate; the head is granulate, and both the prothoracic and elytral granules are larger than in the specimens I attribute to this species. In these respects, also, the specimen is at variance with Pascoe's description. The anal segment is strongly depressed or excavate in its apical portion. If the specimen be correctly identified, it appears to be necessary to sink *P. lemmus* as a synonym of *P. dumosus*. At present, however, I am loth to do so. It is, nevertheless, possible that these are all forms of but one variable species.

PSEUDONOTONOPHES GILESI, n.sp.

♀. In general appearance close to *P. lemmus*, but larger. Clothing scanty, except where forming creamy patches; on thorax as sublateral vittæ; on elytra a humeral patch continuous with prothoracic vittæ, one or two small macules on lateral borders of disc and on sides, an oblique fascia, extending from sides two-thirds of width of elytron, at commencement of declivity. Setæ black.

Head and rostrum as in genus. Head with scattered, small, setigerous granules. Prothorax (2 × 3 mm.), with granules small, moderately closely set, more or less absent along median and sublateral lines. Elytra (5 × 4 mm.) foveo-striate: foveæ small but distinct, subquadrate, continued to apex but diminishing in size on declivity, the intervening ridges not granulate; interstices slightly raised, each with a row of small, decumbent setæ, without granules save for one or two very feeble ones at commencement of declivity, hardly traceable except from certain directions. Sides foveo-striate, interstices broad, not raised. Beneath convex, apical segment without definite impressions. *Dimensions*: ♀, 9·5 × 4 mm.

Hab.—West Australia, South Perth (H. M. Giles).

If *P. lemmus* is to be regarded as a species distinct from *P dumosus*, then this other form deserves a name, if only a varietal one. From *P. lemmus*, the granulate head will separate it, while the practically non-granulate elytra will separate it from both *P. lemmus* and *P. dumosus*. In spite of the granulate head, I regard it as more nearly related to *P. lemmus* than to *P. dumosus*. Until more field-work is done in collecting these species, I think it advisable to maintain the different forms, with the exception of *T. pupa*, as distinct species. I have much pleasure in naming this insect after Mr. H. M. Giles, of Perth, from whose collection I obtained it.

Myotrotus Pascoe.

Pascoe, Journ. Linn. Soc. Zool., xii., p.22.

Type of genus, *Myotrotus obtusus* Pasc.

Head strongly convex. Rostrum short, broad, the upper surface transversely concavo-convex from middle to sides; the external ridges strongly convex in profile, and convex outwardly, strongly incurved to base; internal ridges barely traceable. Scrobes deep, wide, arcuate, ending far from eyes. Eyes small, subovate. Scape short, strongly incrassate. Prothorax with ocular lobes strongly produced to touch or partly conceal the eyes in certain positions. Elytra with interstices finely granulate.

A remarkable form, which I prefer to place among the allies of *Talaurinus* rather than among the "*Euomides*," an assignment about which Pascoe himself felt doubtful. In the male, the fifth ventral segment is moderately deeply and extensively excavate, somewhat in the fashion of *Talaurinus apici-hirtus*. The curiously shaped and strongly convex, external, rostral ridges, the very short, thickened scape, and the strong, ocular lobes afford the most striking characters of the genus.

Myotrotus obtusus Pasc., *loc. cit.*, p.22, Pl. ii., fig.5.

To this species, I would refer several specimens in the Macleay Museum, though they show slight variation *inter se* in the elytral granules. A specimen (♀) received some years ago from the late Mr. George Masters, was sent to the British Museum for comparison with the type. In reply, Mr. K. G. Blair writes: "Yes, a *Myotrotus*. Type ♂, and more slender than yours, and its granulation is much obscured by clothing, but appears to agree very well with yours." A male in the Macleay Collection agrees well with Pascoe's description and figure. The elytra have the first, third, and fifth interstices with numerous fine granules in double and multiple series, the second and fourth with much fewer (six on one, nine on the other side), and isolated granules. The fifth ventral segment has an extensive, somewhat boat-shaped excavation at apex, occupied by dense golden-brown hair or bristles, which are continued forward to form a dense, median vitta. The length of the fifth segment is greater than that of the two preceding, but hardly as long as the three preceding combined. Corresponding females have the fifth ventral segment not excavate, and the intermediates longer. Another female has somewhat less rugose, elytral sculpture, interstices flatter, and the granules more numerous on the second and fourth interstices.

Hab.—Queensland, Rockhampton (*teste* Pascoe, Macleay Museum); Gayndah (George Masters).

MACRAMYCTERUS, nom.nov.

Amycterus Lacordaire (nec Schönherr), Gen. Coleop., vi., p. 310, 1863; Macleay, Trans. Ent. Soc. N. S. Wales, i., p. 265, 1865.

Type, *Phalidura draco* W. S. Macleay.

Large or very large species; male elongate, subparallel; female elongate, ovate. Head concave in front, centre of forehead subtriangularly raised. Rostrum not separated from head above, external ridges running backward along head, internal ridges present, strongly convergent. Scrobes open posteriorly, extending back to orbit. Eyes subovate, rather deeply set, overhung by lateral ridge of forehead (in *M. Boisduvali*, eyes rounded, strongly projecting). Prothorax strongly transverse, tuberculate or granulate. Elytra strongly tuberculate on second, third, sixth, and seventh interstices. Prosternum with a tubercle on each side, in front of anterior coxæ. No median ventral vitta present.

While in the past, accepting the name *Amycterus* for the genus under consideration, I have done so with considerable hesitation. I had not seen Schönherr's paper (Curc. Disp. Méth., p. 202, 1826), but, at the time the genus Amycterus was described by him, the only species known were *Curculio mirabilis* Kirby, already referred to *Psalidura* by Fischer von Waldheim, *C. bucephalus* Olivier, *C. bubalus* Olivier, and *Hipporhinus nigrospinosus* Don., members of the genera *Talaurinus* and *Sclerorrhinus*. No member of the present genus was described until 1827, when W. S. Macleay (King's Survey, ii., App., p. 244) published the description of *Phalidura draco*. By the early authors, the name *Amycterus* was used in a sense wide enough to embrace the whole subfamily, though *Acantholophus* was early separated but not described. In its usual restricted sense, the name was first employed by Lacordaire, who gives no reason for allocating it to this special and numerically small group. Macleay merely followed Lacordaire in his use of the name, which, by usage, has come to be universally adopted for these species.

Quite recently, however, Mr. K. G. Blair, of the British Mnseum, has kindly looked up the original descriptions, and, from the information supplied by him, I am able to make the following notes. Fischer's figure and description of *Phalidura mirabilis* Macleay, represent the gular-horned species, for many years known as *Psalidura mirabilis* Kirby; but his species is evidently not the same as the *Curculio mirabilis* of Kirby. Schönherr was apparently unaware of Fischer's paper, and, in describing his genus *Amycterus*, he quotes *Curc. mirabilis* Kirby as the type. Though not the same, the two species are undoubtly congeneric, and the name *Amycterus* must, therefore, fall as a synonym of *Phalidura*. Accordingly, I now propose the name *Macramycterus* for this genus.

Since the above was written, I have had an opportunity of seeing Schönherr's original description. As he quotes *Curculio mirabilis* Kirby, as the type of his genus, *Amycterus* (1826) becomes an absolute synonym of *Psalidura* Fischer de Waldheim (1823).

The second species, *A. Boisduvali* Boisd., was described in 1835 (Voy. de l'Astrolabe, ii., p. 393); and a third species, *A. Schönherri* Hope, was added in 1836 (Hope Trans. Ent. Soc. Lond., i., p. 68, t. 8, f. 2). Macleay (1865) revised the previous species, and added a fourth, *A. Leichhardti*.

To this number, I now propose to add the names of three others. The species of this genus are the giants of the subfamily, *M. draco* being one of the largest of the Australian weevils. The chief characters lie in the structure of the head and rostrum, in the explanate tuberculate prothorax, and in the arrangement of the elytral tubercles.

The head is large, with the forehead strongly depressed, the middle being triangularly raised or subcarinate: this concavity is bounded by the prolongation backwards of the external, rostral ridges. The rostrum is directly continuous with the head, and is moderately deeply excavate; the apical marginal plate is small, and is subtended by a triangular, depressed area, which, in turn, is bounded posteriorly by the subobsolete, internal ridges: running round the outer side and end of these ridges, is a narrow, horseshoe-shaped line. The scrobes proper end distant from the eyes, but these are situated immediately under the ridges on the head, and in the depression continuous with the scrobe, and formed by the prolongation backwards of the ridges. The eyes, in almost all the species, are ovate and not prominent, the exception being *M. Boisduvali*, which has round and prominent eyes.

The prothorax, in all except *M. Boisduvali*, is wide and ampliate, and the structure of its upper surface comprises (*a*) plane, more or less smooth areas, a median and two sublateral, (*b*) groups of tubercles, a median and a lateral group on each side, (*c*) smaller granules along anterior and posterior margin. The median tubercles appear to be variable in number in the one species; the lateral group shows good specific differences in the arrangement of the tubercles. The elytra, as a rule, have four rows of strong tubercles, one row on the second interstice, from in front of middle to apex; one row on the third interstice from base to declivity; two rows more laterally, the inner one extending from the middle to the apex, the outer one from the humeral angle to opposite and external to the commencement of the inner row, thence rapidly becoming obsolete. For convenience of description, I have called these rows 1, 2, 3, 4, their relative positions being always the same. As the seriate punctures are, in most cases, very small and indistinct, being broken up and confused by the tubercles, it is not an easy matter to determine the interstices upon which the tubercles are situated. In the female specimens, which I refer to *M. obsoletus*, the elytral striæ are more easily traced. From a study of this species, I believe that the relation of the rows of tubercles to the interstices is as follows: the first and second rows are situated on the second and third interstices respectively, the third row on the sixth interstice, the fourth row on the seventh: the fourth interstice is devoid of tubercles generally if not always; the fifth is represented by the humeral tubercle, and, perhaps, by one or two isolated ones, but these are not present in all species, and, in some, may possibly occur on the fourth. The derm between the tubercles, apart from the seriate punctures, is generally smooth; in some, however, it is more or less asperate. The apex of the elytra, in both sexes, is flanged by a row of strong tubercles, which, in the male, do not reach to the middle line, the apical margin, however, not being emarginate at the suture; in the female, the tubercles extend practically to the suture, the innermost being strongly produced, mucroniform, sometimes conjoined with its fellow of the opposite side, sometimes separated by a deep emargination. The undersurface is smooth and lævigate in all, except *M. Boisduvali*, in which it is more opaque, and closely setigerous. The prosternum bears a pair of mammary-like projections, situated in front of the middle coxæ; but in *M. Boisduvali* these are obsolescent. The ventral segments are transversely convex, more markedly so in the female. The basal segment is depressed in the male, and the apical segment generally has an ill-defined, transversely oval impression at apex. In *M. Boisduvali*, the segments are more flattened. The anterior tibiæ bear a few small granules or denticles varying in position and of specific importance; the posterior tibiæ have a strong excavation immediately above the apex, and on the inner surface of the tibiæ, but this is absent in *M. Boisduvali*. A specimen of *M. Schönherri* was dissected, to examine the male sexual organs. The penis, or the chitinous portion of it, is very large, and the free extremity bicornuate. The forceps are represented by two, small, triangular, chitinous pieces, more or less closely connected, and leaving a brush of hair on the inner border. In this respect, *Macramycterus* approaches closely to *Sclerorrhinus*, these structures being of a similar character in that genus.

Relation to Other Genera.—The species comprising this, numerically small group are, with one exception, remarkably homogeneous in appearance and structure. The exception, *M. Boisduvali*, might well be separated generically; it is, however, more closely related to the other species of *Macramycterus* than to any other genus. In the structure of the prothorax and in the arrangement of the elytral tubercles, these species show a resemblance to *Acantholophus*. I cannot, however, regard this resemblance as more than superficial, nor as showing a connecting link between *Acantholophus* and the *Talaurinus-Sclerorrhinus* Section. The presence of the internal, rostral ridges would point to a relationship with *Talaurinus*, while the structure of the sexual organs suggests affinity with *Sclerorrhinus*. I think it probable that *Macramycterus* has developed from a common ancestor of *Talaurinus* and *Sclerorrhinus*, and has become separated early in the line of descent. The small number of its species, and their large size, perhaps indicate that the genus *Macramycterus* represents a dying race, in the natural order of things to become extinct at no distant date.

Geographical Distribution.—Although a fair number of specimens have passed through my hands, the data, as regards place of capture, have been meagre. All the species occur in West Australia. *M. Leichhardti* was recorded from the Lynd River, North Australia; it appears to occur elsewhere in West Australia. *M. Boisduvali* and *M. draco* were described from King George's Sound, while *M. Schönherri* occurs on the Swan River. Mr. Lea has recorded *M. draco* from Mullewa, though most of the specimens I have seen of the variety I have called *insignis*, were taken either at Kellerberrin or Conjerdin. The male type of *M. obsoletus* is from Yilgarn, but the specimens I regard as probably females of the same species, came from Nangeran. *M. tibialis* is from Shark's Bay.

It will be seen from the above, that the records are too scanty to permit of generalisation on the distribution of the genus. Possibly all the species will be found to have a fairly extensive range.

Table of Species.

1.(12)Prothorax tuberculate, eyes rather deeply set.
2.(9)Sides of prothorax, as viewed from above, with tubercles more or less flattened, outwardly directed in single series.
3.(6)Prothorax widely explanate.
4.(5)Elytra granulose between the rows of tubercles............................ ....*M. draco* W. S. Macleay.
5.(4)Elytral derm smooth, non-granulose between tubercles.................. ....*M. insignis*, n.sp. or var.
6.(3)Prothorax transverse but much less explanate.
7.(8)Tubercles on elytra rounded or conical... . .. .*M. tibialis*, n.sp.
8.(7)Tubercles on elytra elongate, much less strongly raised................. ....*M. obsoletus*, n.sp.
9.(2)Sides of prothorax with tubercles forming a cluster in middle of lateral margin.
10.(11)Elytral tubercles black............... ....*M. Schönherri* Hope.
11.(10)Elytral tubercles reddish........................*M. Leichhardti* Macleay.
12.(1)Prothorax more or less closely granulate: eyes prominent .... *M. Boisduvali* Boisd.

MACRAMYCTERUS DRACO W. S. Macleay.

W. S. Macleay (*Phalidura*), King's Survey, ii., App., 1827, p. 244; W. Macleay (*Amycterus*), Trans. Ent. Soc. N. S. Wales, i., 1865, p. 266.

(Plate xiv., figs.1, 2.)

Type, *Ph. draco* W. S. Macleay, ♂. Elongate, robust, prothorax widely ampliate. Black, with patches of greyish clothing on sides, a few greyish scales on elytra.

Head with middle of concavity strongly raised, elongately triangular. Rostrum with the internal ridges moderately strong, practically meeting. Eyes subrotundate. Prothorax(6 × 10 mm.) strongly ampliate-explanate, disc with median and sublateral areas obsoletely furrowed, median line of tubercles four in number on each side, subconical, briefly transverse; sides explanate, with six laterally projecting tubercles or teeth, widest across at level of fifth, sixth smaller, thence very suddenly diminishing in width to base; apical and basal margins each with a row of small granules, width across base 5 mm. Elytra (16 × 10 mm.): apex with a strong flange of six or seven tubercles on each side not extending to middle; disc between tubercles roughly granulate; suture granulate; with four rows of strong tubercles, seven in the first row, extending from near base to apex, strong, separate, conical, and spinose, especially on declivity; second row with eight from base to declivity, tubercles strong, closer together; third row with six spinose tubercles outwardly directed, from middle to near lateral flange; fourth row with six, large, outwardly directed tubercles, then with more obsolete ones; sides with rounded, obsolete tubercles. Beneath subnitid; fifth ventral segment concave, with scattered punctures; prosternal tubercles small but definite; anterior tibiæ with sparse setæ arising from small granules along the length of the tibiæ. *Dimensions*: ♂, 25 × 10 mm.

Hab.—West Australia, King George Sound; type in Macleay Museum.

The above description was drawn up from the type in the Macleay Collection, which has the elytral derm evidently granulose between the rows of tubercles. Recently, I have had a number of specimens submitted to me by the authorities of the South Australian Museum. These I cannot separate from *M. draco*, but they show a good deal of variation, both in shape and in the degree of granularity of the derm, so much as to cause me some doubt as to the validity of *M. insignis* as a species. All these specimens, which include three females, have the median prothoracic tubercles few in number, and, even if on this account alone, it seems advisable to give a distinguishing name to the form I have called *M. insignis*.

Only the male was known to Macleay, but Lea has recently described the female; the specimens before me are, apart from the tubercles on the prothorax, extremely like the female I have described below as *M. insignis*, ♀; they have, however, the centre of the forehead more convex, and the derm slightly more granulose. One male is labelled Northern Territory; the others are from West Australia, without exact locality.

MACRAMYCTERUS INSIGNIS, n.sp. or var.

(Plate xiv., figs.3, 4.)

Size large, elongate, robust; female by far the larger and more robust insect. Prothorax widely explanate, median tubercles variable in number, elytra strongly tuberculate. Black, tubercles nitid, with sparse greyish clothing, generally abraded, sides maculate with white.

♂. Head broad, forehead deeply concave, bounded by a prolongation backwards of the external rostral ridges, middle of cavity rather strongly raised, subcarinate: internal rostral ridges not prominent, rounded in appearance, short, strongly convergent, median area depressed, apex of rostrum widely but not deeply emarginate. Scrobes not definitely limited behind; undersurface of external ridges thickened in middle. Eyes subovate, deeply set. Prothorax (6 × 9 mm.) widely explanate-tuberculate at sides, suddenly constricted before base, tubercles seven in number on left, five on right, flattened above, projecting laterally, graduated in size to middle, apical margin with a single row of small tubercles, a similar but smaller row along posterior margin; an irregular row of tubercles on either side of median area, tubercles irregular in size, mainly transverse, not greatly elevated, ten in number on each side in type; median and sublateral areas smooth, save for some obsolete scarring, a few granules at base of median area. Sides with small granules, with a few, larger, flattened tubercles beneath lateral edge. Elytra (16 × 8 mm.) elongate, little dilatate, apex strongly rounded, with a flange of small tubercles, absent in centre; base subtruncate, humeral angle with a small tubercle projecting laterally. Disc with lines of minute punctures, subtended by small setæ, hardly traceable into striæ, only clearly seen where tubercles are deficient; with rows of strong tubercles, suture with a row of fine granules, first row with five or six tubercles, not extending to base, last two on declivity, conical; second row with six or seven from base to edge of declivity, the last one conical; a single tubercle corresponding to fourth interstice; third row with conical tubercles commencing from the middle, and extending down declivity; fourth with six strong tubercles from humeral angle to middle, thence as smaller flattened tubercles external to third row. Sides striate, interstices with small, flattened tubercles. Fifth ventral segment with an irregular mesial depression rather strongly punctured. Penis with apex emarginate, lateral angles strongly produced, out-turned. Tibiæ long, anterior with a few small dentiform projections on under surface.

♀. Larger, more robust; head and rostrum as in ♂. Prothorax (7 x 11 mm.) widely explanate-tuberculate as in ♂, mesial tubercles small, transverse, rounded, somewhat depressed, very irregularly arranged, twelve on left and ten on right side in the type. Elytra (21 x 12 mm.) more ampliate, more robust: apex strongly flanged, the flange strongly mucronate in centre; disc, save for seriate punctures, smooth between the tubercles; first row with nine tubercles, last four on declivity conical; second row with eight ; a row of three corresponding to fourth interstice: third row with nine, from middle extending down declivity, first four rounded, transverse, the others conical: fourth row with about eight, well defined transverse tubercles, then with more obsolete ones. Beneath convex: fifth segment with strong, rugose punctures at apex. *Dimensions*: ♂, 25 x 8 mm.: ♀, 35 x 12 mm.

Hab.—West Australia, Kellerberrin, Conjerdin; several specimens, without exact locality.

When the description of this species was drawn up, I regarded it as distinct from *M. draco,* on account of the difference in the granularity of the derm. I have had reason to doubt the value of this feature, however, for separating the species, and it may be perhaps better to regard *M. insignis* as a variety of *M. draco.* A specimen (♂) received from Mr. Froggatt, has the prothoracic tubercles four on each side, but the derm is smooth between the tubercles. When the description was drawn up, I had, under examination, in addition to the types, six specimens belonging to the British Museum—one male and five females. The male and one female had the tubercles as in the types. The other four differed in the much more numerous prothoracic tubercles, now hardly larger than granules; the elytral tubercles also appeared to be more numerous. For purposes of comparison, I append a short table showing the difference in the number of the prothoracic tubercles; the elytral tubercles are also given, numbered for convenience according to the interstices on which they are situated, not according to rows. It is possible that these specimens should be regarded as a distinct species, and the examination of a series including the male, might settle the question; but with the material at present available, I cannot consider them distinct from *M. insignis*, and only separate that species from *M. draco* with doubt. I would, therefore, pro tem., regard as *M. draco* those species having the derm more or less granulose, and the prothoracic tubercles few in number; as *M. insignis*, those which have the prothoracic tubercles more or less numerous, and the derm non-granulose, at the same time recognising the existence of forms, intermediate or otherwise difficult to classify.

Prothoracic tubercles.			Elytral tubercles.					
Left.		Right.	2	3	4	6	7	
i. 12	...	10	9	8	3	9	8	Type ♀. *M. insignis.*
ii. 19	...	20	12	12	4	14	10	Fry Coll.
iii. 20	...	17	9	10	5	10	8	Fry Coll.
iv. 27	...	25	10	11	5	12	7	W. Australia (blue label)
v. 19	...	20	8	8	3	11	8	W. Australia (blue label)

Macramycterus tibialis, n.sp.

(Plate xiv., fig.9.)

♂. Large, elongate, subparallel. Black, tubercles nitid, practically without clothing. Head and rostrum as in the genus, the convexity of the forehead wedge-shaped, subcarinate: internal rostral ridges rather strongly convergent basally.

Prothorax (5 × 7 mm.) subdilatate on sides, apical margin with obsolete granules, median and sublateral spaces smooth, not strigose or cicatrised. Median tubercles six in number on each side, rounded, slightly transverse and in single series; lateral border not explanate, with a single row of tubercles, five in number, starting from the apex, the first very small, then gradually increasing in size to the middle one(the fourth), space between last and base with only a small obsolete granule. Sides granulate, obsoletely so towards coxæ. Elytra (14 × 7 mm.) elongate, apex flanged, flange set with a row of small granules, suture not granulate; disc between tubercles smooth, not granulate, with very faint, obsolete traces of seriate punctures; tuberculate, first row with seven or eight large tubercles, rounded basally, becoming strongly conical posteriorly, extending from in front of middle almost to apex; second row with eight or nine from base to edge of declivity, basal ones slightly transverse, closer together, posterior ones more conical, third with seven tubercles all conical, fourth with six conical tubercles from humeral tubercle (which is large and conical) to opposite commencement of third row, thence with four smaller, more obsolete ones; sides with two rows of obsolete tubercles. Beneath smooth, apical segment with a shallow, transverse impression. Prosternal tubercles distinct. Anterior tibiæ with a strong triangular tooth, one-third of length of tibia from apex. *Dimensions* : ♂, 22 × 7 mm.

Hab.—West Australia, Shark Bay.

Probably nearest to *M. insignis* mihi, but sides of prothorax not explanate, suture not granulate, humeral tubercle large, not the smallest of the row, tibial dentition different, etc. From *M. Schönherri*, which has a similar but smaller tibial dentition, it differs in the non-granulate suture, in the lateral prothoracic tubercles forming a single row, and in the much smaller elytral tubercles. From *M. Leichhardti*, it differs in the colour of the tubercles, in their smaller and less spinose shape, and in the prothoracic tubercles in single series at sides and on disc. From *M. obsoletus*, the conical, non-flattened tubercles will serve (*inter alia*) to distinguish it.

Macramycterus obsoletus, n.sp.

(Plate xiv., fig.10.)

♂. Large, elongate, subparallel. Black, without clothing, subnitid.

Head and rostrum as in the genus; middle of forehead with the convexity subcarinate, internal ridges rather strongly developed. Prothorax (6 × 9 mm.) strongly transverse, apical margin with rather large, flattened granules irregularly arranged in two rows, basal margin with smaller, more rounded ones; median space wide, convex in middle, smooth; sublateral spaces strongly longitudinally strigose; mesial row of tubercles with seven on each side, in single series with a tendency to duplication near base and apex, the individual tubercles transverse, depressed, flattened, the central tubercle being the largest; with a lateral row of five tubercles or dentations on each side, tubercles of same size and appearance as the mesial row, in single series as viewed from above (but not so widely explanate as in *M. draco*); as viewed from the side, arranged in a cluster; sides strongly granulate, size of granules diminishing from above downwards. Elytra (17 × 9 mm.) elongate, apical margin with a flange of small tubercles, emargination feeble; disc subgranose between tubercles, suture with granules subobsolete, confluent; first row of tubercles from near base to apex, consisting of four or five elongate, flattened tubercles, and two or three larger conical ones on declivity; second row from base to edge of declivity of about seven elongate tubercles, somewhat larger than in first row, last one rounded, hardly conical; fourth interstice with two elongate tubercles anterior to middle; third row of five rounded, subconical ones extending from middle; fourth row with about twelve, the first six, large, rounded, the remaining ones becoming progressively smaller. Sides with rows of somewhat flattened subcontiguous tubercles. Beneath subnitid, apical segment with a narrow transverse impression. Prosternal tubercles rather strong. Anterior tibiæ with a small group of teeth one-third of the length from apex. Penis strongly emarginate at apex, angles produced into subparallel horns. *Dimensions*: ♂, 27 × 9 mm.

Hab.—West Australia, Yilgarn.

A single male under examination, readily distinguished from all its congeners by the flattened appearance of both prothoracic and elytral tubercles. It comes nearest to *M. insignis*, but the difference in the tubercles is too great to allow of my considering it as a variety of that species.

After the above description of the male was drawn up, I received from Mr. Spry, of the National Museum, Melbourne, two specimens which, though differing considerably from the type, I nevertheless believe are females of this species.

♀. Large, robust, convex. Moderately densely clothed with very minute, brownish, subsetose scales, giving the insect a dingy appearance, elytral tubercles not clothed.

Head and rostrum as in the male. Prothorax (6 x 9 mm.) similar to that of male, slightly more convex, derm not rugulose between the groups of tubercles, lateral group in single series, about seven in number, less prominent than in the male, mesial groups similar, flattened, obscure, but about twice as numerous—fifteen to sixteen on each side; the median area broader. Elytra (20 x 12 mm.) convex, ovate, apex with a flange composed of a few granules, and with a strong mucroniform projection on each side of suture, this latter not granulate; tubercles of interstices long, narrow, depressed, the second interstice extending practically to the base, with eleven to fourteen tubercles, almost continuous basally; third with ten similar tubercles ending at edge of declivity; fourth with three; fifth with a small humeral tubercle, and with a row of four isolated ones from behind shoulder to about the middle; sixth with six, rounded, hardly subconical tubercles, extending from near the middle down the declivity, slightly overlapping fifth; seventh with eight flattened ones, from base to beyond middle. Beneath convex, fifth segment with a transverse apical impression. Prosternal tubercles strongly developed. *Dimensions*: ♀, 33 x 12 mm.

Hab.—West Australia, Nangeran (Enderbee, per F. P. Spry).

The differences between these specimens are all of the nature of sexual variation, which exists to a considerable extent in this genus. The structure points strongly to the relation of these to *M. obsoletus.* I have described the tubercles according to the interstices, not according to the rows, as, in these specimens, the arrangement of the seriate punctures can be fairly definitely determined, whereas in most species the punctures are crowded out and broken up by the rows of tubercles. Examination of the position of the rows of tubercles shows that the first and second rows are situated on the second and third interstices respectively; the third row is really on the sixth interspace, and the fourth on the seventh; the fifth interstice is, in most species, represented by the humeral tubercle alone, while the fourth is generally untraceable.

MACRAMYCTERUS SCHÖNHERRI Hope.

(Plate xiv., figs.7, 8.)

Hope, Trans. Ent. Soc. Lond., i., 1836, p.68, t.8, f.2: Bohem., Schh., Gen. Curc. vii.(i.), p.82: Macleay, Trans. Ent. Soc. N. S. Wales, i., 1865, p.268.

♂. Large, elongate, subparallel. Black, subnitid, practically without clothing, a few minute greyish scales in parts.

Head large, concave between external ridges, middle of concavity with the surface convex. Rostrum excavate, a small punctiform depression in midline at base; external ridges prominent, continued on to forehead; internal little raised, broad, apices meeting. Eyes rather deeply set. Prothorax (6 × 8 mm.) transverse, angulate in middle of sides; with a row of strong, rounded tubercles, subconical and slightly transverse, on either side of middle, the space between wide and smooth; with a group of three or four smaller tubercles clustered at the lateral angle on each side; apical and basal margins with a few granules, remainder of disc smooth, save for a few obsolete scars. Elytra (14 × 8 mm.) with four rows of large, closely placed, subimbricated, conical tubercles, suture with a few granules, first row of four or five from behind middle down declivity, second row of five from base to edge of declivity, third row of five commencing about middle, the tubercles directed outwards and downwards, fourth row with five strongly conical tubercles closely placed from base to commencement of third row, thence continued on as a row of much less elevated, subconical tubercles. Sides with tubercles smaller, more or less flattened, their apices projecting posteriorly. Ventral segments with sparse, fairly large punctures, fifth segment with a shallow impression, posterior edge raised. Prosternal tubercles obtuse. Anterior tibiæ with a small spine or denticle one-third of the length from apex.

♀. Larger, more robust than male. Head and prothorax (7 x 10 mm.) similar. Elytra (17 x 10 mm.) more ovate, apex with a strong, granulate flange on each side; disc with rows of tubercles, situated not so close together, anterior tubercles of two inner rows more rounded, all the tubercles less acute, first row with tubercles more spaced out, second with seven, an intermediate row of one or two on fourth interstice, outer two rows as in ♂. Beneath strongly convex, fifth segment without impression. *Dimensions*: ♂, 23 x 8; ♀, 27 x 10 mm.

Hab.—West Australia, Swan River.

A very distinct species, having the prothoracic tubercles differently arranged, and the elytral tubercles stronger than in all the other species. *M. Leichhardti* approaches it most nearly in these respects; but, *inter alia*, the colour of the tubercles will prevent their confusion. The central group of tubercles on the prothorax varies in number, and while most specimens possess only a few, I have seen specimens possessing almost as many as some varieties of *M. insignis*.

The description given by Hope is very short, and his figure is bad; but both clearly refer to the present species.

MACRAMYCTERUS LEICHHARDTI Macleay.

(Plate xiv., figs.5, 6.)

Macleay, Trans. Ent. Soc. N. S. Wales, i., 1865, p.269; Lea, Trans. Roy. Soc. S. Aust., 1911, p.76.

♂.—Type, *Amycterus Leichhardti* Macleay.—Elongate, subparallel. Black, elytral tubercles reddish; with feeble, muddy grey clothing.

Head with middle of concavity triangularly convex. Internal rostral ridges well defined, almost meeting, but separated by a groove. Eyes round. Prothorax (6 x 8 mm.) rather strongly transverse, subangulate on sides in front of middle, central and sublateral spaces smooth, with obsolete longitudinal striæ; median group of tubercles about twelve on each side, rounded in shape, a large one near apex, followed by a smaller transverse one, and then by an irregular double row of smaller ones; lateral group consisting of similar but smaller tubercles mainly situated around lateral angle, at immediate angle tubercles somewhat obsolete, sides granulate. Elytra (14 × 7 mm.) subparallel, narrower than prothorax, base subtruncate, apex with a strong flange of five or six tubercles, not extending quite to suture; disc between tubercles with obsolete punctures, suture practically non-granulate; tubercles strong, acute; first row of ten extending from near base to apex; second row of six from base to edge of declivity; third row with five, strong tubercles, outwardly and backwardly directed, from middle down declivity; fourth row with five, strong tubercles from shoulder to middle, thence with obsolete tubercles; sides with obsolete tubercles. Fifth ventral segment concave, not excavate, posterior border of segment raised. Prosternal tubercles small. Anterior tibiæ with three or four strong setæ beneath, a stronger seta arising from a small denticle two-thirds of the length from base.

♀. Elongate, more robust than ♂. Head and rostrum as in ♂. Prothorax (7 × 9 mm.) strongly dilatate, subangulate; mesial group of tubercles small, about fourteen on each side, irregularly arranged in double series; laterally with numerous tubercles similar to those in mesial group, the largest at the lateral angle, median and sublateral spaces smooth. Elytra (18 × 10 mm.) widest a little behind middle, apex with a strong flange of single tubercles, innermost the largest, mucroniform, the two flanges separated in middle by a well-marked emargination; disc with small punctures traceable in striæ; with rows of round or subconical tubercles of a moderate size, first row with nine, second with six, third with eight, fourth with six to middle, thence with obsolete ones, tubercles arranged in the same relative positions as in male; sides obsoletely rugose. Beneath convex; fifth segment without an impression; prosternal tubercle small. *Dimensions*: ♂, 22 × 7; ♀, 29 × 10 mm.

Hab.—North Australia, Lynd River (Leichhardt, *teste* Macleay); West Australia.

The description of the male was drawn up from the type in the Macleay Museum, that of the female from a specimen in my own collection. While presenting considerable difference in the size and appearance of the elytral tubercles. I believe both specimens to belong to but one species. Mr. Lea says that red is probably the normal colour of the tubercles; I believe it to be the invariable colour in this species. Macleay, beyond describing the insect as "ater," makes no mention of the colour of the tubercles; in the type, however, they are certainly reddish, though the colour has been dimmed by age, and obscured probably by immersion in preservative. Macleay records the species as from Lynd River, North Australia. Most of the specimens I have seen, bore the label "West Australia," without exact locality; probably it has a wide distribution.

MACRAMYCTERUS BOISDUVALI Boisd.

Boisduval, Voy. de l'Astrolabe, ii., 1835, p.393; Macleay, *loc. cit.*, p.266.

(Plate xiv., figs.11,12.)

♂. Narrow elongate. Black, with minute squames, more numerous laterally (where they unite to form small patches).

Head excavate between the ridges, these merging into head and losing their distinctness opposite the middle of the eye; central ridge distinctly carinate in front, broadening behind. Rostrum with internal ridges low and broad, the median sulcus rather deep. Eyes not sunken, round, distinctly protuberant. Prothorax (5 × 6 mm.) transverse, evenly rounded on sides, apex subtruncate, a fairly definite, transverse, subapical impression present, median line free from granules but not depressed, rest of disc set with small, rounded granules, not contiguous and somewhat irregular in size, being slightly transverse near centre, and distinctly smaller along the sublateral areas; sides granulate. Elytra (12 × 6·5 mm.) elongate, apex rounded, base truncate; disc with obsolete punctures or small foveæ hardly traceable in series, tuberculate in four rows, tubercles strong, conical, projecting backwards; first row with three or four extending from behind middle down declivity; second row with four from base to middle, the tubercles far apart, and increasing in size from base; third row of four, not extending to base or apex, tubercles separate, increasing in size posteriorly;

fourth row with a rounded humeral one, and four small tubercles or granules, tubercles wanting beyond level of commencement of third row. Sides smooth, with obsolete punctures. Beneath set with minute, setigerous granules; apical segment with a slight impression at apex. Anterior tibiæ without denticles.

♀. Larger, more obese; head, rostrum, and prothorax similar. Clothing rather denser. Elytra (14 × 9 mm.) more convex, strongly ampliate, tubercles more numerous, smaller, rounded, at most subconical; first row of five increasing in size from near base to declivity, and two decreasing in size on declivity; second with eight, rather more closely set, extending back with a slight inclination outwards to behind middle; third with six, rather closer together, and smaller; fourth with about four small ones; sides without tubercles or granules. Beneath convex, with minute granules as in male; no impression on apical segment. *Dimensions*: ♂, 20 × 6·5; ♀, 23 × 9 mm.

Hab.—West Australia, King George Sound.

Very distinct from all its congeners, and possibly requiring a separate genus. The protuberant eyes, and the granulate prothorax seem almost to be of generic importance.

Specimens of ♂(F) and ♀(G) were kindly forwarded, for me, by Mr. A. M. Lea, to M. Lesne, of the Museum d'Histoire Naturelle, Paris, for comparison with the type. In reply, M. Lesne states: "Nous n'avons pas le type, qui faisait partie de la collection Dupont; mais le specimen F. est bien conformé à un exemplaire de la collection Fairmaire determiné 'Am. Boisduvali Boisd.,' par Bohemann. G. est conformé aux specimens que nous possedons sous le nom de Am. Mannerheimi Schönh."

Chriotyphus Pascoe

Pasc., Journ. Linn. Soc., xii., 1873, p. 19, t. 2, f. 10.

Type of genus, *Chriotyphus acromialis* Pasc.

Head strongly convex, separated from rostrum by a narrow, deep, circumferential sulcus. Rostrum considerably narrower than head; dorsal surface narrow, with a deeply impressed median line, separating dorsum into two parallel ridges, these feebly bifurcate at base, the inner portion slightly raised, the outer extending outwards, downwards, and backwards towards eye. Scrobes curved. Eyes large, ovate. Scape long. The rest as in *Talaurinus.*

I have grave doubts as to the correctness of the position assigned to *Chriotyphus* among the long-scaped genera. To my mind, the characters of the rostrum show much more affinity to several Euomid genera; indeed its structure is practically identical with that of *Alexirhea*, a genus which was also originally placed among the long-scaped *Amycterides.* There is such considerable difference of rostral structure in the *Euomides*, that I cannot regard them as constituting a homogeneous group, but a good deal of further study is required on this point.

I have preferred, therefore, to describe here the species of *Chriotyphus* known to me, leaving *Alexirhea* (which, however, I regard as its nearest ally) to be dealt with later.

CHRIOTYPHUS ACROMIALIS Pasc., *loc. cit.*, p.19.

Of the genus *Chriotyphus,* there are, before me, specimens which I would refer to two different species. Unfortunately, I am not absolutely certain which species is *C. acromialis* Pasc. One species is represented by a female from Swan River, the other by a pair from Onslow. The original specimens of *C. acromialis* came from Champion Bay.

Some little time ago, I sent my specimens to the British Museum for comparison with the type. In reply, Mr. K. G. Blair kindly wrote: "15, (Swan River specimen) agrees very well with type of *Ch. acromialis* Pasc., though the latter has not the purplish hue of light colour, and the distribution of the dark colour does not quite agree. In both these respects, our series shows considerable variation, one specimen (Swan River) being closer than others, though another approaches very closely to type. Type has no tibial brush and appears to be of the same sex as yours."

"14-14a, have elytral tubercles distinctly smaller, and are more scantily clad. They also appear longer and narrower; thoracic tubercles seem to me similar, though, in well clothed specimens, they are almost hidden in light bands. One specimen of ours agrees with yours in shape (also in sloping more gradually behind), and has the tibial brush, though slightly less developed. It is from Gascoyne."

From the above, it is fairly certain that my Swan River specimen belongs to *C. acromialis*, and as, in its clothing, it differs rather considerably from the description of the type, I here give a description of the clothing, together with the chief points of difference between it and *C. tibialis.*

♀.(Swan River). Clothing with the light portion forming a longitudinal band along each side of dorsum of head, prothorax and elytra, median line of prothorax with a similar though narrower vitta, disc of elytra mainly clothed with intermingled greyish and ochraceous subpubescence, centre of head, prothorax (except vittæ), irregular macules on elytra, especially near declivity, black. Prothorax with smaller granules than in *C. tibialis*, more obscured by clothing, apparently absent along vittæ; elytra with granules smaller basally, larger, almost tuberculiform, about declivity, these most marked on second interstice, less so on third and fourth; tubercles not extending more than half-way down declivity.

I am indebted, for my specimen, to Mr. H. J. Carter, who captured it crawling along a path in King's Park, Perth.

CHRIOTYPHUS TIBIALIS, n.sp.

♂. Elongate, ovate, small. Black; densely clothed with dull golden-brown subpubescence, feebly trivittate on prothorax and near lateral border of elytra with lighter yellow or greyish, head with yellow supraorbital vittæ, elytra obscurely maculate with brown; beneath with greyish-yellow clothing at sides of basal segments and covering the greater parts of the last three segments, irrorate with small, dark spots; median vitta brownish.

Head strongly convex, with a feeble, longitudinal impression and rather obscure rugose punctures in front near base of rostrum. Rostrum as in the genus. Prothorax (3 × 3·5 mm.) rounded on sides, with feeble ocular lobes; disc with a narrow, subapical constriction; regularly set with moderately small, round granules, the apices feebly flattened and crateriform, each bearing a moderately long, black, decumbent seta. Sides granulate. Elytra (9 x 5 mm.) elongate, ovate, apex moderately produced; base arcuate, with humeral angles strongly produced anteriorly; disc foveo-striate, the foveæ small, shallow, punctiform; interstices with small, closely set, somewhat umbilicate, setigerous granules, for the most part in single series, more or less obscured by the clothing; granules on second interstice slightly larger about declivity; granules on interstices not extending down the whole of declivity. Beneath without impressions. Anterior tibiæ with a strong, hirsute brush on outer two-thirds of undersurface.

♀. Very similar, rather more ovate, without median vitta and convex beneath; tibiæ simple. *Dimensions*: ♂, 13 x 5 mm.; ♀, 13 x 5·5 mm.

Hab.—West Australia, Onslow (C. French). Type in Coll. Ferguson.

Very similar to *C. acromialis;* apart from clothing, the differences set down under that species appear sufficient to separate them. Unfortunately, I have never seen a male of *C. acromialis*, and do not know whether it possesses the tibial brush.

EXPLANATION OF PLATE XIV.

(Figures slightly smaller than natural size.)

Fig. 1.—*Macramycterus draco* W. S. Macleay, ♂.
Fig. 2.—*Macramycterus draco* W. S. Macleay, ♀.
Fig. 3.—*Macramycterus insignis*, n.sp., ♂ (type).
Fig. 4.—*Macramycterus insignis*, n.sp., ♀ (type).
Fig. 5.—*Macramycterus Leichhardti* Macleay, ♂.
Fig. 6.—*Macramycterus Leichhardti* Macleay, ♀.
Fig. 7.—*Macramycterus Schönherri* Hope, ♂.
Fig. 8.—*Macramycterus Schönherri* Hope, ♀.
Fig. 9.—*Macramycterus tibialis*, n.sp., ♂ (type).
Fig. 10.—*Macramycterus obsoletus*, n.sp., ♂ (type).
Fig. 11.—*Macramycterus Boisduvali* Boisd., ♂.
Fig. 12.—*Macramycterus Boisduvali* Boisd., ♀.

(From a photograph by H. V. Macintosh.)

ORDINARY MONTHLY MEETING.

JUNE 24th, 1914.

Mr. C. Hedley, F.L.S., Vice-President, in the Chair.

Mr. REGINALD W BRETNALL, Gower Street, Summer Hill, was elected an Ordinary Member of the Society.

A communication from Mr. James A Barr, Manager of the Panama Pacific International Exposition, 1915, and Director of Congresses, was read to the Meeting by the Secretary. Congresses, Conferences, and Conventions are to be a feature of the Exposition; and the Society had been invited to take part by holding a Meeting The Council was desirous of ascertaining what Members were likely to be able to visit the Exposition, so that a reply might be sent to Mr. Barr, who is engaged in drawing up his programme. The Secretary, therefore, would be glad to hear as soon as possible from Members who were contemplating a visit to San Francisco in 1915.

The Donations and Exchanges received since the previous Monthly Meeting (27th May, 1914), amounting to 15 Vols., 70 Parts or Nos., 18 Bulletins, 5 Reports, and 2 Pamphlets, received from 41 Societies, etc., and two private donors, were laid upon the table.

NOTES AND EXHIBITS.

Mr. W. W. Froggatt exhibited for his son, Mr. J. L. Froggatt, specimens of fossil-bones obtained at Cuddie Spring, on Gilgoan Station, Barwon River. Cuddie Spring is in the centre of a sandy depression of about 10-15 acres in extent, in open forest-land, about 15 miles from Mr. Allan Yeomans' homestead. When the locality was first discovered, a mud-spring existed. Mr. Yeomans sunk a well about 80 feet, and obtained a fine supply of water. At 8 feet from the surface, passing through very sandy loam, a deposit of bones, several feet in thickness, was discovered. Those exhibited were some that had been thrown out in the course of excavating. It is probable that there is a large deposit of fossil-bones that could be very easily unearthed in the soft loam (of what appears to have been a subartesian spring), and that it is well worthy of investigation by geologists. The authorities of the Mines Department, some years ago, sent collectors to visit the spot; but, at that time, the depression was a sheet of water due to local rains, and the specimens collected were simply those lying on the surface. No excavations have been made except in this one well. Cuddie Spring is on a freehold block of 100 acres, owned by Mr. Allan Yeomans; but authority could be obtained by the Geological Department to investigate this unique deposit.

Mr. A. A. Hamilton exhibited, from the National Herbarium, a series of cultivated examples of *Calendula officinalis* L., from the Sydney Botanic Gardens, showing prolification accompanied by various alterations of position.—Two forms of *Bæckea densifolia* Sm., from the Blue Mountains, showing the effect of environment. The specimen from Valley Heights(about 1,000ft.) growing in a sheltered position, is a slender plant with rampant branches, and small fine leaves. The example from Newnes Junction (about 3,500 feet), which grows on the stony soil of a denuded hillside, exposed to the westerly winds, is a closely packed shrub, with coarse leaves and virgate branches, the whole plant showing the effects of the harsh conditions.—*Acacia melanoxylon* R.Br., from Austinmer, exhibiting changes of juvenile and adult foliage. The examples exhibited were taken in one case from plants 6 ft. high with pinnate (juvenile) leaves, which were then commencing to produce phyllodes. In the other form, plants 15 ft. high, with the foliage exclusively adult, were found reverting to the juvenile stage.—A series of leaves of *Daviesia corymbosa* Sm., showing variation, from rotundate to linear, obtuse, acute to long acuminate, and ranging from 1 in. to 7 in. long, and from $2\frac{1}{2}$ in. to 1 line broad.

Mr. E. Cheel exhibited normal specimens of a Puff-ball (*Bovistella aspera* Lloyd), together with other examples of what appeared to be the same species, having an outer shell or coating of cemented sand and other particles of earth adhering to the peridium. He suggested that the original olive-brown coloured spores had been ejected or washed out by rain, and the gleba or capillitium left intact within the peridium; but that was now infested with another species of fungus resembling the moulds, which, together with the sterile base of the capillitium or gleba, was of a light slate-like colour, with an abundance of spores, so that the whole mass of hyphæ somewhat resembled the kernel of a nut. The specimens were found at Hill Top, on the Southern line, usually on the surface or partially buried in the soil. Specimens identical with those exhibited, were collected at Wombeyan Caves in October, 1905, by Messrs. J. H. Maiden, R. H. Cambage, and E. C. Andrews, and are in the National Herbarium Collection, bearing a note from the late Mr. A. Grant as follows: —"I have examined the 'Insect-cocoons,' and found them to consist of a hard outer mud-wall; within this, and in close apposition to it, is a second wall composed of papier-macié material next to this is a soft, felt-like mass of soft material which, on being disturbed, sends up a cloud of very fine dust. This dust, on being examined under the microscope, is found to be composed of a mass of fungus gonidia. This felt-like material completely envelops an inner, hard kernel of considerable size, and on washing away the gonidia, a number of effete gonidiophores are revealed, which have grown from the kernel, and are still completely attached to it." In the Society's Proceedings for 1905, p.351, Mr. R. T. Baker recorded some notes on apparently the same kind of objects, collected at Wombeyan, Taralga, by Mr. H. J. O'Neill.

Mr. L. Harrison exhibited specimens of, and offered remarks upon—(*a*) Two species of *Pauropoda*, an Order of minute myriapods not hitherto recorded from Australia. The larger of the two species shares with *Stylopauropus pedunculatus* of Europe the distinction of being the largest known pauropods, both attaining a length of 1·8 mm. It has been found under bark upon the ground, in great numbers, at Lindfield, during June. Eggs, and larval stages with three, five, six, and eight pairs of legs were also exhibited. The stage with seven pairs of legs, recorded by Lubbock for the European *Pauropus huxleyi*, is not present in the life-history of the Australian form. The eggs have not hitherto been found. Living individuals of this species, which had been in captivity for three weeks, and seemed to flourish in a tube containing some damp earth, were also shown. The second species has a smaller and more slender form, being less than 1 mm. in length, and is considerably rarer than the first, only about a dozen specimens having been taken. The species are generically distinct, and belong to the family *Pauropodidæ*. As they do not conform to the short diagnosis given by Bagnall (Trans. Newcastle Nat. Hist. Soc., 1910), of the two genera comprising this family, they will probably have to be made the types of new genera.—(*b*) A species of *Scutigerella*, belonging to the second Order of minute myriapods, the *Symphyla*. The only previous records of the occurrence of the Order, in Australia, are both West Australian. A species of *Scutigerella* is described in Michaelsen's "Fauna Süd-west Australiens"; and Alexander (Rept. Aust. Assoc. Adv. Sci., 1913) records the occurrence of a species of *Scolopendrella* about Perth, which is probably the same species. Found under bark, Lindfield.—(*c*) A specimen of *Geonemertes australiensis* Dendy, taken under bark at Lindfield. The species has not previously been taken about Sydney.—(*d*) Two individuals of a species of *Pontobdella*, taken on the under side of stones in rock-pools at Long Reef, a somewhat unusual situation.—(*e*) Specimens of the primitive thysanuran insect *Campodea*. Alexander (*l.c.*, 1913) states that it is unknown outside the Holarctic Region. It is very plentiful under logs and bark in the University grounds, at Lindfield, and in many other localities about Sydney.—(*f*) Two individuals of a species of *Myriothela* (*Hydroidea*) found under a stone at Thirroul. Only one species has hitherto been recorded for the Southern Hemisphere (*M. austro-georgiæ* from the Antarctic Regions).

ADDITIONAL NOTES ON THE FERNS OF LORD HOWE ISLAND.

By the Rev. W. Walter Watts.

These Notes are the result, partly of the observations made by Mr. R. B. Oliver, of Auckland, during a recent trip, and partly of my own further investigations.

i. Polystichum.

In my paper on "The Ferns of Lord Howe Island" (These Proceedings, 1912, p. 395), I referred to the fern known on the Island as the "Heavy Fern," as *Polystichum Moorei* Christ. This was due to the fact that this fern was so named in the National Herbarium, Sydney, and that the late Mr. E. Betche had made the following note on the cover: "Not specifically different from *Aspidium adiantiforme* (Forst.) J.Sm., (*A. capense* Willd.), according to Kew, but Christensen supports the view of Christ, and keeps it as a distinct species." I did not attempt to go behind this; and when Dr. Christ wrote, after examining the small fern that Edward King had collected for me, that it appeared to him to be but an umbrageous variety of *P. Moorei,* I took it for granted that he was comparing it with the so-called "Heavy Fern," and, therefore, set up the smaller one as a new species, under the name, *Polystichum Kingii.* Mr. Oliver was the first to suggest a doubt regarding the identity of Dr. Christ's *P. Moorei;* and the result of further inquiry, ending in a letter from Dr. Christ himself, was the conviction that *P. Moorei* (originally returned as *P. aculeatum,* var. *Moorei*) was not the "heavy fern," but was identical with my *P. Kingii.* The position now stands thus: *P. Kingii* becomes a synonym of *P. Moorei*, and the "heavy fern" has to be described as a new species. I am dedicating it to Mr.Thomas Whitelegge, who was, apparently, the first to point out how this fern differed from *P. capense*, with which it had been identified.

1. P. Moorei Christ.

P. aculeatum var. *Moorei* Christ, in Proc. Linn. Soc. N.S.Wales, 1898, p. 146; *P. Kingii* Watts, Proc. Linn. Soc. N.S.Wales, 1912, p. 401.

Western base of Mt. Gower (King, Oliver).

Var. tenerum, var.nov.; f. *umbrosa*, op. cit., 1912, p.403.

Tenerius, paleis ad stipitis basin dense et pulchre confertis, stipiti supra et rhachidi subnudis.

Dr. Christ thought this an umbrageous form of *P. Moorei*, but it is doubtful if it is limited to specially shaded places.

Among rocks at mouth of Soldier Creek (Maiden); base of Mt. Gower (King).

2. P. Whiteleggei, sp.nov.

P. adiantiforme (Forst.), J.Sm. (*P. capense* Willd.), *fid.* Kew; *P. Moorei* Christ, *fid.* Betche in Herb. Syd., and Watts, *loc. cit.*; local name "Heavy Fern."

Rhizoma erectum robustum, fibrosis radiculis atris, validis densis instructum; stipes validus, ad 75cm. longus, paleis brunneis dense vestitus, infra magnis fusco-brunneis, supra parvulis teneris pallido-brunneis; rhachis et costæ paleis similibus vestitæ; frons ovato-lanceolata vel subtriangularis, subinæqualis, plus minusve curvata, pinnis lanceolatis acuminatis, sursum curvatis, pinnulis numerosis lanceolatis sursum curvatis, pinnatilobis, lobis inferioribus ad rhachidem divisis, segmentis integris vel crenulatis vel sublobatis, acroscopicis evolutioribus, marginibus plus minusve recurvis; sori pernumerosi, interdum fere integram frondis faciem subtus tegentes, indusio magno rotundo membranaceo, facile cadenti, marginibus subrecurvis.

Fairly common on mountain-slopes.

This fern is certainly distinct from *P. adiantiforme* (*capense*), which has a creeping rhizome, a firmer and more persistent indusium, and other distinguishing characters. *P. adiantiforme* must now be removed from the flora of Lord Howe Island.

ii. Dryopteris.

D. apicalis, *D. nephrodioides*, and *D. decomposita* have been recorded from the Island, the first two as indigenous. *D. apicalis* is very rare. I did not find it during my many excursions to different parts of the Island, but Mr. Oliver has sent me a specimen of what certainly appears to be this species. I am not quite sure that there has not been some confusion between *D. apicalis* and *D. nephrodioides*. The latter is described (H. B. Syn., p. 266) as having the rhachis smooth on the under side, and the sori solitary on the anterior side of each lobe; while *D. apicalis* is said (*ibid.*, p. 499) to have the rhachis "glanduloso-pilose," and the sori at the sinuses of the lobes. The specimens labelled *D. nephrodioides* in the National Herbarium, Sydney, however, scarcely have a smooth rhachis, and the placing of the sori is not always easy to distinguish with certainty. Christensen (Index Fil.) regards *D. nephrodioides* as a variety of *D. decomposita*, but, as the late Mr. Betche remarked, in an Herbarium note, he cannot have seen a specimen. Both *D. apicalis* and *D. nephrodioides* must stand for the present, but I have not seen an undoubted specimen of *D. decomposita* from the Island.

iii. Marattia.

The Marattia of Lord Howe Island deserves closer study. Domin, in his "Beiträge," regards it as *M. fraxinea* simply, and denies it rank even as var. *salicina* (Sm.), under which name I previously recorded it. But, after seeing and examining many specimens of *M. fraxinea* in North Queensland, I am convinced that the var. *salicina*, in which the sori are much less numerous, considerably larger, and more medial than marginal, ought to stand. Both the Lord Howe fern and that of North Queensland are growing in my bush-house, and the differences, in the young forms, are most marked.

iv. Ophioglossum.

In my paper on "The Ferns of Lord Howe Island," I recorded *Ophioglossum vulgatum* L., as new to the Island. Since then, I have gone carefully into the question of the geographical distribution of this remarkable plant. Christensen, in his Index Fil., follows those who exclude *O. vulgatum* from Australia, limiting it to "Europe, Madeira, Amer. bor., Asia occ.," and assigning to Australia and New Zealand several distinct species, as follows: *O. Dietrichiae* Prantl, *O. Prantlii* C. Chr., (*O. lanceolatum* Prantl), *O. costatum* R. Br., *O. Luersseni* Prantl, *O. minimum* Hook. fil., *O. coriaceum* A. Cunn., (*O. gramineum* R. Br.), and *O. pedunculosum* Desv. My Lord Howe specimens, therefore, had to be re-examined. The result has been to convince me that the supposed Australian species show so few decided differences from *O. vulgatum* as to be indistinguishable, except as varieties, or even forms. In this, I follow C. Luerssen, who, in the Journ. Mus. Godeff., iii., 233ff(1875), subjected the genus to exhaustive examination and figured the various Australian forms with much patience. Domin also, in his "Beiträge zur Flora und Pflanzengeographie Australiens," Vol i., accepts the findings of Luerssen. The fact is, the apparent differences are not constant. Lueressen shows, it seems to me conclusively, that no distinctive specific characters are to be found in (*a*) the number of leaves springing from one rhizome, (*b*) the length of the common stipes, (*c*) the form of the sterile leaf-section, (*d*) the relation between the sterile and fertile parts, (*e*) the vascular formation of the stipes, (*f*) the number of the sporangia and the form of the sterile apex, (*g*) the nervature of the sterile part of the leaf, (*h*) the form of the surface-cells of the sterile leaf-section, (*i*) the presence or absence of a central nerve, (*k*) the shape and character of the spores. Where the variations are so marked, and the different forms run into one another so freely, it would seem preferable to give the name *O. vulgatum* L., to all the specimens, with some indication of the general form of the plant collected, such as is attempted in the names "gramineum" and "lanceolatum." For the present, I record the Lord Howe specimens as *O. vulgatum* L., var. *lanceolatum* Luerss.

V. Tree-Ferns.

Mr. Oliver, at my suggestion, made careful notes of the characteristics of the Tree-Ferns of the Island, and I am venturing to reproduce his notes in their entirety.

"*Alsophila robusta* C. Moore.—Trunk smooth, with clean, distinct scars. Dead fronds fall away. Stipes with linear, brown scales at base. Rhachis and costæ muricate throughout. No scales or tomentum." [But see description below.]

"*Hemitelia Moorei* Bak.—Trunk rough with broken stipes of fallen fronds. Stipes covered with dense, linear scales. Rhachis and base of costæ with scales more or less thickly over the whole undersurface, and muricate below the scales; upper surface similar, but fewer scales and fewer prickles; costæ tomentose above."

"*Cyathea brevipinna* Bak.—Trunk smooth, with clean, distinct scars. A few scales at the base of the inner stipes; otherwise stipes, rhachis, and costæ quite clean and muricate, except costæ tomentose above."

"*Cyathea Macarthurii* Bak.—Trunk rough with broken bases of fallen fronds. Dead fronds hanging from top of trunk. Stipes with long, linear, brown scales at base. Undersurface of rhachis and costæ muricate, and with few scattered scales, and dense appressed tomentum."

The characters noted by Mr. Oliver are of the greatest importance in the determination of the tree-ferns, the pinnæ alone being often of little determinative value.

Alsophila robusta was published in the Flora Australiensis as *A. australis* var. *nigrescens,* but it is an undoubted species, and Moore's name should be appropriated to this fine tree-fern.

Alsophila robusta C. Moore, Herb. Syd.; *A. australis* ? var. *nigrescens* Benth., Fl. Austr., vii., 711.

Caudex 8-10 ped. altus, robustus, subglaber per frondicum cicatrices cadentium; stipes 3-5 dm. longus, turgidus, subglaucus, basi paleis linearibus longis (ad 4 cm.) vel brevibus, albescentibus ad pallido-brunneis, serratis, dentibus brunneis nitentibus; frons 10-15 dm. longa et 6-8 cm. lata, horizontaliter pinnata; pinnæ ad 40 cm.

longæ et 15 cm. latæ, virides, breviter acuminatæ, rhachidibus et costis in superiore latere dense tomentosis, subtus muricatis, punctis cum apice rotundo brunneo nitenti; pinnulæ creberrimæ, ad 10-12 cm. longæ et 1-1·25 cm. latæ, in pinnulas sessiles, falcatas divisæ; pinnulis ii. integris vel crenulatis, pinnato-nervatis, marginibus recurvis; sori 10-12 in singulis pinnulis ii.; color læte-viridis, subtus subcæruleus, siccitate fuscescens; textura firma subcoriacea.

This fern is easily distinguished from all its congeners, even by the bluntish pinnæ; the swollen base of the stipes is quite distinctive; it could only have been referred to *A. australis* through the insufficiency of the specimens available.

A REVISION OF THE MONAXONID SPECIES DESCRIBED AS NEW IN LENDENFELD'S "CATALOGUE OF THE SPONGES IN THE AUSTRALIAN MUSEUM." Part i.

By E. F. Hallmann, B.Sc., Linnean Macleay Fellow of the Society in Zoology.

(Plates xv.-xxiv.)

Introduction.

In view of the many serious inaccuracies found by Mr. Whitelegge and myself in the portions, revised by us, of the "Catalogue of the Sponges in the Australian Museum," and my further discovery that, contrary to Mr. Whitelegge's assumption, the specimens standing as the types of the species therein described are not in every case to be relied upon as authentic, I have deemed it advisable to continue much further my investigations in regard to those species before proceeding with other work intended for publication on Australian sponges. The results of these investigations, in so far as they pertain to the Monaxonida, it is the purpose of the present paper to set forth.

The material upon which the revision has chiefly been based, consists of the reputedly original specimens preserved in the Australian Museum, and of sample-fragments of an incomplete duplicate set of specimens belonging to the British Museum. The correspondingly labelled specimens of the two sets, however, are not always in agreement; and among the latter are included examples of species which are not to be found in the existing collection of the Australian Museum. At the same time, a number of the Monaxonid species described in the Catalogue are unrepresented in either set of examples. In the case of the former specimens—all of which are labelled in Dr. Lendenfeld's own handwriting—the original labels, as a rule, bear only "manuscript" names, and for the published equivalents of these dependence has mainly to be placed on a synonymic list (hereinafter referred to as the key-list) furnished by the author of the Catalogue at the request of the Museum Trustees some years after his departure from Australia: the specimens also have attached to them labels added by Mr. Whitelegge, indicating their correct names according to the key-list, and marking them to be the type-specimens.

The examination of portion of this material, undertaken in connection with my previous paper, disclosed that many of the specimens were altogether incompatible with the descriptions of the species they purported to represent; and that, as a rule, considerable disagreement existed between description and specimen even in those cases in which the latter had to be adjudged as beyond question correctly labelled. So far as the evidence then forthcoming enabled one to determine, however, the discrepancies observed were, with two exceptions, such as it seemed necessary to attribute either to inaccuracy of observation on Dr. Lendenfeld's part or to a mislabelling of the specimens; the exceptions—both of which I referred to in my previous paper—were in connection, firstly, with *Clathrissa arbuscula*—the figure given in illustration of which is in reality one of *Clathriodendron arbuscula*; and, secondly, with the two so-called varieties of *Thalassodendron rubens*, the descriptions of whose skeletal characters should be interchanged. The investigation of the remaining material, while proving the descriptions to be almost without exception faulty (often even to an extreme degree), has resulted in the discovery that errors of the kind last-mentioned are by no means of isolated occurrence in the Catalogue; in other words, that not a few of the figures are wrongly designated, and that in repeated instances the disparity between specimen and description is in consequence of the fact that the description is an account partly of the external features of one species and partly of the internal features of another. The former of these extraordinary errors were comparatively easy of detection, and are indubitable, since the actual specimens from which the figures were taken have been found; but those affecting the descriptions only became apparent, at a late stage of the investigation, as a result of accumulated circumstantial evidence, and have been responsible for the chief difficulties which the task of revision has presented.

The alterations in nomenclature which have been found necessary in connection with the species revised are indicated in the lists given below. In the first list, the left-hand column gives the names under which the species were described or figured in the "Catalogue," and the right-hand the names of the species as now accepted. Where the original name is preceded by the sign †, it is intended to indicate that the species described by Whitelegge under that name was wrongly identified; the correct name of the latter species is given in the second synonymic list. In the case of each of the species whose name is followed by the sign + (only), there is good reason to believe that the original description was based upon two species, only one of which is with certainty known. The single asterisk(*) placed before several of the names indicates a doubt as to whether the specimen examined was a genuine example of the species—and, accordingly, a doubt as to whether the name is really correct. Finally, the double asterisk(**) is employed to denote that the species is known only from its description; and where in addition the name is enclosed within brackets, the description is regarded as insufficient, even if it be correct, to enable one to say positively to what genus the species belongs. Certain of the last-mentioned species were referred to in my previous paper, and assigned doubtfully to the genus *Wilsonella*; but I now consider it better to allow them to remain under their original names.

List A.—Synonymy of the Species, as far as revised by me, of Lendenfeld's "Catalogue."

Tethya multistella var. *megastella*	***Donatia lyncurium* (?) var. *multistella*.
Tethya multistella var. *microstella*	***Donatia lyncurium* (?) var. *microstella*.
Tethya corticata.	**Donatia ingalli* var. *lævis*.
Tethya fissurata	*Donatia fissurata*.
Tethya inflata	**Donatia ingalli* var. *lævis*.
Tethya phillipensis	*Donatia phillipensis*.
Tethya lævis	*Donatia ingalli* var. *lævis*.

Tethyorrhaphis lævis	*Tethyorrhaphis lævis.*
Tethyorrhaphis tuberculata	*Tethyorrhaphis lævis.*
Tethyorrhaphis gigantea	*Tethyorrhaphis lævis.*
Tethyorrhaphis conulosa	*Tethyorrhaphis lævis.*
Sollasella digitata	*Sollasella digitata.*
Spirastrella australis	*Spirastrella* (?) *australis.*
Papillina panis (descr.)	*Spirastrella papillosa* R. and D.+ *S. papillosa* v. *porosa* Dy.
Papillina panis (fig.1)	*Cliona* (*Papillissa*) *lutea*
Papillina panis (fig.2)	*Spirastrella* (?) *ramulosa.*
Papillina ramulosa	*Spirastrella* (?) *ramulosa.*
Raphyrus hixonii	*Cliona* (*Papillissa*) *hixoni.*
Papillissa lutea	*Cliona* (*Papillissa*) *lutea.*
Suberites domuncula	**Suberites* spp.
Plectodendron elegans	*Caulospongia elegans.*
Chondrosia collectrix	*Chondrosia* (?) *collectrix.*
Reniera collectrix	*Chondrosia* (?) *collectrix.*
†*Reniera australis*	*Reniera australis.*
Reniera megarrhaphea	*Amorphinopsis megarrhaphea*+.
Reniera pandæa	*Hemitedania anonyma* Crtr.+.
Reniera lobosa	***Reniera lobosa.*
Petrosia hebes	*Petrosia hebes.*
Halichondria rubra	*Hemitedania anonyma* Crtr.
Halichondria rubra var. *digitata* (descr.)	*Hemitedania anonyma* Crtr.
Halichondria rubra var. *digitata* (fig.)	*Raspailia agminata* sp.n.
†*Halichondria mammillata*	***Halichondria* (?) *mammillata.*
†*Halichondria clathriformis*	*Thrinacophora clathriformis.*
†*Reniochalina stalagmitis*	***Reniochalina stalagmitis.*
†*Reniochalina lamella*	***Axinosia* (?) *lamella* (?+).
Stylotella digitata	*Stylotella agminata* Ridl.
Stylotella polymastia (descr.)	*Ciocalypta* (?) *polymastia.*
Stylotella polymastia (fig.)	*Histoderma actinioides* sp. n.
Stylotella rigida	*Stylotella agminata* Ridl.
Stylotella aplysillioides	***Hymeniacidon aplysillioides.*
Rhizochalina ramsayi	*Phloeodictyon ramsayi.*
Rhizochalina petrosia	*Phloeodictyon petrosia.* +*Ciocalypta* (?) sp.
Gellius panis	***Gellius panis.*
Gellius raphidiophora	*Gellius raphidiophora.*
Tedania rubicunda	*T. digitata* var. *rubicunda.*
Tedania laxa	*Stylotella agminata* Ridl.
Tedania rubra	*Tedania digitata* var. *rubra.*
Tedania tenuispina	*Stylotella agminata* Ridl.+.

Sideroderma navicelligerum (descr.)	*Histoderma actinioides* sp. n.
Sideroderma navicelligerum (fig.)	*Polymastia zitteli.*
Sideroderma zittelii	*Polymastia zitteli.*
Esperella ridleyi v. *robusta*	*Mycale ridleyi.*
Esperella ridleyi var. *intermedia*	*Mycale ridleyi.*
Esperella serpens	*Mycale serpens.*
Esperella penicillium	*M.* (*Paresperella*) *penicillium.*
Myxilla jacksoniana	*Lissodendoryx jacksoniana.*
Clathriodendron arbuscula	*Clathriodendron arbuscula.*
Clathriodendron irregularis	***Clathriodendron* (?) *irregularis.*
Clathriodendron nigra	*Raspailia nigra.*
Kalykenteron elegans	*Echinodictyum bilamellatum* Lam.
Kalykenteron silex	*Echinodictyum bilamellatum* Lam.
Clathrissa arbuscula (descr.)	*Clathrissa arborescens* Ridl.
Clathrissa arbuscula (fig.)	*Clathriodendron arbuscula.*
Clathrissa elegans	***Clathrissa* (?) *elegans.*
Clathrissa pumila	*Crella incrustans* Crtr. v. *pumila.*
Clathrissa pumila v. *rubra*	*Crella incrustans* Crtr. v. *rubra.*
Echinonema anchoratum v. *ramosa*	***Echinonema* [*anchoratum*, var.] *ramosa*
Echinonema anchoratum v. *dura*	***Echinonema* [*anchoratum*, var.] *dura.*
Echinonema anchoratum v. *lamellosa*	***Echinonema* [*anchoratum*, var.] *lamellosa.*
Echinonema levis	*Crella incrustans* Cr. v. *levis*(?+).
Echinonema rubra	*Crella incrustans* Cr. v. *levis*(?+).
Clathria macropora	**Crella incrustans* var. *levis* (?+)
Clathria pyramida	*Wilsonella* (?) *pyramida.*
Clathria australis	*Crella incrustans* v. *arenacea* Cr. (?+).
Thalassodendron digitata	**(*Thalassodendron digitata*).
Thalassodendron typica	**(*Thalassodendron typica*).
Thalassodendron rubens v. *dura*	*Clathria rubens*+*Rhaphidophlus paucispinus.*
Thalassodendron rubens v. *lamella*	*Rhaphidophlus paucispinus* +*Clathria rubens.*
Thalassodendron paucispinus	*Rhaphidophlus paucispinus.*
Thalassodendron brevispina	*Rhaphidophlus typicus* Crtr. var. *brevispinus.*
Thalassodendron viminalis	*Ophlitaspongia hispida* Crtr. var. *viminalis.*
Plectispa elegans	***Echinoclathria* (?) *elegans.*

Plectispa arborea	*Echinoclathria arborea.*
Plectispa macropora	**(*Plectispa macropora*).
Clathriopsamma lobosa	*Wilsonella australiensis*+.
Clathriopsamma reticulata	*Rhaphidophlus reticulatus.*
Aulena laxa	**Echinoclathria laxa.* (?=*E. gigantea*).
Aulena gigantea	*Echinoclathria gigantea.*
Axinella hispida v. *gracilis*	*Raspailia gracilis*+.
Axinella hispida v. *tenella*	*Raspailia tenella*+.
Axinella aurantiaca	*Axinella aurantiaca*
Axinella inflata	**(*Axinella inflata*).
Axinella obtusa	**(*Axinella obtusa*).
Spirophorella digitata	***Trachycladus digitatus* (=*Spirophora digitata* Ldf.)+.

List B.—Synonymy of Monaxonid Species wrongly identified by Whitelegge in his Revision of Lendenfeld's "Catalogue"—(omitting Chalininæ).

Reniera australis(**53**, p.324)	*Reniera* sp.
Halichondria mammillata(**56**, p.282)	*Siphonochalina* sp.
Halichondria clathriformis(**56**, p.282)	*Chalina finitima* Whtlg. (non Schmidt).
Reniochalina stalagmitis (**56**, p.283)	*Axiamon folium* g. et sp.n.
Reniochalina lamella(**56**,p.283)	*Axiamon folium* g. et sp.n.
Echinonema anchoratum var. *ramosa*(**54**, p.81)	*Clathriodendron arbuscula* Ldf.
Echinonema anchoratum var. *dura*(**54**, p.81)	*Clathria*(?) *indurata*, sp.n(**18**).
Echinonema anchoratum var. *lamellosa*(**54**, p.82)	*Clathria spicata*, sp.n (**18**)*
Thalassodendron typica (**54**,p. 86)	*Echinodictyum bilamellatum* Lamk.
Thalassodendron rubens var. *dura*(**54**, p.87)	*Rhaphidophlus paucispinus.*

* On one page of my former paper(p.211) I have inadvertently referred to this species as *C. diechinata*, a name merely which it was at first my intention to bestow on the species.

Thalassodendron viminalis(**54**, p.87)	*Echinochalina intermedia* Whtlg.
Plectispa elegans(**54**, p.90)	*Echinoclathria arborea* Ldf.
Plectispa arborea(**54**,p.89; 55, p.212)	*Clathria multipes*, sp.n.(18).
Plectispa macropora(**54**, p.89)	*Echinoclathria ramosa*, sp.n.(18).

New genera have been established as follows:—*Hemitedania*, for *Rhaphisia anonyma* Carter; *Axiamon*, for *Reniochalina lamella* Whitelegge (non Lendenfeld); *Pseudotrachya*, for *Sollasella hystrix* Topsent; *Stylissa*, for *Stylotella flabelliformis* Hentschel; and *Axinosia* (with *Axinella symbiotica* Whitelegge, as type) to include *Stylotella irregularis* Kirkpatrick. *Amorphinopsis* Carter and *Papillissa* Lendenfeld have been revived—the latter provisionally as a subgenus of *Cliona*. *Plectodendron* Lendenfeld, is found to be identical with the almost forgotten *Caulospongia* Kent, and *Strongylophora* Dendy, to be a synonym of *Petrosia*. The genera *Sollasella* and *Stylotella*(s.str.) are removed from the family Axinellidæ and placed in the Donatiidæ and Suberitidæ respectively.

For convenience of reference, I deal with the species in the same order and under the same names and family headings as in the Catalogue.

Revision of the Species.

Familia TETHYDÆ (= Donatiidæ).

Genus Tethya (= Donatia).

Of the difficulties which the identification of many of the species to be revised has presented, the greatest by far, from the point of view of the expenditure of time they have occasioned, have been those in connection with the several species of *Tethya* (i.e., *Donatia*). In the first place, it was found that the specimens labelled as the types of these species, excepting only *T. inflata*, comprise in each case examples of two or three species (or varieties)—among them, in the case of *T. corticata* and *T. lævis*, being examples even of the genus *Tethyorrhaphis* (which outwardly are hardly to be distinguished from the accompanying specimens of *Donatia*). And, secondly, the examination of all these specimens (some thirty in number), as well as many other examples of the genus from Port Jackson and its vicinity, resulted in my failure to discover any which accorded at all satisfactorily with the description of any one of the species. As a consequence, since it is practically certain that, with the scarcely to be doubted exception of *T. multistella*, all the species in question are comprised amongst the specimens I have examined, I have deemed it best to regard definitely as the types of these species in each case—*T. multistella* excepted—those of the specimens labelled as representing them which best accord with their respective descriptions.

I have found the number of the rays of the spherasters to be very constant in specimens of the same species, and have, therefore, attached importance to it as a specific character. The precise number of the rays not being exactly determinable (owing to their distribution over the surface of a sphere), I have stated, in the following descriptions, only the number of them that can actually be seen and counted.

Tethya multistella.

The "types," labelled as from Port Jackson, comprise three distinct forms, which all resemble *Tethya multistella* in having the surface subdivided into polygonal areas by pore-grooves, but not one of which admits of being identified with either of the varieties into which Lendenfeld divides the species. Some further specimens, left by Lendenfeld and exhibiting a tessellated surface, occur in the collection, labelled (wrongly so far as the specific name is concerned) "*Tethya fissurata*, Port Molle"; and these likewise are unidentifiable with *T. multistella*. As Lendenfeld records the species from Port Jackson, Port Phillip, Port Chalmers, and the Chatham Islands, it accordingly seems probable that his description of it was based solely on specimens from one or other of the last-mentioned three localities, and that the specific identity of the Port Jackson specimens with these was merely assumed from their external resemblance thereto. It is not unlikely that the true types of *T. multistella* are in the

British Museum; though among the sponge-fragments which have been received from that Institution none labelled as *T. multistella* are included.

The following brief descriptions of the several forms above mentioned—which on account of their surface-tessellation and their spiculation, could, I suppose, be designated varieties of *Donatia lyncurium*—are intended merely for the purpose of indicating the chief reasons against the acceptance of any of them as an example of the species here in question.

i. This sponge, which is a common one in Port Jackson and adjacent localities in shallow water, is represented by a number of specimens. The spicules of the radial fibres are styli, which are generally sharp-pointed, and attain a size of about 1250 by 16 μ; the terminal spicules of the fibres project only a slight distance beyond the surface. Between the fibres in the outer region of the choanosome, fairly abundant radially directed slenderer megascleres occur, and in the spicular "nucleus" of the sponge are found comparatively short styli, some of which are less than 200 μ in length. Spherasters occur only in the cortex, and are comparatively very scarce even there; they are at most 45 μ in total diameter, and are provided with straight, conical, smooth rays, the length of which may attain to three-fourths the diameter of the centrum, and the number of which (actually countable) varies from 14 to 18. Tylasters are plentiful in all parts of the sponge, most abundant in the superficial layer of the cortex; they seldom exceed 15 μ in diameter and have the slightly expanded extremities of the rays minutely spined.

ii. A single specimen, labelled as from Port Jackson, is remarkable in having spherasters, the surface of the rays of many of which is roughened with incipient spines; occasionally a few of the spines are of considerable size. In other respects this sponge is very similar to the preceding; but the styli attain a stoutness of 20 μ, and the spherasters a diameter of 55 μ; the length of the rays of the latter may equal the diameter of their centrum; and the tylasters are rare in the choanosome, except in the immediate surrounding of canals.

iii. Another specimen, also labelled from Port Jackson, agrees with those of the two preceding forms in having chiefly stylote megascleres and asters of two kinds; but the spherasters are extremely abundant throughout the entire cortex and occur fairly plentifully also in the choanosome, decreasing in number, however, towards the centre of the sponge. Many of the megascleres are blunt-pointed, and an appreciable number of them approximate in form to (fusiform) strongyla; their maximum size is about 1520 by 22 μ. The spherasters, the largest of which measure 75 μ in total diameter, have from 13 to 17 (actually countable) rays; the rays vary from one-half to three-fourths the diameter of the centrum in length, and are often slightly curved, and occasionally forked, at the extremity. In the choanosome, spherasters of all sizes, from 20 μ in diameter upwards, are common. As regards the tylasters, the same remarks apply as to those of the preceding forms. Radially directed megascleres, lying between the fibres, are not so abundant in this as in the preceding forms, and the surface of the sponge is hispidated by far-projecting spicules.

iv. The specimens labelled "*Tethya fissurata*, Port Molle," differ from the foregoing, and agree with one another, in the following particulars : (1) the megascleres of the fibres, the maximum size of which somewhat exceeds 2000 by 40 μ, are invariably rounded at the apex and are usually almost or quite symmetrically-ended (fusiform strongyla); (2) the megascleres between the fibres are distinctly different from the fibre-spicules (being more or less sharp-pointed at the apex and of much smaller size than them); (3) the chiasters are of two kinds, tylasters and "oxyasters"; and (4) the spherasters have from 19 to 23 actually countable rays. As in the third-mentioned variety, the spherasters are closely packed throughout the entire cortex and occur also scattered in the choanosome. The tylasters, measuring at most 16 μ in diameter, have the ends of the rays slightly expanded and provided with minute spines. The asters of the third kind attain to 23 μ in diameter, and have comparatively slender rays which are not expanded at the extremities, and which usually are blunt-pointed and provided along their whole length with not numerous minute tubercles or spines; a few, however, have the rays sharp-pointed and free from spines (oxyasters). In spite of their many points of resemblance, the specimens nevertheless exhibit certain decided differences, the most noteworthy of which is in regard to the size of the spherasters: these attain a diameter of 100 μ in one specimen, only 65 μ in another, and are of intermediate size in a third.

Tethya corticata.

According to its description, this species is characterised by an irregularly conulated surface (apparently not incised by pore-grooves), obtusely pointed styli of two sizes, the larger of which attain a size of 2000 by 13 μ, and microscleres of only two kinds, spherasters and tylasters, the former abundant in the cortex. The specimens indicated to be the types, however, as well as a fragment labelled *Tethya corticata* from the British Museum, while conforming fairly well with the description as regards external features, have mostly sharp-pointed styli, the largest of which measure 1600 by 28 μ, only moderately few spherasters, and, in addition to (chiefly cortical) tylasters, abundant choanosomal oxyasters, which are well distinguished from the tylasters both in shape and size. They are, in fact, examples of a variety of *Donatia ingalli*, differing in no essential respect from the specimens labelled (correctly, I feel sure) as the types of *Tethya lævis*, except that in several of the latter, apparently merely in consequence of individual variation, the megascleres which lie free in the choanosome are notably of smaller size than those which compose the fibres. One may, therefore, regard *T. corticata* as synonymous with *T. lævis*, and since the latter name rests on a more certain identification than the former, it should be preferred, and the sponge known as *Donatia ingalli* var. *lævis*.

Tethya fissurata. (Plate xv., fig.3).

In addition to the several specimens referred to above in connection with *Tethya multistella*, the "types" of *Tethya fissurata* comprise two specimens which are unquestionably to be identified with this species; yet, strangely, instead of being as the description states "irregularly spherical, more or less kidney-shaped sponges, with a flat base," they are stipitate, with a spherical body (in each specimen about 40 mm. in diameter), and with a well-developed, fairly stout stalk which divides below into a number of root-like processes (Plate xv., fig.3). They correspond exactly with the description with respect to surface-features, as may be seen from the figure which I furnish of one of them; and they also show considerable agreement in other respects. The description, however, makes it appear as if only one form of aster, a small tylaster, was present in addition to spherasters, whereas an oxyaster is also present; but Lendenfeld mentions that "a great abundance of the young stages of the larger kind of stellate is to be found," and I, therefore, take it that he mistook the oxyasters for developmental forms of the spherasters. A more correct account of the spiculation is as follows:—

The spicules of the radial fibres are almost exclusively fusiform strongyla with one extremity (viz., the outwardly directed) somewhat narrower than the other, and attaining a maximum size of about 4000 by (rarely) 80 μ; the terminal spicules of the fibres, however, which project beyond the surface, are usually more or less sharp-pointed and are not so large as the others. Between the fibres, megascleres (styli and strongyla) of smaller size occur, but are rare.

The spherasters are incompletely differentiated into two kinds: (1) a relatively shorter-rayed, ranging in total diameter from about 45 μ to upwards of 160 μ, and having from 13 to 18 actually countable rays of length seldom exceeding (and when least, only about two-thirds) the diameter of the centrum—the number and relative length of the rays decreasing as the size of the spicule increases; and (2) a relatively longer-rayed, ranging in diameter from less than 75 μ up to 240 μ, and having from 10 to 14 countable rays, the length of which is greater than (and occasionally attains to twice) the diameter of the centrum. The former occur only in the cortex, and in some parts of it are abundant throughout its entire thickness; the latter are chiefly confined to the choanosome, where they are extremely abundant in the peripheral layer and gradually diminish in number towards the centre. Frequently in the case of the longer-rayed spherasters, and exceptionally in the case of the shorter-rayed, one to several of the rays are forked, or are once or (seldom) a few times branched, or, on the other hand, are truncated and rounded off at the extremity.

The tylasters, which form a dense layer in the superficial part of the cortex and are scattered sparsely through the choanosome, are at most 19 μ in diameter, and have short stout rays, about equal in length to the diameter of the centrum, with slightly expanded extremities tipped with numerous minute spines.

The oxyasters occur abundantly in all parts of the choanosome, but are absent from the cortex. They attain to 50 or 55 μ in diameter, and have only a very slightly developed centrum and from 6 to 8 slender, usually blunt-pointed rays, generally provided with a few minute spines or tubercles, especially towards their extremities.

Many large spherical embryos occur throughout the sponge, some of which are over 2·5 mm. in diameter. These have radially arranged stylote megascleres and, as microscleres, a very thin superficial layer of tylasters similar to those of the adult, and exceedingly minute developmental spherasters scattered sparsely in the cortex.

Lendenfeld records the species from Port Molle (Queensland), Port Jackson, and New Zealand. The specimens described by me are labelled as coming from Port Jackson.*

If this species is to be placed in the genus *Donatia*, as at present seems necessary, then the latter can no longer be defined as being "without highly specialised pore-bearing grooves."

The sponge described by Hentschel(**19**) from Shark's Bay (Western Australia) as *Donatia fissurata* var. *extensa*, is undoubtedly a distinct species from the above.

TETHYA INFLATA.

According to description, this species has a smooth (*i.e.*, non-tessellated) surface with thread-shaped appendages, cylindrical

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* The Federal trawling-steamer "Endeavour" has now obtained another specimen from Storm Bay, Tasmania.

stylote megascleres 2000 by 14 μ in size, and asters of two kinds —spherasters 50 μ in diameter and tylasters 12 μ in diameter— which are "particularly abundant in the skin"; the colour of spirit-specimens is stated to be light flesh-colour in the cortex, and dirty-yellow in the interior. In agreement with this description, the two specimens labelled as the types have a smooth surface—which in one case is quite even, in the other, slightly tuberculate—and although without filaments and without a pinkish tint (their colour being pale creamy on the surface and brownish-yellow in the interior), yet at any rate they are identical in all other respects with specimens in the collection which exhibit those features. But, contrary to the description, they have fusiform, usually blunt-pointed (occasionally strongyla-like) megascleres, the largest of which are 27 μ in stoutness and less than 1700 μ in length: the spherasters are (comparatively) scarce in the cortex and attain a diameter of 60 μ or more: the tylasters are usually not less than 15 μ (and at most are 20 μ) in diameter; and oxyasters are present. The specimens are, in fact, forms of *D. ingalli* var. *lævis*; and a fragment labelled *Tethya inflata*, from the British Museum, is another example of the same. As I do not think that any reliance can be placed upon the spicule-measurements given by Lendenfeld, or even upon the form which he ascribes to the megascleres, I would, therefore, have but slight hesitation in declaring *Tethya inflata* to be synonymous with *Tethya lævis*, were it not for the fact of the possession by these specimens of oxyasters, and of the comparative non-abundance of their spherasters. I might mention, however, that, in the larger of the two "type-specimens," the oxyasters are rather few in number, and in places are absent (or almost so) throughout considerable tracts; while, at the same time, they are rarely more than 30 μ in diameter, and usually are not very markedly different from the largest tylasters: and thus it is conceivable, in the case of such a specimen, that these spicules could, through hasty observation, be overlooked. Also I might mention that, in some specimens of *Tethya lævis*, the spherasters are abundant in the outermost layer of the cortex; and possibly it is only to the outermost layer of the cortex that Lendenfeld refers in speaking of "the skin" of the sponge. Accordingly, taking everything into consideration, I think one is justified in regarding *Tethya inflata* (like *T. corticata*) as a synonym of *D. ingalli* var. *lævis*.

TETHYA PHILLIPENSIS. (Plate xv., fig.4).

Two of the three specimens labelled as the types of *Tethya phillipensis*, although by no means closely in accord with the description of this species, yet exhibit so many analogies therewith as regards both external and skeletal features, that one is justified, I think, in accepting them as the types of the species. The third specimen, while perhaps more closely in agreement with the description in the matter of skeletal characters, differs from the other two in surface-features, and provisionally I do not regard it as belonging to the same species as they. The locality of all three is given as Port Phillip, and this is confirmed, as regards the two taken to be the types, by the occurrence of a similar sponge in a collection from Port Phillip presented to the Australian Museum by the late Mr. J. Bracebridge Wilson. The following brief description, based on the two type-specimens and the one last-mentioned, will be sufficient to show that *T. phillipensis* is well distinguished from any other of the forms of *Donatia* herein described: and, at present, I consider it to be an independent species. As contrasted with *D. ingalli*, to which it makes nearest approach in spiculation, its chief diagnostic features are the minute pattern of the surface, the presence of (a few) spheres in addition to asters of three kinds, and the plentiful occurrence of spherasters in the choanosome.

The sponge is of more or less globular shape, either sessile (and then at times somewhat depressed) or prolonged below into a short stalk-like portion (*i.e.*, somewhat pyriform). The oscula are conspicuous and several in number. The colour in alcohol varies from a pale creamy-white, with a tinge of pink, to a light salmon. The surface, which is fairly regularly tuberculate, shows over its entire extent a minute reticulation (just visible to the naked eye): the tubercles are usually much depressed, flattened, and the surface as a consequence presents a slightly tessellated appearance. The shallow and, for the most part, narrow grooves separating the tubercles are not of the nature of specialised pore grooves; immediately underlying these grooves, however, and roofed over only by membrane, are narrow cleft-like spaces in the cortex, so that if a thin superficial layer of the sponge were pared off, the surface then would appear imperfectly divided into polygonal areas by discontinuous narrow cracks. The characteristic minute reticulation of the surface (Plate xv., fig.4) is found, on microscopical examination, to consist of polygonal or rounded meshes, averaging 150 μ in diameter, separated by narrow partitions in which are spherasters and megascleres, the latter—directed perpendicularly to, and slightly projecting beyond the surface—being the terminal spicules of the branches into which the radial skeletal fibres divide on entering the cortex. Superimposed upon this reticulation, and immediately external to it, is a finer reticulation with meshes about 25 μ in average diameter, which meshes are formed by pauciserial lines of tylasters and enclose each a single pore.

The spicules composing the radial fibres are styli, which, almost without exception, are more or less blunt-pointed—occasionally to such an extent as to approximate in form to strongyla; their maximum size in the several specimens varies from 1425 by 20 μ to 1600 by 24 μ. In the cortex, as the fibres approach nearer to the surface, their megascleres gradually diminish in size, and become cylindrical and abruptly sharp-pointed; the smallest of these terminal spicules are less than 240 μ in length. Between the fibres, in the choanosome, a fair abundance of radially directed megascleres occur, which are similar in form to those of the fibres, except that a few of them are slenderer and usually gradually sharp-pointed.

The microscleres are spherasters, spheres, tylasters, and oxyasters. The spherasters are abundant throughout the choanosome, and, in the cortex, occur chiefly in a broad superficial layer; they have rarely less than 13, and normally not less than 9, actually countable rays, and measure at most 65 μ in diameter; when, as occasionally happens, the number of rays is less than nine, it is because of the non-development of one or a few rays, and the spicule is then no longer centro-symmetrical. The spheres, which are equal in size to the centrum of the spherasters, occur sporadically both in the choanosome and the cortex; though few in number, they are not so rare as to excuse their being overlooked; in rare instances, two or three spheres may occur fused together.

Although similar to one another in all the foregoing particulars, the specimens are nevertheless of two forms in respect of a number of other (spicular) characters. In one form, (i.) the rays of the spherasters are rarely or never as long as (and usually are somewhat less in length than two-thirds) the diameter of the centrum, and not infrequently one or a few of them are provided with a small spine or two (incipient branches), or are forked at the extremity; (ii.) the tylasters, which may attain to 19 μ in diameter, have short stout rays usually less in length than the diameter of the centrum and provided with a well-developed terminal knob densely covered with minute spines; and (iii.) the oxyasters, which vary from (seldom) 20 μ to 35 μ in diameter and are fairly abundant, have moderately stout rays (1·5 to 3 μ in diameter near their base) with the distal half of their length covered with well-developed tubercles. In the other form, (i.) the rays of the spherasters are generally as long as, or slightly longer than, the diameter of the centrum, and rarely (if ever) exhibit incipient branching; (ii.) the tylasters are at most 17 μ in diameter, and have comparatively slender rays, which are longer than the diameter of the centrum, and are usually only slightly knobbed, and which are provided with spines, not only around their extremity, but also for some short distance along their length; and (iii.) the oxyasters, which are of about the same diameter as those of the preceding form, have slender rays only sparsely provided with tubercles.

Remarks.—Among the fragments received from the British Museum, there is one labelled *Tethya phillipensis* which, in skeletal characters (excepting that the spherasters are at most only about 55 μ in diameter), is in various respects intermediate between the two above-described forms. Unfortunately this fragment was used up in the preparation of sections from it, without a proper examination of its surface-features having been made; but if the specimen, from which it was taken, exhibits the characteristic dermal reticulation that would prove it to be also a form of *Donatia phillipensis*, then I would be inclined to say that a separation of these forms, as distinct varieties, is not feasible.

The specimen referred to in the opening paragraph, which I do not consider to belong to *D. phillipensis*, differs from the type-specimens of that species chiefly in the absence of a dermal reticulation and of subdermal clefts in the cortex, and in almost all respects is closely similar to *D. ingalli* var. *lævis*. In it, however, just as in *D. phillipensis*, spherasters are abundant in the choanosome and spheres are present. Concerning its megascleres, exactly the same remarks apply as to those of *D. phillipensis*, excepting that the largest attain a length of 1670 μ. The spherasters have from 9 to 13 countable rays, the length of which is less than the diameter of the centrum, and which rarely (if ever) exhibit any tendency to branch. Spherasters with one or more rays completely aborted were not observed. The tylasters are rarely more than 16·5 μ in total diameter, and their rays, which are shorter than the diameter of the centrum, have well-developed terminal knobs densely covered with minute spines; an extremely few, however, ranging in diameter from about 16 up to about 23 μ in diameter, have the rays less markedly knobbed, and provided with spines for some distance along their length. The oxyasters, which are abundant, occasionally attain to 43 μ in diameter, and have, as a rule, stout rays (2 to 4 μ in diameter at the base), the distal half of the length of which is covered with well-developed tubercles; some of the more slender-rayed spicules (? developmental forms), however, are without tubercles; in a small proportion of cases, the rays, which in such instances are usually stunted, are provided along their whole length with tubercles, and the spicule then often closely approaches in form to the oxyasters of *D. ingalli* as figured by Bowerbank (**3**, Pl. v., fig.17). In no other example of *Donatia* examined by me, does the tuberculation of the rays of the oxyasters reach quite such a degree of development.

Tethya lævis.

The sponge, which I identify as *Tethya lævis*, is a common one in the neighbourhood of Port Jackson, and is represented in the Australian Museum by some dozens of examples. The specimens labelled as the types of *Tethya corticata* and *Tethya inflata*, as well as the fragments labelled with the same names from the British Museum, are, as already stated, examples of it; and it is represented (along with several examples of *Tethyorrhaphis lævis*) among the specimens labelled as the types of *Tethya lævis*. There can be no doubt, also, that the species is identical with the *Tethya ingalli* recorded from Port Jackson by Sollas(**36**); but as proof is yet lacking of its strict identity with Bowerbank's species of that name, the locality of which is Western Australia, I propose to regard it as a variety thereof, and to designate it *D. ingalli* var. *lævis*.

The sponge, which appears always to be more or less spherical in shape, and to grow attached to the substratum by root-like processes, is chiefly distinguished, so far as external features are concerned, by the entire absence of any sign whatsoever of surface-tessellation, and by the very small size of the oscula,—the latter being, as a rule, at any rate in the case of preserved (and contracted) specimens, almost or quite invisible. The pores are not discernible; and there is no perceptible minute reticulation of the surface as in *D. phillipensis*. The surface is mammillated, the elevations varying in shape in different specimens, or even in different parts of the same specimen, from low and dome-like to verruciform; in most specimens, a certain proportion of these elevations are provided apically with a thread-like process, at the extremity of which a bud is often to be observed.

The two previous accounts of the sponge are not quite full and accurate concerning its spiculation, more especially in regard to the megascleres. These spicules are imperfectly differentiated into three kinds, the typical representatives of each of which are distinguished not only by their form and size, but also by their different situation in the sponge. The spicules of one kind are chiefly or exclusively confined to the fibres and almost entirely compose them; these attain a maximum length varying between

1·5 and 1·9 mm., (but only in rare specimens exceeding 1·6 μ) and a maximum stoutness approximating to 30 μ. The spicules of the second kind, which are typically of much smaller size than the preceding, though connected with them by a perfect gradation, contribute to form a "nuclear" skeleton surrounding the centre from which the fibres radiate, and are found also in the cortex in the penicillately outspread terminations of the fibres; the smallest of them measure less than 275 by 10 μ. Those of the third kind occur between the fibres, chiefly in the more peripheral part of the choanosome, and they vary markedly in size and abundance in different specimens. All three kinds are alike styli, which gradually taper towards the basal end and usually exhibit a faint constriction just immediately above that end: but the first-mentioned, or chief fibral, spicules are fusiform, and almost invariably have the apical end more or less rounded off so as occasionally to approximate in form to strongyla; the second are nearly cylindrical in shape, and are more or less abruptly sharp-pointed; while those of the third kind taper gradually to a usually very fine point. As already stated, the last-mentioned spicules are subject to considerable variation in size and number. Thus in one specimen (which is to be regarded as strictly typical of the var. *lævis*) these spicules are very few in number and rarely exceed 600 by 6 μ in size; whereas in most of the specimens labelled by Lendenfeld as the types of *Tethya inflata* and *Tethya corticata*, they are, on the other hand, extremely abundant and about equal in size to the spicules composing the fibres. Other specimens which I have examined are less widely divergent in these respects, and at present (although further investigation is necessary in order to settle the point) I do not think that the differences in question are varietal, more especially as they do not appear to be associated with any constant differences in respect of other characters.

The spherasters are almost entirely confined to the more superficial part of the cortex, and to the outermost region of the choanosome adjoining the cortex; the largest have a maximum diameter varying in different specimens from 60 to 85 μ; the rays, which in length are about equal to the diameter of the centrum, are rarely if ever bifurcate or branched, and their number (actually countable) varies (in the same specimen) from 9 to 13. The chiasters (tylasters) form a very thin layer at the surface of the sponge and are scattered through both the cortex and the choanosome – more abundantly in the former region, especially in the immediate surrounding of the canals traversing it; they measure from 10 or 11 μ up to from 17 to (rarely) over 20 μ in diameter, have from 6 to rarely more than 10 moderately stout rays, which are provided with a well-developed terminal knob covered with minute spines, and exhibit a fairly well-marked centrum, the diameter of which may equal or even slightly exceed the length of the rays. The oxyasters are entirely confined to the choanosome, are usually abundant, and vary in maximum diameter in different specimens from about 30 to slightly upwards of 40 μ; they have from 5 to 9 rays, which are provided over their distal moiety with tubercles, some of which are elongated so that the rays may appear branched.

Loc.—Port Jackson.

Genus TETHYORRHAPHIS.

According to their description, the four species, ascribed by Lendenfeld to this genus, are distinguished both by differences in the shape and degree of development of protuberances on the surface, and by a number of points of difference in spiculation. Thus, in the case of *T. lævis* and *T. gigantea*, the brushes, formed by the skeletal fibres on approaching the surface, are stated to be lacking in the shorter stylote spicules present in the other species; in the same two species and in *T. conulosa*, asters of two kinds, spherasters and chiasters, are mentioned as occurring, but in *T. tuberculata* only chiasters; and the peculiar microscleres characteristic of the genus are described as strongylote in *T. lævis*, simply as "diact" in *T. tuberculata*, and as oxeote in *T. gigantea* and *T. conulosa*. I have examined all available examples (some twenty in number) of the genus, including those labelled as the types of the several species; but I have failed to find any differences among them in spiculation, except as regards the size and relative abundance of the several kinds of microscleres. Considerable diversity, indeed, exists among them in the character of their surface-elevations, these being either few or numerous, and either rounded (varying from wart-shaped to dome-like) or conical (and then sometimes prolonged each into a filament). But the various differences observed are apparently merely the outcome of individual variation.

The labelled specimens, excepting those purporting to represent *T. conulosa* and *T. tuberculata*, are in fair agreement with the description of the species whose name they bear, as regards outward characters, and it is beyond reasonable doubt that they are authentic examples of those species; while among the remaining specimens, there are some which exhibit the external features ascribed to *T. tuberculata*, and others, again, having the surface provided with tapering conical processes, which presumably are to be identified with *T. conulosa*. Accordingly, I look upon Lendenfeld's four species of *Tethyorrhaphis* as representing but a single species, which we may call *Tethyorrhaphis lævis.*

In every respect, *Tethyorrhaphis lævis* resembles a species of *Donatia* except in possessing, in addition to asters, microscleres in the form of small blunt-ended rods (microstrongyles) densely covered with minute spines, and along with these a number of forms variously intermediate between them and chiasters. Asexual propagation, by means of buds, occurs, and in the same way as in *Donatia.* The superficial appearance of the sponge, owing to the absence of any trace of pore-grooves, approaches at times very closely to that of *T. ingalli* var. *lævis*; and, in some cases, microscopical examination is necessary before one can say with certainty to which of the two species a given specimen belongs.

The spicules composing the radial fibres within the choanosome are blunt-pointed, fusiform styli, frequently almost or quite symmetrically ended (*i.e.*, strongyla); their maximum size varies in different specimens from 1850 by 30μ to 2300 by 38μ. Near the surface of the sponge, the fibres expand penicillately, and their fusiform spicules are there largely replaced by shorter, abruptly sharp-pointed, and more cylindrical styli of various lengths down to 280μ or less. Spicules similar to the latter occur also, abundantly, disposed concentrically around the centre from which the fibres radiate, forming a well-marked spherical "nucleus" to the sponge. Between the fibres elsewhere, megascleres are rare or absent. The spherasters are found chiefly in the outer region or the cortex, and in the peripheral layer of the choanosome close beneath the cortex; they are provided with, usually, from 11 to 15 actually countable rays, and vary in their maximum total diameter, in different specimens, from about 50 to 90 μ. It appears to be the rule that, in specimens in which the maximum diameter of the spherasters is less than 70 μ, the rays, for the most part, are shorter than the diameter of the centrum, and frequently are bifurcate at the extremity; whereas when the spicule is of greater diameter than 70 μ, the rays appear usually to be longer than the diameter of the centrum and to be only very rarely forked. The chiasters (which are almost entirely confined to the choanosome) are sometimes abundant, sometimes rather scarce; they usually have from 6 to 10 rays, the surface of which is minutely tuberculate. The diameter of the chiasters that occur in the cortex rarely exceeds 12 or 13 μ, while those within the choanosome range in diameter up to 18 or 20 μ; also, in the case of the smaller chiasters, whether in the cortex or the choanosome, the rays usually are slightly expanded at the tip, whereas the larger ones approach more closely in form to oxyasters, and, in addition, they occasionally exhibit a branching of their rays; there would thus appear to be an incipient differentiation of the chiasters into two forms, tylasters and oxyasters. As intermediates between the chiasters and the microstrongyles, somewhat plesiaster-like forms are commonly met with, in which the rays proceed, not from a common centre, but from a shorter or longer axis, and are usually also reduced in number. In addition to these, triradiate or Y-shaped forms are frequent, as well as bent rods derived from the latter through the loss of one ray. The microstrongyles occur in moderate abundance throughout the entire cortex and are densely aggregated to form a thin layer immediately below the surface; they are also scattered through the choanosome, gradually decreasing in numbers towards the centre of the sponge. They vary from 6 to (rarely) 20 μ in length and up to 3 μ or slightly more in stoutness. In their earliest developmental stages, they have the form of very slender centrotylote amphioxea.

Loc.—Port Jackson.

Familia SOLLASELLIDÆ.

From the description given below, it will be seen that *Sollasella digitata*, the single species on which this family was founded, is unquestionably aberrant, and that it cannot with any justification be retained in the *Axinellidæ*, to which it is generally regarded as belonging. Nor can it be referred to any other of the recognised families as ordinarily defined. In some features, however, it shows a striking similarity to certain *Donatiidæ*. Thus its cortex appears to be exactly similar in character to that of the genera *Donatia* and *Xenospongia*; it further resembles *Xenospongia* and some species of *Donatia* in having inhalant pore-like apertures localised along lines; and, although not possessed of a typically radiate skeleton—being of ramose habit—is provided, externally to the core-region, with a system of fibres which run perpendicularly to the surface, and expand penicillately in the cortex. Accordingly, for the reception of the genus *Sollasella*, either the family *Sollasellidæ* will have to be retained, or the *Donatiidæ* defined in a broader sense; and of the two alternatives, I think the latter has most to recommend it. It is to be noted that, in *Donatia* itself, the skeleton is not completely radiate, since there is present a central core-region in which the spicules have a confused arrangement, and, besides this, the spicules lying between the radial fibres are not always radially directed.

Topsent(47) has referred, to the genus *Sollasella*, the species originally described by him as *Trachya hystrix*. As it now becomes evident that this is a markedly different type of sponge from *S. digitata*, I venture to propose for its reception a new genus, *Pseudotrachya*, to be placed provisionally in the *Axinellidæ*.

SOLLASELLA Lendenfeld.

Donatiidæ(?), typically of ramose habit, with well-developed fibrous cortex and with linearly disposed inhalant openings leading into chones. Microscleres absent. The megascleres are of two kinds—the larger, monactinal (typically subtylostrongyla); the smaller, diactinal (oxea). The skeleton of the interior, consisting chiefly of longitudinal spicule-bundles and variously oriented scattered spicules, is supplemented in the axial region by a reticulation of fibres composed of a sponginous substance, and in the extra-axial region by radiating spicule-fibres, which continue into the cortex.

SOLLASELLA DIGITATA. (Plate xv., figs.1,2; and text-fig.1).

The species is represented by the incomplete type-specimen (Pl. xv., fig 2), by a correctly labelled fragment from the British Museum, and by an entire specimen (Pl. xv., fig.1) from an unknown locality, probably obtained by the "Thetis" Expedition.

External features.—Sponge ramose, stipitate; stalk and branches short, stout and cylindrical, the latter extending upwards and outwards in various directions without anastomosis. Surface even, very sparsely hispid with singly dispersed long spicules that project 2 or 3 mm. beyond it, and conspicuously characterised by a polygonal areolation formed by lines of uniserially disposed, closely approximated, small shallow pits; these pits are terminated below by a microscopically cribriporal membrane, which roofs over an inhalant chone. The oscula are few, scattered, small; they measure up to 2 mm. in diameter. Consistency very firm, dense, and tough. Colour in alcohol brownish.

In one of the specimens (Pl. xv., fig.2), the surface-areolation is generally hexagonal, the areolæ average between 2 and 3 mm. in width, and the pore-pits, which are usually elliptical in outline, measure from 0·2 to 0·5 mm. in their longer diameter. In the other, the type-specimen, the areolæ are, as a rule, much elongated in the longitudinal direction of the branches, but are very variable in length, and measure only 1 to 2 mm. in width; while, at the same time, the pits are comparatively small, being rarely as much as 0·2 mm. in diameter. Neither of the specimens affords any particular justification for Lendenfeld's statement that the polygonal fields (areolæ) are "expressions of the terminations of the surface-tufts of the spicule-bundles"; nor do they at all substantiate his statement that these fields "are divided from each other by sharply defined incisions" unless the word "incisions" is used in a quite unusual sense. The two specimens are of nearly the same height, viz., 120 mm., which is 20 mm. less than the maximum height recorded by Lendenfeld.

Internal structure.—A transverse section across a branch permits three regions to be distinguished with the naked eye: (i.) a pale-coloured external layer, or cortex, which, in different parts of the sponge, varies in width from about 0·8 to 1·5 mm.; (ii.) a deeply brownish-coloured subcortical layer, usually much wider than the cortex, but in width rather variable; and (iii.) a broad axial region or core, also brownish-coloured, distinguishable from (ii.) by reason of its being traversed longitudinally by numerous spicule-strands, the cut ends of which show clearly on the surface of the section. In the figure of the type-specimen (Pl. xv., fig. 2) a branch is seen in longitudinal section, showing the relative extents of these three regions. In this example, however, the subcortical tissue has mainly disappeared owing to maceration (which it undergoes more readily than do the other tissues), and, as a result, a system of fibres, crossing the subcortical layer and passing into the cortex, is brought into view. Owing to these fibres, the cortex cannot be peeled off separately, but, in its removal, drags with it most or all of the underlying layer. In a longitudinal section of a branch, ordinarily, the subcortical region is not recognisable as a layer distinct from the core-region (Lendenfeld includes them both under the term "pulpa'); but the demarcation between the subcortical layer and the cortex is well-pronounced, owing to their difference in colour, and to the presence, immediately beneath the latter, of a narrow zone of lacunæ and canals. Lendenfeld's statement that these lacunæ (and canals) form a "nearly continuous cavity" beneath the cortex, appears to be somewhat exaggerative.

On treatment with a macerating agent, such as caustic potash, the two outer layers of the sponge readily soften and come away, leaving intact the stout core, the thereby exposed surface of which bristles sparsely with long spicules projecting, nearly perpendicularly, 1 to 3 mm. beyond it. The core is very resistant to maceration, but after prolonged treatment, aided by washings with a pipette, it becomes reduced to a reticulation of fibres composed of a substance much resembling spongin, entangled with which, and apparently for the most part independent of it, are numerous indifferently oriented oxea. Many of the apparently free spicules, however, prove, on close scrutiny, to be ensheathed, over portion at least of their length, with a thin layer of spongin continuous with that of the fibres: and the long spicules (subtylostrongyles) which project from the core, are likewise found to be held in position by a partial covering of spongin. The sponginous fibres are not provided with an axial core of longitudinally disposed spicules.

Skeleton.—The skeleton of the axial region consists, in addition to the spongin-reticulation and the irregularly disposed oxea, of ill-defined longitudinal strands of loosely associated oxea and subtylostrongyla. The reticulation of spongin-fibres is exceedingly irregular in pattern, and the fibres themselves are very variable in stoutness and uneven in their outlines. The spongin has a faintly brownish-yellow tint, and is of low refractive index, and is readily stainable.

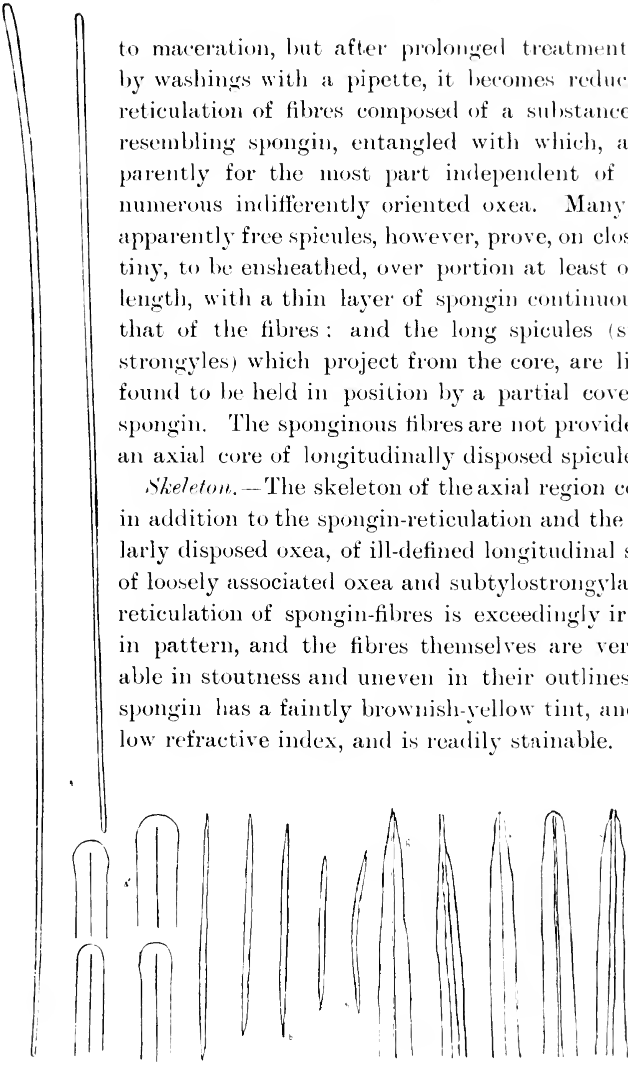

Fig. 1.—*Sollasella digitata.* *a*, Subtylostrongyla. *a'*, Basal extremities of ditto. *b*, Oxea. *b'*, Extremities of oxea.

Immediately surrounding the core-region, and forming the inner limit of the subcortical layer, is a narrow belt of longitudinally disposed spicules, which are chiefly subtylostrongyla. This belt is crossed, at rather wide intervals in a radial direction, by single spongin-fibres, each ensheathing the basal portion of a subtylostrongyle; and immediately external to the belt, the already-mentioned radial fibres, composed of closely packed parallel oxea, take origin, each fibre having, as its axis, one of these radially directed long spicules. The remaining skeleton of the subcortical layer consists of abundant oxea arranged in an irregular, somewhat halichondroid, fashion, even if, for the most part, more or less longitudinally directed.

The radial fibres increase in stoutness on their way across the subcortical layer, and on their arrival at the cortex sometimes exceed 200 μ in diameter. On entering the cortex, each fibre spreads out into a widely divergent brush, the terminal spicules of which project slightly beyond the surface. Apart from the occasional long spicules which project from the surface, these spicule-brushes constitute the entire cortical skeleton.

Spicules.—(*a*) The oxea are very slightly fusiform, mostly straight, and nearly always irregularly ended, very frequently having abrupt, more or less mucronate, sharp points. They vary from about 340 to 760 μ, but are usually between 450 and 650 μ in length, and attain (rarely) to 15 or 16 μ in stoutness. (*b*) The so-called subtylostrongyla are usually only very faintly expanded at the basal end, and often are without any sign of such enlargement; occasionally, however, the phyma is so well developed that the spicule could be called a tylostrongyle. They are nearly always quite straight, taper slightly from base to apex, and vary from (rarely) less than 2 mm. to upwards of 4 mm. in length, and from 10 to 35 μ in diameter measured just above the base. Among the slenderest spicules, there are some which are gradually sharp-pointed at the apex, *i.e.*, are subtylostyli.

Histology. Rounded cells, about 12 μ in diameter, containing brownish granules, occur abundantly in all parts excepting the cortex. The flagellated chambers are confined to the axial region of the sponge, and are of rounded shape, measuring about 25 μ in diameter. The cortex consists of a dense fibrous tissue, resembling that of the cortex of *Donatia.*

Familia SPIRASTRELLIDÆ.

Of the five species of *Spirastrellidæ* described in the Catalogue, one, *Papillina panis*, is a *Spirastrella*, identical partly with *S. papillosa* R. and D., and partly with *S. papillosa* var. *porosa* Dendy; two, *Spirastrella australis* and *Papillina ramulosa*, are, in virtue of their outward form and spiculation, likewise referable to *Spirastrella*, yet exhibit a character apparently not possessed by any other species of the genus; and the remaining two, *Raphyrus hixonii* and *Papillissa lutea*, belong to the genus *Cliona (sens. ampl.)*. Vosmaer recently(**50**), after a comprehensive study of the genus *Spirastrella* based on numerous specimens, including the types of many of its described species, has expressed the opinion that, of the thirty-four (excluding the insufficiently described) species known to him, which are referable to this genus, all but two are to be regarded as no more than forms or "tropi" of a single species, *S. purpurea*. Of the three species of *Spirastrella* indicated above, *S. australis* was dismissed by Vosmaer as insufficiently described to admit of an opinion regarding it, and *S. ramulosa* (probably thought by him to be a species of *Cliona*) he does not mention; while *S. papillosa* (more especially its variety *porosa*), although taken into account by him, seems not to have received due consideration. Accordingly, in dealing with these species, even while not intending to furnish a detailed description of them in this paper, it seemed to me necessary that I should attempt to determine, if possible, whether they admitted or not of being specifically distinguished from *S. purpurea (sens. ampl.)*. At the outset, little hope was felt of arriving at a definite conclusion, inasmuch as Vosmaer allows, in the case of this species, exceedingly wide variation in almost every character that can be utilised for species-differentiation; but though it was found impossible to come to a decision regarding *S. papillosa*, it very soon became evident that *S. australis* and *S. ramulosa* are species quite of a distinct kind; and, indeed, it is only provisionally that I refer them to the genus.

The peculiar and distinctive feature of these two species is their possession of a skeleton consisting in part of a system of exceedingly stout "fibres" which remain intact when the sponge is macerated by means of caustic potash, and which consist of closely packed spicules held together by what appears to be a kind of connective tissue. A skeleton of similar nature, though of very different conformation, is possessed also by *Cliona hixonii*; but I have so far met with nothing of a like kind in any other of the species of *Spirastrella* that I have examined, nor has such a skeleton been mentioned by Vosmaer.* It would seem not unlikely, therefore, that *S. australis* and *S. ramulosa* are more closely related to *Cliona* than to *Spirastrella*; and the question arises as to what particular features are to be regarded as essentially distinguishing the two genera. To this question, I do not think a satisfactory answer can, at present, be given. The distinction recognised by Vosmaer is summed up in his statement that, "whereas the latter (*Cliona*) begins its post-larval life by boring into calcareous matter, *Spirastrella* never does so"; but although this may ultimately prove of value as a basis for separating the two genera, the fact remains that the life-history of most of the species included in the genus *Spirastrella* is as yet unknown to us. At present, the practical difficulty which presents itself is how to determine, in a given case, whether a massive sponge seemingly a *Spirastrella* has or has not been in early life a boring sponge; and in striking illustration of this, is the fact that Vosmaer himself has confounded with *Spirastrella purpurea* a species that undoubtedly should be referred to *Cliona*. I refer to *Spirastrella areolata* Dendy, which in the areolation of its surface and in its possession of spined microxea (apparently overlooked by Vosmaer) shows so close an analogy with *Cliona hixonii* as to render unquestionable the close relationship of the two. There is a number of species also - unreferred to by Vosmaer—concerning which it is an entirely open

* I think it is exceedingly probable, however, that *Spirastrella robusta* (Carter) Dendy(14)—which was regarded by Carter as a variety of *Spirastrella cuncatrix*—will be found to possess an analogous type of skeleton. I have seen only a thin section of this sponge—one presented to the Australian Museum by Prof. Dendy—and although this is insufficient to provide unmistakable evidence of the presence of such "fibres," nevertheless the structure of the skeleton, as displayed therein, exhibits, on the whole, a marked similarity to that of *S. australis*.

question whether they belong to *Spirastrella* or *Cliona*; one may mention, for example, *Cliona phallica* Leidy(**25**), and several species described by Verrill(**49**), viz., *Heterocliona cribraria*, *Spirastrella mollis*, and apparently also *Polymastia varia*.

Having examined an undoubted example of *Spirastrella fibrosa* Dendy(**14**), from the type-locality, I agree with Vosmaer that this species does not belong to *Spirastrella*; I find it to be congeneric with the species described by me(**15**) under the name *Latrunculia conulosa*.

Spirastrella australis. (Pl. xv., fig.5; Pl. xvii., fig.3).

The species is well represented in the collection, both by a number of the original specimens and by others more recently obtained; among the latter, there is a single small one which differs from the rest in being of submassive form. The chief distinguishing characters of the species are its typically compressed plate-like form, its smooth and even surface without tubercles or papillæ, and the density and compactness of its substance; in addition to these, but becoming manifest only when the sponge has been macerated, is the reticulation of stout cord-like "fibres" forming the main skeleton. An adequate idea of the conformation of this skeleton may be obtained from the figure (Pl. xvii., fig.3). Apart from being lamellar, the sponge is without definite habit; occasional specimens are more or less regularly flabelliform. Contrary to the description, apparently in no case do oscula occur on either of the flattened surfaces of the sponge, but only along its margin; and these are of minute size. Lendenfeld's description of the canal-system, also, appears to me to be quite without value.

In thin sections cut transversely through the entire thickness of the sponge, the naked eye can distinguish (i.) a less compact middle region within which are denser areas corresponding to transected "fibres," and, on either side of this, (ii.) a more compact superficial layer of mottled appearance (because not uniformly dense), which extends to the surface and has a width of 1-2 mm. Under the microscope, the demarcation between these regions is indistinct, and what difference there is, in their appearance, seems mainly to be due to differences in the closeness of aggregation of the spicules, and particularly of the microscleres, the abundance of which, throughout all parts of the sponge, constitutes a marked characteristic of the species.

The tylostyli are straight non-fusiform spicules, very gradually tapering throughout the greater part of their length, and, as a rule, terminating in a sharp point; their length ranges from (rarely) less than 390 μ to 610 μ, while the stoutest of them are 11 μ or 12 μ in diameter. The spirasters are separable into two groups: (i.) those which occur in great abundance throughout the whole interior, and (ii.) those which are almost exclusively confined to a very thin superficial layer of the sponge. The former are stout, with a straight axis, and with close-set large spines, which are not uncommonly as much as 20 μ in length, and are frequently more or less curved in the manner of a rose-thorn; inclusive of spines, these spicules measure 35 μ to 60 μ in length, by 30 μ to 55 μ in breadth. The spirasters of the second group, which are usually of much smaller size than the preceding, are very variable in form, and perhaps are divisible into several kinds; of chief importance concerning them, however, is the fact that they include forms much resembling the "lophasters" of *Timea lophastræa* Hentschel(**19**), as well as forms intermediate between such and spirasters of more typical shape.

Loc.—Port Jackson.

Papillina panis.

In connection with this species, a difficulty presents itself which, in spite of the fact that over a dozen specimens (all labelled as *Papillina panis* by Lendenfeld) are at hand, cannot be solved until additional material is forthcoming. The specimens, while extremely alike in all other essential respects, are in some cases provided with small oscula, in others instead with one or several sieve-areas; in no observed instance do both oscula and sieve-areas occur in the same specimen. So far as I can see, if there is another difference between the two forms, it lies in this, that, generally speaking, the oscula-bearing specimens are rather of conical or wedge-shaped form, while the sieve-bearing specimens are low and broad, or (less frequently) more or less compressed into plate-like form, and have a flattened upper surface. In both forms, the oscula or the sieve-areas, as the case may be, occur on the upper aspect of the sponge. There can scarcely be any doubt that the form with oscula is identical with *Spirastrella papillosa* Ridley and Dendy, although the oscula are very much smaller than in the type of that species; while it is equally certain that the form with sieve-areas is identical with *S. papillosa* var. *porosa* Dendy(**14**) from Port Phillip. What I cannot decide is whether we have to do with a single form or with two distinct forms.

The sieve-areas, which measure several square inches each in extent, are free from the tubercles that occur in other parts of the surface, and are usually slightly depressed below the level of the surrounding surface; they are perforated by close-set circular pores (measuring from 75 μ to 160 μ in diameter, and between 100 μ and 200 μ in distance apart), and thus present an appearance very much resembling that of the pore-bearing surface of certain polyporaceous fungi (e.g., *Polystictus*). Possibly it is to these sieve-areas that Lendenfeld refers, when he speaks of "movable membranes" by which "for the most part" the "vents" are covered; but it is strange that he makes no reference to their perforate or sieve-like character. The "perforated membranes," or "inhalant pore-sieves," which he mentions as occupying the depressions between the papillæ, are different, and correspond to what is described by Dendy (*loc. cit.*) as a "beautiful pore-bearing membrane" stretched between the "conuli." This membrane has a minutely reticulate appearance, which, in some specimens, is very distinct, in others scarcely perceptible; but it is not, to the naked eye or even with the aid of a lens, "perforate" or "porous" in the sense of "sieve-like."

As far as I know, oscular sieve-areas in the genus *Spirastrella* have been observed only in *S. papillosa* var. *porosa*. Vosmaer makes no mention of the occurrence of anything of the kind in any of the numerous forms of *Spirastrella* studied by him; nor, by the way, does he comment upon their occurrence in *S. papillosa* var. *porosa*—an omission difficult to account for, since he quotes this sponge in support of his reasons for regarding *S. papillosa* and *S. cunctatrix* as identical. There is good reason to believe, therefore, that *S. papillosa* var. *porosa*—even though it should prove to be merely a variant of *S. papillosa* – belongs to a species quite distinct from any other that Vosmaer would include under *S. purpurea*: as we have yet no proof that it and *S. papillosa* are connected by intermediate forms, and as the distinction between the two seems so definite, I am inclined to regard it as at least an independent variety.

Seeing that Vosmaer considers that no importance can be attached to the presence or absence of papillæ as an indication of specific difference, I may mention that every specimen of *S. papillosa* and of its variety I have seen, is not only provided with papillæ, but these always have the same characteristic appearance, and are always distributed over all parts of the surface except in the neighbourhood of the oscula or upon the sieve-areas. There may be considerable variability in the degree of development of these papillæ as regards their size, but scarcely any as regards their relative number; when least pronounced, they resemble those of the specimen figured by Vosmaer (Pl.iii., fig.5). Besides *S. papillosa*, I am acquainted with at least five that I believe to be quite distinct species of *Spirastrella*, and, in the matter of papillæ, no specimen of these makes any approach to *S. papillosa*.

The character of the papillæ in *S. papillosa* is such as to suggest that they are morphologically related to the papillæ and areolæ of *Cliona* (*Papillissa*) *lutea* and its allies; because of this, I am inclined to attach importance to the fact that, in many specimens, both of *S. papillosa* and of its variety, I have found incorporated, pieces of shell and other calcareous fragments which, in every case, showed the characteristic perforations due to a boring sponge.

It remains to be mentioned that, in connection with the two figures given in the "Catalogue"(Pl. i., figs.1-2), which purport to be in illustration of *Papillina panis*, a serious mistake has been made: the first is unmistakably a figure of *Cliona* (*Papillissa*) *lutea*, and the second is one of *Spirastrella*(?) *ramulosa*.

PAPILLINA RAMULOSA. (Pl. xxii., fig.5).

In addition to the type-specimens, five in number and well-preserved, another example of the species (correctly labelled) is included among the fragments received from the British Museum.

As I already have had occasion to mention, a figure of a specimen of *Spirastrella*(?) *ramulosa* is given in the Catalogue (Pl. i., fig.2), but is wrongly indicated as being one of *Papillina panis*. In regard to the external features of the species, the original description may stand without amendment, except in one particular: the small circular openings scattered over the surface are not oscula, as Lendenfeld has stated, but simply holes due to the presence, here and there beneath the surface, of symbiotic operculate Cirripedes. These openings, then, are of the same nature as those which Lendenfeld also described as oscula in the case of *Cliona lutea*. In view of such an error, indicative as it is of extremely superficial and hasty observation, one need scarcely remark how little is the value to be attached to the statements concerning the minuter details of the canal-system. As in *S. australis*, the whole interior of the sponge, quite to the surface, is very dense, and canals are few and of small size. The largest canals, which run in an ascending direction, are usually very much less than 1 mm. in diameter; they are always easily traceable to immediately beneath the surface of the upper parts of the sponge, and some of them, at least, can be seen to terminate in very minute oscula.

The peculiar "fibres" composing the main skeleton, as revealed in a macerated specimen, are arranged dendritically; owing to their mode of branching, they exhibit a tendency to become restricted in their disposition to a limited number of vertical planes of branching, or, in other words, to be arranged in flabellate systems. They are from more or less strap-shaped to cylindrical, and (in the only specimen in which they were examined, one measuring 120 mm. in height) measure about 1 mm. in stoutness at the base of the sponge, and about 0·5 mm. at its top. Anastomosis between the "fibres" occurs, but it is not very frequent, except in the older portions of the sponge.

Between the "fibres," megascleres are scattered in profusion and without apparent order. Spirasters likewise occur in all parts, but only in moderate abundance (as compared with those of *S. australis*) except at the surface, where they form a dense layer varying in width from about 100 μ to 450 μ.

The tylostyli are typically straight, and are usually more or less rounded off at the apex, so as occasionally to resemble tylostrongyla; the largest vary in length, in different specimens, from 440 μ to 560 μ and are about 11 μ in diameter. The spirasters are roughly divisible into two groups: (i.) those of larger size and more regular and typical form, provided with large spines, which comprise the majority of the microscleres scattered throughout the interior of the sponge; and (ii.) those of smaller size and variable form, with comparatively small spines, which chiefly compose the dermal crust. The largest of the former measure 45 by 8 μ, exclusive of spines; and their spines are, at most, 12 μ in length.

Remarks.—I have carefully examined many of the Cirripede-shells that occur in the specimens of this species, but in no case have I been able to detect (as in *Cliona lutea*) any sign of their perforation by the sponge.

Loc.—Port Jackson.

RAPHYRUS HIXONII. (Pl. xvi., figs. 1, 2).

This species, so far known only in the free or raphyroid stage, is conspicuously characterised by a beautifully regular areolation of the surface (Pl. xvi., fig. 1), the areolæ being circular in outline, of diameter varying (gradually) over different parts of the surface from 3 to 6 μ, and placed at intervals apart of from 2 to 3·5 μ: the pattern of the areolation, when viewed from a distance, consequently appears hexagonal. Judging from the material at my disposal, which consists of some half-dozen large pieces of the original specimens (including the piece figured by Lendenfeld), and a small complete specimen obtained recently, the areolæ—except rarely and apparently abnormally—are situate on a level with the general surface, and are distinguishable to the eye only by reason of their difference in colour from the intervening areas;

only over a limited portion of the surface of one specimen are the areolæ at all depressed and pit-like. Accordingly, in conveying the impression that the reticulation of the surface is produced entirely by a "network . . . . of projecting lines" with "polygonal meshes" in which are "depressions about 4 or 5 mm. deep," the original description is quite misleading: one can see, indeed, from the figure in the "Catalogue" (Pl. i., fig.3) how free from any pitted appearance is the portion of the surface therein shown.

The description is inaccurate also in several statements regarding the excurrent canal-system. We are told that vents are scattered over the surface and lead into short conic tubes, which are not oscula but præoscula: that these "short" (*sic*) tubes, which in the case of the original specimen are "nine in number and measure 250 mm. long by 20 mm. wide at the mouth," have their walls covered throughout by a reticulation similar to that of the exterior surface; and that proper oscula, 2 to 10 mm. in diameter, are scattered over the whole surface including the sides of the conic tubes. After the most careful examination of the several specimens, I can find no reason to doubt (what, even at first sight, seemed most probable) that all the tubes referred to, including those leading from the so-called oscula, are nothing more than excavations made by crustaceans and other boring organisms, a considerable number of which are still present in most of the tubes; it is significant, also, that many of the smaller tubes are entirely filled with sand and mud. The tubular excavations are everywhere lined with a dense tough rind, often exceeding 1 mm. in thickness, composed almost entirely of closely packed megascleres; on no part of their wall, have I seen any trace of areolation.

If the soft tissues be removed by means of a macerating agent, there remain (Pl. xv., fig.2) finally (i.) the rind-like cortical layer forming the outer surface; (ii.) the rind which lines the abovementioned cavities; and (iii.) extending through the whole interior, a coarse network of somewhat flattened or strap-shaped trabeculæ, similarly constituted to the "fibres" of *Spirastrella australis* and *Spirastrella*(?) *ramulosa*, which are ordinarily 0·5 mm. to 1 mm. broad, and enclose meshes, on the average, several millimètres in width. In reference to the pattern of this network, I need only mention here that, in the peripheral layer of the sponge, to a considerable distance below the surface, the trabeculæ are so arranged as to form incomplete boundaries between elongated "cells," the outer ends of which correspond in position with the areolæ of the surface, and the disposition of which, relatively to one another and to the exterior, is exactly similar to that of the cells of a honeycomb. In the case of the small specimen before me, the trabeculæ forming these cells still retain their separate individuality, thus enabling one clearly to distinguish between (i.) main ones, relatively few in number, running in the longitudinal direction of the cells, *i.e.*, perpendicularly to the surface, and (ii.) more numerous transverse or connecting ones; but in the large (and older) specimens, presumably as the result of the increase in width and gradual concrescence of the trabeculæ, and of the consequent reduction (even to the point of complete obliteration) of the intervening meshes, the condition is such that the cells are divided from one another by almost or quite comp'ete partitions, and thus bear a structural likeness to the cells of honeycomb, which is almost perfect.

The cortical rind, which is of very firm, dense, and fairly tough consistency, varies in thickness, in the different parts of the surface, from about 0·5 mm. to upwards of 1 mm. In the macerated sponge, it separates from the underlying skeleton with the greatest ease, and is then seen to be not less thick, or scarcely less thick, at the position of the areolæ than elsewhere; accordingly, the original description seems again to be at variance with fact, when it speaks of "membranes which extend in the meshes of the surface-network," and mentions, further, that these membranes have "groups of small pores" situated in them and are "very thin and delicate." The skeleton of the cortex, apart from a thin external layer of microscleres (of the two non-oxeote kinds) consists of closely packed tylostyles, the most superficially situated of which are disposed vertically to the surface; within the circular meshes or areolæ, the skeleton is much less dense, and the cortex is, consequently, much softer than in the intervals between.

Spicules. - The tylostyli are straight or nearly so, gradually sharp-pointed, and of approximately uniform diameter throughout more than three-fourths of their length; are usually provided with a phyma of moderately large size, which is of very variable shape, and is frequently asymmetrical and misshapen; and measure from 330 to 450 μ in length by 12·5 μ, at most, in diameter. Styli, of similar dimensions, occur, but are comparatively rare. The microscleres are of three kinds: (i.) spirasters of variable form; frequently with a straight or nearly straight axis; with usually more or less radially disposed, not numerous, spines, the length of which is not greater than the diameter of the spicule; rarely more than 30 μ long; and in different specimens varying in maximum diameter from 5 to 7 μ, exclusive of spines. (ii.) Minutely and closely spined, generally straight, truncately-ended rods; 7 to 19 μ in length; and seldom more than 3 μ in diameter, inclusive of spines. (iii.) Sharp-pointed slender acanthoxea; with a not very pronounced, elongate, median, spiral flexure of usually less than one complete turn; with linearly and usually spirally arranged, sharp, slender spines, the length of which sometimes exceeds the diameter of the spicules; varying in length from 55 to 110 μ; and rarely more than 2·5 μ in diameter.

Loc.—Port Jackson.

Remarks.—I regard this species, provisionally, as belonging to a subgenus of *Cliona*, having as its type *Papillissa lutea* Lendf., and including *Spirastrella areolata* Dendy(**14**).

Very closely allied to *Cliona hixonii*—although to be regarded, I think, as a quite distinct species - is another large sponge from Port Jackson (represented in the Australian Museum by a single specimen), in which (Pl. xvi., figs.3, 4), instead of a simple areolation of the surface, there are low papillæ of very uniform size, shape, and distribution, and more widely separated from one another than the areolæ of *C. hixonii*; and in which, also, the microscleres corresponding to those termed by me spirasters in the above description, are comparatively short and stout, and provided with close-set, fairly large spines that often show a tendency to assume a whorled arrangement.

Topsent(46), in describing *Cliona celata*, has drawn attention to a number of points of resemblance between it and *C. hixonii*, and expresses the opinion that "un rapprochement entre les deux espèces est tout indiqué." The additional information which I have furnished concerning the microscleres of the latter, shows, however, that there is not such a close analogy between the spiculation of *C. celata* and that of *C. hixonii* as Topsent supposed, and particularly is it questionable whether the oxea "lisses, acérés aux deux bouts, légèrement courbés, très fins" of the former are homologous with the acanthoxea of the latter.

In their possession of a vestigial spiral flexure, and of spines linearly and in some degree spirally disposed, the acanthoxea of *C. hixonii*, as well as those of the next-described species (*C. lutea*),* exhibit characters which render it practically certain that they are derivatives of spirasters. They are, thus, quite unlike the acanthoxea of such species as *C. vastifica* Hancock, *C. stationis* Nassanow, and *C. velans* Hentschel, which are quite devoid of any sign of spirality, which are provided with numerous very minute uniformly distributed spines, and which frequently exhibit a centrotylosis: the latter spicules, indeed, are regarded by Topsent as belonging to the category of megascleres. I consider it exceedingly probable, therefore, that acanthoxea have originated in the genus *Cliona* in two independent ways: and it is possible that those of *C. vastifica*, etc., are derived from smooth oxea such as do occur in some species of *Cliona*, and which perhaps are of common origin with the tylostyli.

Papillissa lutea. (Pl. xviii., figs.1, 2)

Though I do not doubt that the several specimens labelled *Papillissa lutea*, in Lendenfeld's handwriting, are genuine examples of the species, I am at a loss to account for the absence of any reference in his description to the fact that they are

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* In *Cliona areolata* (formerly known as *Spirastrella areolata*) also, of which species I have seen a mounted section presented to the Australian Museum by Professor Dendy, the acanthoxea are undoubtedly spiraster-derivatives; and, in the case of *C. margaritifera* Dendy(15), an actual transition between acanthoxea and spirasters has been recorded.

almost completely packed throughout with the shells of operculate Cirripedes, and I cannot understand how, under the circum stance, Lendenfeld was able to speak with confidence concerning the arrangement of the canals. One can only assume that he looked upon the inclusion of the shells as fortuitous, and on that account scarcely worthy of mention, and that his opinion regarding the canal-system was arrived at by inference rather than actual investigation. The most considerable mistake, however, made by Lendenfeld in connection with this species, lies in the fact that a specimen of it has been figured by him in the Catalogue (Pl. i., fig.1) as *Papillina panis.*

In agreement with the description of the species, the type-specimens are massive, irregular, more or less laterally expanded (*i.e.*, depressed) sponges of moderate size, are covered with papillæ (of variable size and distribution), are of a yellowish-white colour in spirits, and (in some cases) exhibit circular oscula-like openings scattered irregularly over the surface. Lendenfeld says of these openings, or "vents" as he terms them, that they are not true oscula, but "lead into a system of vestibular lacunæ which occupies the interior of the sponge": in view of the fact that, in almost all other respects, the specimens afford practically indisputable evidence of their identity with *Papillissa lutea*, I venture to say that, as regards the nature of the "vents," Lendenfeld was entirely in error. In every case, I have found that these openings are situated each immediately above the orifice of an inhabited Cirripede-shell; and it is clear that they are simply the means whereby the crustaceans maintained communication with the exterior. All indications point to the fact that, with continued growth of the sponge, these openings gradually become closed over and finally disappear from external view.* It is

* At the time of writing the above, I was inclined to attach some importance to the presence of these Cirripedes, thinking it likely that the case was one of regular symbiosis; but I have since observed sporadic occurrences of a similar association in various species. Owing to the abundance of these shells in the specimens, I have not been able to determine, with certainty, whether *C. lutea* possesses anything analogous to the trabecular skeleton of *C. hixonii* or not.

interesting to note that many of the shells, even in the upper part of the sponge, are penetrated by tubular excavations similar in nature to those produced by other species of *Cliona.*

Spicules.—The tylostyli are straight or nearly so, gradually sharp-pointed, and of nearly uniform diameter throughout three-fourths or more of their length; they are provided with a rather large phyma of variable but usually symmetrical shape, which is often surmounted by a smaller dome; and they measure from about 300 to 490 μ in length by 13 μ in maximum diameter. Occasional styli of the same dimensions are met with. The microscleres are of three kinds: (i.) spirasters, of variable form; usually with a nearly straight axis; provided with spines of medium length, rarely exceeding the diameter of the spicule, and more or less spirally disposed; rarely less than 25 or more than 45 μ in length; and measuring up to 6 μ in stoutness, exclusive of spines. (ii.) Cylindrical, slightly undulating or spiral, truncately-ended, very minutely and closely spined rods; seldom less than 10 μ or more then 30 μ in length; and rarely exceeding 3 μ in diameter, exclusive of spines. (iii.) Spined microxea; similar to those of *Cliona hixoni*; 55 to 110 μ in length.

Loc.—Port Jackson.

Remarks.—For reasons indicated in my remarks on *Cliona hixoni*, I propose that *Papillissa* be provisionally retained as a subgenus of *Cliona.*

Familia SUBERITIDÆ.

In addition to *Plectodendron elegans*, dealt with below, there is described in the Catalogue, under this family, a species, recorded from Port Jackson and the South Coast of Australia, to which Lendenfeld attached the name *Suberites domuncula* Nardo. The identity of this sponge, I have been unable to determine. A specimen labelled, in Lendenfeld's handwriting, "*Suberites domuncula*, Port Jackson," is preserved in the Australian Museum, and a fragment of a specimen, bearing the same name and locality, has been received from the British Museum; but these agree neither with the description given nor with one another,—although both, however, are examples of species of *Suberites*, and both exhibit much the same pattern of skeleton as that apparently of the species described. For one thing, their spicules are too large, —the maximum sizes of these, in the two cases, being respectively 800 by 14 μ and 1040 by 19 μ, as against 700 by 8 μ, the size stated by Lendenfeld ; and in addition to this, the spicules of the second (*i.e.*, the British Museum) specimen are *not* "constricted below the bulb," and are almost as frequently *rounded off* at the apex as they are "sharp-pointed," while those of the first-mentioned, although actually narrowed towards the base and gradually sharp-pointed at the apex, are characterised, not by a "spherical bulb," but by one, the surface of which, as a rule, is uneven and somewhat tuberculate. Lendenfeld also states, concerning the spicules, that "the bulb is situated a little below the termination : the truncate end of the spicule appears as a slight centrally situated excrescence of the bulb" ; but in neither of the specimens do the spicules exhibit such a peculiarity, save exceptionally.

Nevertheless, in view of the frequently only rough approximation to accuracy of the measurements and descriptions of spicules given in the Catalogue, I should, perhaps, have been disposed to regard the Australian Museum specimen as a genuine example of the species, but for the fact that it also fails to comply with the description in certain additional respects. The description states that the sponge "always forms the abode of a crab" ; that the largest Australian specimens measure only 35mm. in breadth and 15mm. in height ; and that the main exhalant canals, 1mm. wide, "are not rare in the interior and pour their contents into the wide and short oscular tube." On the other hand, the specimen is merely borne loosely (in the form of a thick concave plate) upon the back of a crab ; measures 60mm. long by 45mm. broad ; and is without apparent oscula or canals visible to the naked eye. This specimen is apparently of the same species as one in the British Museum labelled "*Suberites lamella*, Port Jackson."

There is also included, among the fragments received from the British Museum, a tiny piece labelled "*Suberitella laxa*, Port Jackson," the spicules of which correspond to the description of those of the so-called *Suberites domuncula* exactly in every way, excepting that they never attain to more than 300 μ in length. It would be interesting to know whether this sponge agrees with the description of the species in question in other respects: if it does, one would be justified, I think, in identifying the latter (as recorded from Port Jackson) with it.

PLECTODENDRON ELEGANS. (Pl. xviii., fig.1).

In the pattern of its skeleton and the form of its spicules, *Plectodendron elegans* bears an almost exact resemblance to a species, represented in the Australian Museum by two specimens from N.W. Australia, which I unhesitatingly identify as *Caulospongia verticillata* Kent(**22**); as the two species are congeneric, and each is the type of its genus, *Plectodendron* is, consequently, a synonym of *Caulospongia*. Kent described also, from an unknown locality, *Caulospongia plicata;* and Bowerbank (**3a**) described, at a later date, as new, from Western Australia, *Chalina verticillata;*—both of which species appear to me to be identical with *Caulospongia verticillata*. In spite of these several descriptions of its type-species, the genus *Caulospongia*, for some reason, never gained recognition, and since the time of its erection (1871) has apparently received no other mention than that by Vosmaer(**50**), who lists it among the genera, the systematic position of which "absolut unsicher oder unbekannt ist," and that by Topsent(**46**), who quotes it as a synonym of *Semisuberites* Carter(**4**); but for this identification, there appears to be no foundation.

The main skeleton, in the several species of *Caulospongia* known to me, is a very irregular, small-meshed reticulation of spicules and spiculo-spongin fibres, some of which fibres are stout and densely multi-spicular: the pattern of the skeleton is such that, if the stouter fibres were absent, one might describe it as confusedly renieroid. In *C. elegans*, spongin is barely more than sufficient in quantity to bind the spicules together; but in another (undescribed) species, it is developed fairly abundantly and forms a well-defined sheath to all but the slenderest fibres. The spicules are of a single kind, and of characteristic form; they are tylostyli with a much depressed phyma, which makes them appear nail-shaped. Of the dermal skeleton of *C. verticillata* I cannot speak, since both specimens at my disposal have the surface completely abraded; but in *C. elegans*, and in the undescribed species, (which comes from the south coast of Australia, and in habit somewhat resembles *C. elegans*), there is a well-defined dermal membrane containing tangential, reticulately-arranged spicules and provided also with slightly projecting spicules directed vertically. The dermal membrane of *C. elegans* is thin and translucent; that of the undescribed species is much more densely charged with spicules, and, in the dry sponge, appears as a well-marked, easily separable, whitish pellicle.

This combination of characters, to which might be added the non-massive external form of the sponge(Pl.xviii., fig.1), definitely distinguishes *Caulospongia* from any other genus of the *Suberitidæ*. Indeed, owing to the considerable degree of development of spongin, it is somewhat doubtful whether the genus really is related to the *Suberitidæ*, although in *Laxosuberites*, spongin, in small amount, is said to occur.

Lendenfeld's description of *C. elegans* is, in the main, correct, and is sufficient to enable the species to be identified: in the type-specimens, the spicules measure from (rarely) less than 140 μ to 220 μ in length, and attain 11 μ in diameter

Loc.—Port Jackson.

Familia CHONDROSIDÆ.

CHONDROSIA COLLECTRIX.

Introductory.—The type-specimen, allowance being made for its being only a portion of the original, is consistent in every way with the description except as regards colour, and perhaps also certain features of the canal-system—more especially those involved in the statement that "subdermal cavities are found in the shape of tangentially extended canals 0·2 mm. below the surface, which are, on an average, 0·17mm. wide, and connected with inhalant pores on the outer surface by straight or curved canals, 0·024mm. in diameter." The presence of these subdermal spaces, canals, and pores, I have been unable to demonstrate; but the sponge is so loaded with foreign matter, including abundant and often large sand-grains, that thin sections are possible only after prolonged desilicidation, and it is then very difficult to distinguish between spaces proper to the sponge and those due to particles removed. I have found another (apparent) example of the species, however, which, throughout considerable portions of the interior, is comparatively free from inclusions: and this differs from the type-specimen in other respects also. It has been described by Whitelegge(56) under the name *Reniera collectrix*, of which species it is labelled as the type; for the reasons given below, I am of opinion that it is correctly labelled so, and accordingly hold *Chondrosia collectrix* and *Reniera collectrix* to be synonymous.

Description.—The sponge is provided with a thin cortex, not easily separable nor distinctly marked off from the underlying tissue, which is of a pale greyish or dirty-white colour, and generally about 0·2 or 0·3mm. in thickness. In the type-specimen of *Reniera collectrix*, the colour of the choanosome, where not disguised by foreign inclusions, is brownish-yellow, and this is in accordance with Lendenfeld's statement regarding the internal colour of *Chondrosia collectrix;* but in the type-specimen of the latter species, the colour is greyish, and scarcely different from that of the cortex. The two specimens also differ very considerably in consistency. The former, where most free from inclusions, is dense, fleshy, firm, and fairly tough; but the latter, owing to the abundance and mainly arenaceous nature of the foreign elements, is, for the most part, hard and gritty. The "slightly conulated" appearance of portions of the surface, referred to by Lendenfeld, is merely an unevenness due to the presence, close below the cortex, of occasional, rather large grains of sand, etc.; what other inequalities of the surface there are, appear to be the result rather of irregularity of growth than of any definite tendency or habit of growth. Oscula, or openings resembling oscula, were observed only in the complete specimen; they are situated in two small groups, and in each group are closely arranged, and of variable diameter up to 2·5mm. The canals traversing the sponge are comparatively few in proportion to its mass, and at most only about 1mm. in diameter.

(The following brief account of the minute anatomy is intended mainly only as a guide to the identification of the species. A fuller description is necessary, but is scarcely possible with the material at my disposal, the condition of preservation of which, after nearly thirty years in spirit, leaves much to be desired.).

The cortex is without fibrous tissue, and consists of a kind of chondrenchyma. The mesoglœa is very extensively developed and characterised by a peculiar vesicular structure due to numerous very distinctly outlined, apparently empty, oval cells (cystencytes), which are arranged in clusters rather than uniformly distributed, and measure 15 μ to 20 μ in diameter. There is no proper skeleton, nor anything of the nature of connective tissue fibres. The chamber-system appears to be eurypylous. The flagellated chambers vary in shape, from oval to nearly spherical; in the type-specimen, presumably owing to contraction, they are very seldom much more than 30 μ (yet may attain to 40 μ) in diameter; but in the other specimen (*Reniera collectrix*), they are usually between 35 and 40 μ in diameter, while a certain few, which are more elongated and relatively narrower than the others, measure 45 by 30 to 35 μ. Inside most (if not all) of the smaller canals, lying in contact with, or in close proximity to, their wall, there occur a variable number of irregularly rounded cells, measuring 10 to 12 μ in diameter; the nature of these is not clear, but possibly they are algæ.

Loc.—Port Jackson.

Remarks.—Whether the species belongs naturally to *Chondrosia*, is doubtful; but it conforms more closely to the definition of that genus than of any other, and there is scarcely sufficient ground to warrant the introduction of a new genus for it.

It is quite possible that the differences between the two specimens described may prove to be specific.

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EXPLANATION OF PLATES XV.-XXIV.

Plate xv.

Fig. 1.—*Sollasella digitata* Lendenfeld; ($\times \frac{2}{3}$).

Fig. 2.—*Sollasella digitata* Lendenfeld, from the type; ($\times \frac{2}{3}$).

Fig. 3.—*Donatia fissurata* Lendenfeld; (slightly reduced).

Fig. 4.—*Donatia phillipensis* Lendenfeld; surface-section showing the dermal reticulation, the primary meshes of which are subdivided (by lines of tylasters) into smaller meshes, each enclosing a pore; ($\times 18$).

Fig. 5.—*Spirastrella*(?) *australis* Lendenfeld; a flabellate example; ($\times \frac{1}{2}$).

Fig. 6.—*Polymastia zitteli*, from the type of *Sideroderma zittelii* Lendenfeld; (nearly nat. size). The specimen is in a fragmentary condition.

Plate xvi.

Fig. 1.—*Cliona* (*Papillissa*) *hixoni*, from the type of *Raphyrus hixonii* Lendenfeld; portion of the exterior, showing the character of the surface-areolation; ($\times \frac{3}{4}$).

Fig. 2.—*Cliona* (*Papillissa*) *hixoni*; showing the skeleton (after maceration by means of caustic potash) of a thick slice of a small specimen; (nat. size).

Figs.3-4.—*Cliona* (*Papillissa*) sp., allied to *Cliona hixonii*; portions of the concave and convex surfaces respectively of a specimen having the form of a thick, curved plate, showing the character and arrangement of the surface-papillæ; ($\times \frac{3}{4}$).

Plate xvii.

Figs.1, 2.—*Cliona* (*Papillissa*) *lutea*, from the types of *Papillissa lutea* Lendenfeld; ($\times \frac{1}{2}$).

Fig.3.—*Spirastrella*(?) *australis* Lendenfeld; showing the skeleton (as prepared by maceration by means of caustic potash) of the specimen illustrated in Pl. xv., fig.5; ($\times \frac{1}{2}$).

Fig.4.—*Amorphinopsis megarrhaphea* Lendenfeld; dermal skeleton; ($\times$ 8).

Fig.5.—*Amorphinopsis megarrhaphea* Lendenfeld; pattern of the skeleton as shown in portion of a moderately thin section ($\times$ 10 approximately).

Fig.6.—*Tedania digitata* var. *rubicunda*, from the type of *T. rubicunda* Lendenfeld; ($\times \frac{1}{2}$).

Plate xviii.

Fig.1.—*Caulospongia elegans*, from the type of *Plectodendron elegans* Lendenfeld; ($\times \frac{2}{7}$).

Fig.2.—*Axiamon folium*, sp.nov.; ($\times \frac{4}{9}$).

Fig.3.—*Axiamon folium* (var.?); ($\times \frac{4}{9}$).

Fig.4.—*Hemitedania anonyma* Carter; from a specimen of somewhat cartilaginous consistency, and with coarse-fibred skeleton; ($\times \frac{1}{2}$).

Plate xix.

Fig.1.—*Hemitedania anonyma* Carter, from a specimen labelled as the type of *Halichondria rubra* Lendenfeld; ($\times \frac{3}{4}$).

Fig.2.—*Hemitedania anonyma*; from a macerated, coarse-fibred specimen; ($\times \frac{1}{2}$).

Figs.3, 4, 5.—*Hemitedania anonyma*; illustrating various forms assumed by examples of this species; ($\times \frac{1}{2}$ approximately).

Plate xx.

Fig.1.—*Chalina finitima* Whitelegge (non Schmidt); an incomplete specimen.

Fig.2.—*Phlœodictyon ramsayi*, from one of the co-types of *Rhizochalina ramsayi* Lendenfeld; illustrating a specimen of irregular shape provided with *many* root-like processes.

Fig.3.—*Phlœodictyon ramsayi* var. *pyriformis* (var.nov.); portion of the upper surface showing the sieve-like area formed by the closely apposed oscula; ($\times \frac{2}{3}$)

Figs.4-5.—*Phlœodictyon ramsayi*; tangential sections close beneath the surface, showing the pattern of the reticulation formed by fibres of the bast-layer in the wall of the fistula and in between the fistulæ respectively; ($\times$ 10).

Plate xxi.

Figs. 1, 2, 3, 4.—*Stylotella agminata* Ridley, from type-specimens of *Stylotella digitata* Lendenfeld, and of *Tedania laxa* Lendenfeld; (× ½ approximately).

Fig. 5.—*Stylotella agminata* Ridley; further illustrating the variable habit of the species.

Plate xxii.

Fig. 1.—*Axinella aurantiaca* Lendenfeld; longitudinal median section taken at the extremity of a thin branch; (× 15).

Fig. 2.—*Stylotella agminata* Ridley; longitudinal section taken at the extremity of a branch; (× 12).

Fig. 3.—*Histoderma actinioides*, sp. nov.; (× ⅔ approximately).

Fig. 4.—*Phlœodictyon ramsayi* Lendenfeld, var. *pyriformis* (var. nov.); inner surface of longitudinally bisected specimen, showing disposition of oscular canals; (× ⅗).

Fig. 6.—*Spirastrella*(?) *ramulosa* Lendenfeld; showing the skeleton which remains after maceration by means of caustic potash; (× ⅗).

Fig. 6.—*Raspailia tenella* Lendenfeld; longitudinal median section taken at the extremity of a branch; (× 12).

Fig. 7.—*Raspailia gracilis* Lendenfeld; longitudinal section of a branch; (× 9).

Plate xxiii.

Fig. 1. *Raspailia gracilis*, from the type of *Axinella hispida* var. *gracilis* Lendenfeld; (× ¾).

Figs. 2-3.—*Raspaila tenella*, from the types of *Axinella hispida* var. *tenella* Lendenfeld; (× ¾ approximately).

Fig. 4.—*Raspailia agminata*, sp. nov.; from the specimen wrongly figured in the Catalogue (Pl. ii., fig. 1) in illustration of *Halichondria rubra*, var. *digitata* Lendenfeld; (× ¾).

Fig. 5.—*Chalinodendron dendrilla* Lendenfeld; (× ⅘).

Plate xxiv.

Fig. 1.—*Mycale* (*Paresperella*) *penicillium* Lendenfeld; dermal skeleton; (× 18).

Fig. 2.—*Tedania digitata* var. *rubicunda* Lendenfeld; dermal skeleton; (× 18).

Figs. 3, 4, 5.—*Hemitedania anonyma* Carter; dermal skeleton; (× 18).

Fig. 6.—*Mycale serpens* Lendenfeld; dermal skeleton.

Figs. 7, 8.—*Axiamon folium*, sp. nov.; pattern of the skeleton as shown in moderately thin sections. Fig. 7, (× 10).

THE BONDI ANTICLINE.

By C. Hedley, F.L.S.

(Plates xxv.-xxvii.)

To ascertain the quality and position of coal-seams beneath and inland from Sydney, a series of bores were drilled to a great depth. As a result, the conformation of the remotely underlying strata is unusually well known in this neighbourhood.

Sections* composed from these borings develop a central basin rising to the coast on the one side, and to the Blue Mountains on the other. This basin is here regarded as the lap of a fold. Had the basin existed before the deposition of the strata it contains, then salt would have accumulated in an area of internal drainage below sea-level. Further, the steep slope, on the western side, of about five thousand feet in forty miles would have thrown brisk streams, and would not have supported such swamps as grew the coal. Consequently, the bowed strata were not laid down in their present attitude, but on an almost level surface. So considerable deformation of the original coal-horizon has therefore happened. Since drawing the following sketch, it occurs to me that the watershed, on which was laid down the Hawkesbury Sandstone, might have descended inland westwards, while the granite mountain-range, whose waste supplied its materials, was situated seawards and to the east. This would harmonise with deeper, coarser deposits on the east becoming finer and thinner on the west.

Compressive crustal action has already been suggested (*ante*, xxxvi., p.14) as an agent competent to effect the changes that have taken place. On this hypothesis, both the coal and the succeeding shale and sandstone were spread evenly on an almost level floor, and by subsequent earth-movements were compressed and bent, first into smaller, then into larger, folds—wavelets on a wave (text-fig.1).

* Carne, Mem. Geol. Survey N.S.W., Geol. vi., 1908, p.160.

Various alternations of Wianamatta shale and Hawkesbury sandstone indicate the former, while the latter are represented

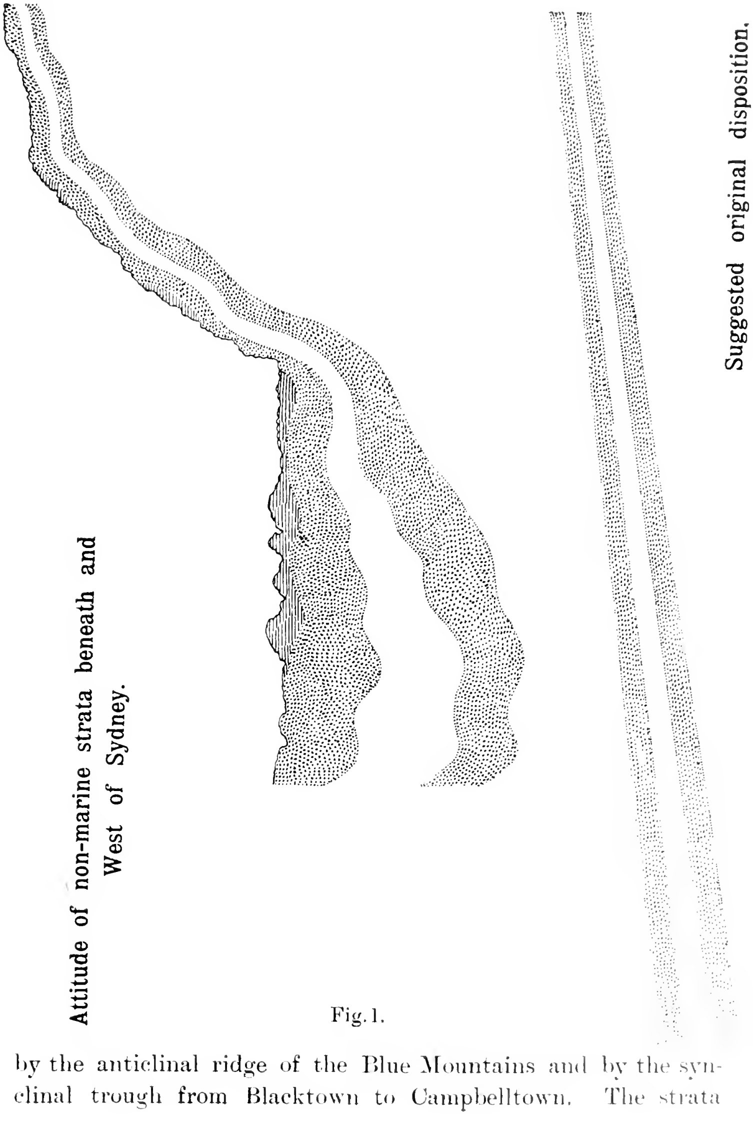

Fig. 1.

by the anticlinal ridge of the Blue Mountains and by the synclinal trough from Blacktown to Campbelltown. The strata rising with increased rapidity near Sydney* point to the completion of the series by an anticline on the east. It is proposed to name this the Bondi Anticline. Apparently its crest lay beyond the present coast, and though now shattered and sunk, may yet be traced from its dyke-complex, and from the crushing of the rocks before it.

In its prime, the Bondi anticline probably rose to a considerable height, for denudation has pared off from its flanks the Wianamatta shale and some sandstone as well. The drowned valley of Port Jackson indicates recent subsidence: so that the anticline sank, perhaps through the withdrawal of a fluid core, perhaps through being involved in another and larger folding movement, or perhaps through faulting.

Evidence in support of this idea is offered from the radiating dykes and from the crushing of the shale.

(1) *The radial dykes.*—Around Sydney, the sandstone-rocks are fissured by a series of dykes, some of which run roughly north and south, and others cross at about right angles. Both are of later date than the crushing of the shale, as they traverse the distorted strata indifferently.

It was remarked by Mr. G. A. Waterhouse that the easterly and westerly series assumed a radial direction, and converged to a point east of Bondi.†

If the Bondi anticline swelled to bursting point and then cracked lengthwise and crosswise, these dykes would be the casts of those cracks (Plate xxv.). By their direction, the hypothetical anticline might be restored as a crescent billow convex to the present coast and rising in the centre. When pressure was relieved by the bursting of the lava into dykes, the folding movement was perhaps arrested.

(2) *The mashing of the anticline.*—In the composition of the Hawkesbury Sandstone, the Rev. J. E. Tenison-Woods distinguished a smaller stratification, whose lines are mostly inclined to the horizon, as "laminæ," and a greater division,

* David & Pittman, Journ. Roy. Soc. N. S. Wales, xxvii., 1893(1894), p.459.
† Morrison, Rec. Geol. Survey N.S.W., vii., 1904, p.261.

including one or more series of laminæ, as "layers." Between these layers, there is often a bed of shale. This shale may be yards in thickness, reduced to a thin sheet or spattered about in discs and pebbles.

Near Sydney, the lip of the basin bearing the brunt of the pressure, the shale is rarely undisturbed. Frequently, it rests on a floor which curves abruptly up and down, and underlies a roof which, in a short space, makes equally sudden contortions (Plate xxvi.). From its nature, the shale, deposited horizontally in calmest pools, could not have formed on such a floor or under such a roof. Into present positions the shale has slid over a strange floor, and been wedged under a misfit roof. Sometimes a shale bed thinning out is continued by a stream of biscuit-shaped flakes. These are morsels chewed in the jaws of the sandstone layers. Fish-remains are abundant in some shale-beds, and such are usually distorted by a very slow oblique pressure they have undergone. The sudden bumping of stranded icebergs could not account for the screwing these fossils have received. Besides, under floating ice the shale would disintegrate rather than bend or break. Pressure, too, is perhaps expressed by the readiness of exposed shale to crumble away, due to the breaking of its grain.

The butter would ooze out, if pressure were put upon a pile of slices of bread and butter. So where hard sandstone and soft shale were squeezed together, the shale first gave way, and thus furnishes the most obvious evidence of displacement. To some extent, the false bedding disguised dislocation, but, though less apparent, the sandstone exhibits its own signs of disturbance. Continually it falls in belly-sags, and rises in back-humps, the imprint of thrust-movements. Layers are rolled over or telescoped into each other, and in places the sandstone is curled like carpenter's shavings (Plate xxvii.).

Such phenomena are well known. Mr. C. S. Wilkinson* described disturbed beds at Fort Macquarie, Woolloomooloo, and Flagstaff Hill, where there were "angular boulders of the shale

* Wilkinson, Journ. Roy. Soc. N.S.W., xiii., 1879(1880), p. 106.

of all sizes up to twenty feet in diameter, embedded in the sandstone in the most confused manner": also rounded pebbles of shale "usually oval in shape and embedded in such a manner that the longer axis of the pebble is nearly always inclined, or dips towards the South-west." In his matured opinion, these rocks were broken and pushed by the movement of ice.*

Contorted beds at Coogee were figured and described by Prof. David,† who accepted Mr. Wilkinson's explanation that the disturbance was caused by the grounding of contemporary icebergs.

Objections to this theory were raised by the Rev. J. E. Tenison-Woods,‡ who contended that the usual accompaniments of ice-action, such as transported and engraved stones, moraines, till, glacial mud, or boulder clay, are here absent. He considered that the breaking and scattering of the shale might have been accomplished by the floods of contemporary streams.

Mr. R. D. Oldham|| was not convinced that the evidence advanced by Mr. Wilkinson proved the presence of glaciers.

Neither afloat nor aground does ice work thus. Transported rocks, so constant a feature of ice, and so easy to detect, are absent here. It is now submitted that neither ice-action nor contemporaneous denudation satisfactorily explains the crushed shales. On the contrary, it is thought that their injuries were received when they were caught in the press of the Bondi anticline, and ground between moving masses of sandstone, and that the disturbances arose from a series of thrusts and folds started in the yielding and quaking mass by the advancing anticline.

From an economic point of view, it will be of importance to consider if the coal-deposits in this area have deteriorated by crushing.

The dune-and-pond origin of the Hawkesbury Sandstone, so ably advocated by Tenison-Woods, would be favoured by the withdrawal of the ice-hypothesis.

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* Wilkinson, Mem. Dept. Mines, Pal. iii., 1890, p.28, footnote.

† David, Quart. Journ. Geol. Soc., xliii., 1887, pp.190-196.

‡ Ten.-Woods, Proc. Roy. Soc. N. S. Wales, xvi., 1882(1883), p.75.

|| Oldham, Rec. Geol. Survey India, xix., 1886, p.43.

In conclusion, the Bondi anticline is suggested as the medium of that tremendous driving force which thrust down the basin now outlined by the Wianamatta shale, till the Prospect lava squirted through its broken floor, displaced the Hawkesbury River from Camden to Windsor, and pressed up the Blue Mountain ridge behind. The giant fold, of which it was a part, relaxed its grip and died in its youth, as the anticline cracked and burst.

EXPLANATION OF PLATES XXV.-XXVII.

Plate xxv.

Scheme of an anticline deduced to match the Blue Mountain ridge and the Parramatta trough, and to account for the disturbed shales and sandstones about Sydney. From the paths of the radial dykes it is developed as a crescent directed west and swollen medially near Bondi. Based on the Geological Sketch Map of Sydney, Dept. Mines, 1903.

Plate xxvi.

Example of a crumpled sheet of shale regarded as entangled in a slide of the sandstone-beds. Opposite Cremorne Wharf, Milson Road in the foreground. Drawn by Miss P. Clarke.

Plate xxvii.

A series of coils of sandstone which, it is presumed, were slowly rolled up and together when a superincumbent mass of rock was launched across them. From the road side, between Seaforth and the Spit, east side of Middle Harbour. Photographed by Dr. H. G. Chapman.

ORDINARY MONTHLY MEETING.

July 29th, 1914.

Mr. C. Hedley, F.L.S., Vice-President, in the Chair.

The Chairman called attention to the programme of the Meeting of the British Association for the Advancement of Science, in Sydney, August 20-26th, and particularly requested intending members to facilitate the work of the Hon. Treasurer [Dr. H. G. Chapman, Royal Society's House, 5 Elizabeth Street North] by forwarding their subscriptions without delay.

Reference was made to the decease of Mr. Richard Helms, for some time a Member of the Society, in the interval since the last Meeting. Mr. Helms had a considerable knowledge of the entomology of New Zealand, where he resided before coming to Australia. For some years, he was an officer in the Department of Agriculture of New South Wales, afterwards in West Australia, and, subsequently, again in New South Wales. As naturalist of the Elder Exploring Expedition to Central Australia, he did excellent work. Evidence of glaciation on the Kosciusko Plateau was first brought prominently into notice by him; and this was subsequently confirmed and amplified in collaboration with Prof. David, and Mr. Pittmann. Mr. Helms also prepared a very useful account of the physiography, flora, and fauna of the Plateau.

It was resolved that an expression of sympathy and good-will should be tendered to Mr. R. J. Tillyard, concerning whom a disquieting, but happily somewhat exaggerated announcement in connection with a railway accident, appeared in the morning papers.

The Donations and Exchanges received since the previous Monthly Meeting (24th June, 1914), amounting to 19 Vols., 117 Parts or Nos., 23 Bulletins, 2 Reports, and 7 Pamphlets, received from 79 Societies, etc., and two authors, were laid upon the table.

NOTES AND EXHIBITS.

Mr. Hedley exhibited an advance copy of a monograph of Australian Rhopalocera, by Messrs. G. A. Waterhouse and G. Lyell, just published, a most important addition to entomological literature, and especially noteworthy because every known species is figured.

Mr. Fred Turner exhibited, and contributed notes on, the following grasses, now apparently acclimatised in Australia. The seeds of most of these grasses have, no doubt, been accidentally introduced with agricultural and other seeds, or in packing material. The other species are evidently escapees from cultivation, though none of them have been collected on cultivated areas. *Agrostis pulchella* Guss.,(Sicily); near Parramatta, 1905. *Agrostis stolonifera* Linn.,(Europe); Shoalhaven River, 1899. *Alopecurus agrestis* Linn.,(Europe); near Stonehenge, 1906. *Alopecurus pratensis* Linn.,(Europe); near Berry, 1901. *Avena pratensis* Linn., (Europe and Asia); near Bega, 1893. *Avena pubescens* Huds., (Europe and Asia); near Candelo, 1893. *Cynosurus cristatus* Linn.,(Europe); near Robertson, 1912. *Cynosurus echinatus* Linn.,(Europe and Orient); near Cooma, 1899. *Festuca gigantea* Vill.,(Europe, Asia, and Africa); near Uralla, 1905. *Festuca loliacea* Huds.,(Europe); Coolangatta, 1899. *Festuca pratensis* Huds.,(Europe); near Delegate, 1893. *Phleum arenarium* Linn., (Europe); Shoalhaven River, 1899. *Phleum pratense* Linn., (Europe); Tenterfield, 1905, and Moruya, 1895. *Poa distans* Linn., = *Glyceria distans* Wahlenb.,(Europe); Coolangatta, 1899. *Poa nemoralis* Linn.,(Europe and Asia); near Tenterfield, 1905. —When the plates from Bauer's "Illustrationes floræ Novæ Hollandiæ," &c., presented to the Society by Rev. J. Lamont, F.L.S., were under notice at the last Meeting, Mr. Turner remarked that he remembered having communicated, for the author, a paper entitled "Ferdinand Bauer and some of his Drawings," by the late Rev. Dr. Woolls, F.L.S., to the Horticultural Society of New South Wales some years ago. He now supplied the information, that the paper was read at a meeting on 9th April, 1889; and was subsequently published in the "Rural Australian," 1st May, 1889, at that time the official organ of the Society.

Mr. McCulloch exhibited a copy of the first part of the "Australian Zoologist," a new publication issued by the Royal Zoological Society of New South Wales. Attention was drawn to the large-sized page and plate, which are particularly convenient for certain classes of work. He also exhibited a specimen of an interesting fish, *Jordanidia solandri* Cuv. & Val. It was originally noticed by Solander, naturalist to Cook's first voyage to Australian waters, who described it as *Scomber macrophthalmus*, a manuscript name afterwards altered to *Gempylus solandri* by Cuvier & Valenciennes. It was also named *Thyrsites micropus* by McCoy, while Waite has recently proposed the new generic and specific names *Rexea furcifera* for it. It proves to belong to the genus *Jordanidia* Snyder, however, and should, therefore, be called *J. solandri*.

Mr. Mitchell exhibited specimens of a fossil fish, found in the Newcastle Coal-Measures. It probably belongs to the *Palæoniscidæ*. This fossil is interesting, because it is the only one yet obtained from the Coal-Measures in a good state of preservation. The specimens were found in a railway cutting at the junction of the Newcastle Wallsend Coal Company's line with the Great Northern Railway. The geological horizon of the occurrence of these fossils is about 200 feet below the Borehole Coal-seam of the Newcastle Series. He also reported the occurrence of the trilobite, *Calymene nasuta*, in the Upper Silurian rocks of Bowning.

Mr. A. A. Hamilton showed a series of botanical specimens from the Botanic Gardens, Sydney, including: (1) *Lactuca virosa* Linn., (Cult.), showing complicated prolification. An umbel of abortive flowers projects from the primary capitulum, which is reduced to a foliaceous involucre. The flowers consist of an involucre supporting a series of florets, which have united, and form an envelope occupying the greater part of the flower, partially enclosing the few remaining florets, a third primitive flower filling the vacancy on the opposite side. In some of the flowers, the involucral bracts are broadened at the expense of their length, and a number of the florets have developed an inflated corolla, together with suppression of the pappus.—(2) *Ipomœa versicolor* Meissn., (*Mina lobata* Cerv.); cultivated; showing prolification, fasciation, and torsion. The normally attenuated base of the corolla is elongated, and an abortive flower, with its apex produced into long points, proceeds from between the corolla-lobes, which are severed to thrice their usual depth. The calyx, which in the perfect flower has a short tube and lobes with a basal dilation, has separated into distinct sepals, which have elongated and lost their dilation, and, in some cases, represent the whole flower. The rhachis of the proliferous upper portion of the raceme is fasciated; flowers are observed with twisted, infertile stamens; and stem-leaves and flowers are contorted.—(3) *Phlox* (perennial; Hort. var.), showing virescence developing into frondescence. In the early stages of the trouble, the somewhat impoverished, but sexually perfect, flowers were unable to colour their petals, and, as it became more acute, the whole series of organs constituting the flower gradually lost their floral character, finally degenerating into tufts of leaves.—(4) *Conospermum* spp. The difference between *C. ericifolium* Sm., and *C. taxifolium* Sm., is, according to the Flora Austr., a foliate one, based chiefly on the length and breadth of the leaves. In the specimens exhibited, the leaves are graded, from the typical, short, and narrow form in *C. ericifolium*, to the broader and longer leaves of *C. taxifolium*; so that the two species are merged into one continuous series, in which a difficulty arises as to where the dividing line should be drawn.—(5) *Dodonæa pinnata* Sm. Description of fruit-capsules, not previously described, as far as known: four or frequently five-angled, with a few long hairs on the top, membranous, the wings undulate-wrinkled, viscid, dotted with resinous glands. Peduncles $\frac{3}{4}$ in. long. Sepals ciliate, lanceolate, about 2 lines long.—(6) *Telopea speciosissima* R.Br., showing leaf-variation. Margins entire, serrate, or lobed: leaves from 2-9 inches long, and from $\frac{1}{4}$-3 inches broad.—(7) *Notelæa longifolia* Vent., showing leaf-variation: ovate-lanceolate to orbicular. Some measurements: 7×3; $6 \times 1\frac{1}{3}$; $4\frac{1}{2} \times 3$: 4×1; $3 \times \frac{3}{4}$; 2×2 inches.

On behalf of Mr. C. T. Musson, Mr. Fletcher showed specimens of the coral-like surface-roots of *Macrozamia spiralis* [N.O. CYCADEÆ], and transverse sections mounted in the fresh condition, showing the presence of an endophytic green alga, *Anabæna cycadearum* (*Nostocaceæ*) [*vide* Tubeuf, Diseases of Plants, p.542].

A REVISION OF THE MONAXONID SPECIES DESCRIBED AS NEW IN LENDENFELD'S "CATALOGUE OF THE SPONGES IN THE AUSTRALIAN MUSEUM." Part ii.

By E. F. Hallmann, B.Sc., Linnean Macleay Fellow of the Society in Zoology.

(Plates xv.-xxiv.)

Familia HOMORRHAPHIDÆ.

Subfamilia Renierinæ.

Reniera collectrix.

For various reasons one is obliged to conclude that this species was founded on specimens of *Chondrosia* (?) *collectrix*, the mistake in all probability having been due to the fact that the specimen examined by Lendenfeld for description happened to contain a considerable number of foreign spicules derived from a *Reniera* growing in contact with it. This, in the first place, is the conclusion to be drawn from the ostensible type-specimen, as well as from a fragment labelled *Reniera collectrix* that comes from the British Museum,—both of which are examples of the species I have named. The fragment referred to is practically free from spicules, but the complete specimen (which is encrusted in many places by other sponges, including *Reniera*) shows here and there—as already mentioned by Whitelegge(56), who himself regarded them as proper to the sponge—patches of small oxea, which occur more especially in some parts near the surface. Furthermore, this specimen, apart from the fact of its being without proper spicules, is consistent with the description of *Reniera collectrix* in every respect excepting only that its oscula are but 2·5mm. wide instead of 5mm. And a point particularly to be noted in connection with the description is the statement therein that the consistency of the sponge is very hard: for this in itself is an indication that the species described was not a *Reniera*. Finally, some significance attaches to the fact that although the specimen in question was undoubtedly known to Lendenfeld,—as is shown by its having a label written by him attached to it—he omitted to take it into account in his description of *Chondrosia collectrix*, which he states to be an "incrusting" sponge, attaining only "a height of 20mm., and a breadth of 60mm."; and thus it seems certain that the real identity of this specimen was unsuspected. Accordingly, although it is difficult to believe that *Chondrosia* (?) *collectrix* could under any circumstances be mistaken for a species of *Reniera*, all the evidence supports the view that such a mistake was actually made.

RENIERA AUSTRALIS. (Text-fig.2).

Introductory.—The type specimen, which is preserved in alcohol, has the form of a thick layer covering one side of a piece of blackish wood, which has imparted to the sponge a brown stain. Although at first sight not appearing so, it consists of two specimens united laterally, one of which has grown over the edge of the other in such a way as to produce an appearance of continuity. Both specimens are generically the same—*Reniera*; but one of them has a rugged and granular surface, a somewhat olive-brown colour, and spicules measuring 80 to 125 μ in length by 5 μ in maximum stoutness; while the other, which is the smaller, has a smooth surface, a yellowish to faintly reddish-brown colour, and spicules measuring 60 to (rarely) 115 μ in length by at most 4·5 μ in diameter. And there is also, apparently, a slight difference between them with regard to the mode of arrangement of the skeleton. It is not unlikely that the two are specifically distinct; and I, therefore, take the latter to be the representative of the species, since it agrees the better with

Fig.2.—*Reniera australis.* Oxea.

Lendenfeld's description. As this, the only specimen available, is small, incomplete, and much damaged, it unfortunately affords but little information regarding the external features of the species; and with respect to these, accordingly, I can only quote the original description, which was based apparently upon several specimens.

Description.—"Massive, lobose, horizontally extended, more or less incrusting sponges, with dome-shaped protuberances on the upper surface, on the summits of which the circular, 3 to 5mm. wide, oscula are situated. Surface smooth. The sponge attains a height of 30mm., a length of 150 to 200mm., and a width of 100mm. Colour in the living state rosy red, in spirit grey." The consistency is soft and fragile, and the texture slightly porous. A very thin and delicate, non-separable, dermal membrane is present, and when this is removed (by cutting a thin shaving from the surface) the structure immediately beneath is seen to be minutely and irregularly honeycomb-like.

The skeleton-reticulation (as it appears in rather thin sections) does not extend continuously, as is perhaps usually the case in *Reniera*, but is interrupted by many wider or narrower gaps in which there occur only a comparatively few scattered spicules. The pattern of the reticulation is very irregular. Main fibres, 3 to 5 spicules broad, usually not traceable for any considerable distance and not disposed in orderly parallelism with one another, run at varying distances apart in a general surfaceward direction; and between these, in addition to some inter-reticulating, 2 to 3 spicules broad, connecting fibres, is a unispicular meshwork, the meshes of which, for the most part, are formed not of spicules placed end to end, but of intercrossing spicules. A noteworthy feature of the skeleton, though one which perhaps is not uncommon in *Reniera*, is the occurrence here and there, only at irregular and very wide intervals, of broad strings of loosely associated parallel spicules, which appear to be without relation to the rest of the skeleton or to one another, and run in various directions through the sponge; they are variable (20 to 100 μ) in width, and their spicules—as are also the scattered spicules of the skeleton—are shorter and slenderer than most of those composing the reticulation. Strings of spicules analogous to these are met with in *Tedania* and *Hemitedania*. The dermal skeleton is an irregular polygonal reticulation of pauciserial fibres, the meshes of which average about 120 μ in width.

The oxea are slightly curved, gradually sharp-pointed, and measure 60 to 115 μ in length by 4·5 μ in stoutness.

The flagellated chambers are spheroidal, and closely arranged; they measure about 40 μ in diameter. The nuclei of the choanocytes are large, averaging slightly more than 2·5 μ in diameter.

Loc.—Port Jackson.

Remarks.—Under the name *Reniera australis*, Whitelegge(**53**) has recorded several specimens from Funafuti which, in my opinion, after examination of the original preparations, belong to two different species both distinct from the sponge described above. In one of these species, the skeleton consists of a unispicular reticulation and of scattered foreign particles; while, in the other, the spicules do not form a meshwork at all, but are disposed in a quite irregular halichondroid fashion. The oxea in both species attain a length of between 130 and 140 μ.

Dragnewitsch(**16**), in a paper which I have not seen, has also recorded as *Reniera australis* Lendenfeld, a sponge from Singapore.

RENIERA MEGARRHAPHEA. (Pl. xvii., figs.5, 6; and text-fig.3).

Introductory.—Whether this species is properly represented by the specimen described by Whitelegge, it is not at present possible, with complete certainty, to say. The chief reason for doubt is the fact that the specimen, which unfortunately is only a small portion of the original, fails to enable one to reconcile it with Lendenfeld's description as regards external features; it is *not* digitate or lobose, but is portion of what, to all appearance, was a massive sponge unprovided with lobes or prominences of any kind. But in its skeletal character, it exhibits considerable agreement with the description, except in one particular. Thus, in keeping with what is therein stated, its skeleton consists of bundles of spicules arranged somewhat in the manner of a network, spongin is not discernible, the spicules of the bundles are oxea of large size, and there are present smaller spicules of a different kind. But the last-mentioned spicules are stated by Lendenfeld to be oxea, and to occur interstitially in some abundance; whereas in the specimen, as Whitelegge has already made known, they are styli, and, moreover, are comparatively scarce except in the dermal region. This discrepancy in the matter of spiculation, however, cannot be regarded as serious. For, in the first place, as the smallest of the oxea are of about the same size as the styli, one can see how, through hasty or careless observation, the mistake could easily be made of supposing that all the smaller spicules were oxea; and in the second place, as regards their abundance, it is possible that in some parts of the sponge the smaller spicules are plentiful, inasmuch as Whitelegge also has described them as numerous. Consequently, the only serious obstacle to the acceptance of the specimen, as a genuine example of *Reniera megarrhaphea*, is its apparent non-agreement therewith in respect of external features; but as this may possibly be due merely to its incompleteness, I accordingly propose that the specimen (which, for reasons stated below, I refer to the genus *Amorphinopsis*) be definitely adopted as the type.

Description.—Sponge more or less massive; its precise external form not with certainty known. Oscula scattered, variable in size (up to 2 mm. in diameter), irregular in shape, perhaps restricted in their occurrence to the more elevated parts of the surface. The surface is generally even, but may become, in places, deeply wrinkled or folded. No dermal membrane is recognisable. The arrangement of the dermal skeleton is such that the surface exhibits a minutely reticulate or a perforate pattern (Plate xvii., fig.5), the one or the other according as the interstices, the diameter of which varies from about 150 to 400 μ, are separated by relatively narrow lines or by relatively broad. The interior of the sponge is traversed by abundant canals, of which the largest measure 4 mm. in diameter; and, in consequence of this, its structural appearance, as shown on a cut surface, somewhat resembles that of well aërated bread. The consistency is firm and moderately tough. The colour in spirit is greyish-brown within, and yellowish-grey on the surface.

Fig 3. — *Amorphinopsis megarrhaphea*. *a*, Principal spicules. *a'*, Abnormal forms (very rare) of the preceding, with accessory actines near one extremity. *b*, Dermal styli.

The main skeleton (Pl. xvii., fig. 6) is halichondroid, consisting of a dense, irregular, ill-defined meshwork of spicule-bundles; fibres, in the proper sense of the term, can scarcely be said to be present, and even the bundles as a rule are not very distinct as such. Frequently the disposition of the spicule-bundles is such as to produce a somewhat lattice-like pattern; but even so, the pattern is much confused. For the most part, the bundles are multispicular, and the meshes of the network are very much less in width than the length of the spicules. The dermal reticulation (the meshes of which, as already stated, measure in diameter from 150 to 400 μ) is formed by coarse fibres, varying from 130 to upwards of 280 μ in stoutness, composed of oxea similar to those of the main skeleton. Supported upon these fibres are closely-crowded short styli, which stand perpendicularly to the surface with their apices directed outwards. Styli similar to these also occur scattered sparsely through the interior.

Spicules.—(*a*) The oxea, which range in length, with increasing stoutness, from very rarely less than 220 to about 950 μ and attain a maximum diameter of 31 μ, are very slightly curved, fusiform spicules, tapering from the middle of their length gradually to sharp points, and peculiar in the fact that their outer or convex side is curved somewhat angulately as compared with their concave side. The last-mentioned feature is usually best marked in the stoutest spicules As modifications of the oxea, a few styli occur, which are evidently the result of a partial atrophy as regards length, and the rounding off of the extremity, of one actine. Further, a peculiar abnormality is occasionally shown, perhaps too rare to be considered of phylogenetic significance, in which the spicule is provided near one extremity with one to several short accessory actines, so as to resemble a Tetraxonid mesoclad.

(*b*). The styli are straight or slightly curved, somewhat fusiform, and gradually sharp-pointed at the apex. They measure from 160 to 250 μ in length, and are at most 9 μ in diameter.

Loc.—Port Jackson.

Remarks.—The species is, without doubt, of the same genus as *Hymeniacidon* (?) *fœtida* Dendy(**11**), concerning whose correct generic designation, however, there is considerable difference of opinion. It has been referred by Topsent(**44**) to the genus *Amorphinopsis*; by Dendy at a later date(**15**) to *Leucophlœus*; and by Lindgren(**30**), Thiele(**42**), and again quite recently by Hentschel(**21**), to *Ciocalypta*. I cannot agree that such species, possessing a halichondroid main skeleton of oxeote spicules and a dermal skeleton of erect styli, are correctly assignable to *Ciocalypta*; nor can I see any better reason why they should be referred to *Leucophlœus*, the type-species of which, *L. massalis* Carter (**6**), besides lacking their characteristic dermal skeleton, has a main skeleton composed of styli. On the other hand, in the forms of their spicules, *Hymeniacidon* (?) *fœtida* and *Reniera megarrhaphea* agree with Carter's *Amorphinopsis excavans* very closely; though, unfortunately, we do not know whether in this, the type species of *Amorphinopsis*, the stylote spicules form a dermal skeleton. There is, however, a probability that they do; for Lindgren (*loc. cit.*) has described as *Ciocalypta fœtida*, a sponge which, while exhibiting the characteristic skeletal features of *Hymeniacidon* (?) *fœtida*, also bears so striking a resemblance in its stelliform surface-pattern to *Amorphinopsis excavans* that he regarded it as sufficient to establish the identity of these two species. The evidence is sufficient, therefore, to render it advisable, for the present, to assign *H. fœtida* and *R. megarrhaphea* to the genus *Amorphinopsis*.

The character of the main skeleton in these two presumable species of *Amorphinopsis* suggests that the genus is related to *Halichondria* and *Topsentia*; and one cannot regard it as other than significant, therefore, that whilst oxea exhibiting the peculiarity of form of those of *R. megarrhaphea* are of very rare occurrence, closely similar spicules are found in *Topsentia colossea* Lundbeck (**31**), = *T. pachastrelloides*, *fide* Topsent (**47**). In the genus *Halichondria* also, somewhat similar spicules are possessed by *H. firma* Bowerbank (**2c**). Accordingly, I would say that these three genera, which at present are referred to three different families, ought to be included in the same family, either the *Epipolasidæ* or the *Haploscleridæ*—and perhaps preferably in the former, since it seems now generally to be conceded that *Topsentia* and (some species at least of) *Halichondria* have originated from Astromonaxonellida. If such a classification were adopted, the genera *Pyloderma* (**24**), *Eumastia*, *Trachyopsis* (**15**) and *Migas* (**37**)* might also be admitted in the *Epipolasidæ*; and it would then be advisable to divide this family into three subfamilies—Coppatiinæ, Streptasterinæ, and Halichondriinæ.

Reniera pandæa.

The specimen labelled as the type of this species—a description of which has already been furnished by Whitelegge (**56**)—agrees excellently with the original description so far as skeletal characters are concerned, but is wholly incompatible therewith in other respects; its spiculation, in consequence of which Whitelegge referred it to the genus *Rhaphisia*, is similar to

* The name *Migas* is preoccupied for a genus of spiders.

that of *Hemitedania anonyma* Carter (*vide* Appendix), and of that species I consider it to be an example. This discrepancy between the ostensible type-specimen and the description of the species renders extremely significant the fact that the skeletal characters ascribed by Lendenfeld to *Reniera pandæa* are not only quite inappropriate to the genus to which he has assigned it, but are even inconsistent with his definition of the family to which it belongs; for the *Homorrhaphidæ* are defined by him as having only oxeote or strongylote megasclera, whereas the spicules of *Reniera pandæa* are stated to be stylote.

The evidence regarding *Reniera pandæa* seems to me, therefore, to justify the conclusion that the skeletal characters attributed to it are those of a different species from that upon which the description of its external characters was based, and that the latter species, represented by the above specimen, is that to which the name *Reniera pandæa* was intended by Lendenfeld to apply; but, as to the identity of the former species, I am yet unable to express an opinion.

Under the circumstances, I consider that the name *Reniera pandæa* should be regarded as a synonym of *Hemitedania anonyma*.

Reniera lobosa.

No specimen labelled as *Reniera lobosa* occurs either in the collection of the Australian Museum or among the fragments recently received from the British Museum; and no sponge admitting of identification with the species is known to me.

Petrosia hebes. (Text-fig.4).

Introductory.—As Whitelegge has already indicated, the specimen standing as the type is sufficiently in agreement with the description of the species to obviate any doubt as to its being a genuine example thereof, but the description omits certain important particulars concerning the spiculation. To this it may be added that the specimen is specifically identical with a fragment labelled *Petrosia hebes* from the British Museum. The information furnished by Whitelegge is very meagre, and, moreover, is found to be not quite accurate. The species consequently needs redescription. Unfortunately, the specimen is only a very small piece of the original, and affords no information concerning the external form, or the character and arrangement of the oscula. In regard to these features, therefore, I have in the following description, in order to make it as far as possible self-complete, rewritten what is stated in the original description.

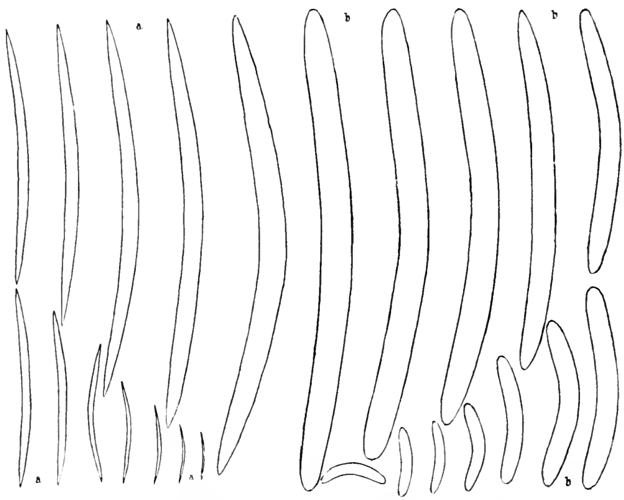

Fig. 4.—*Petrosia hebes.* *a*, Strongyla. *b*, Oxea.

Description.—"Irregular, massive sponges, horizontally extended, 80mm. broad and 30mm. high; with digitate processes on the upper surface, which attain a length of 40mm. and a thickness of 15mm.; they are irregularly curved, knotty, and often flattened. The surface is smooth. Oscula inconspicuous and scattered, circular, 1 to 3mm. in diameter."

The single piece, which is preserved in alcohol, shows a thin, delicate, non-separable dermal membrane. The consistency is firm and fairly hard, but brittle and somewhat pulverable. The texture is finely porous; the colour, light yellowish-grey.

The main skeleton is a coarse, irregular, reticulation of very stout fibres, often exceeding 300 μ in thickness, composed of densely packed strongylote and substrongylote spicules uncemented by spongin. The meshes of the reticulation, which are usually more or less rounded in outline, are of very variable width, averaging, say, 500 μ. Within the meshes are abundant scattered spicules, which sometimes form rather dense masses; these spicules for the most part are similar to those forming the fibres, but comprise also fairly numerous, slenderer, oxeote spicules of a distinct kind. At the surface, the outermost transverse fibres of the main skeleton constitute a subdermal reticulation that extends horizontally immediately beneath and in contact with the dermal membrane. The dermal membrane is provided with numerous horizontally directed oxea (similar to those scattered in the choanosome) which in general are arranged reticulately, forming meshes of about 120 μ in diameter. Where the membrane overlies the interstices of the subdermal reticulation, it is pierced by round pores, each of which singly occupies one of the meshes of the dermal reticulation.

Spicules.—(*b*). The strongyla are more or less curved, range in length from (rarely) less than 40 to about 280 μ, and attain a maximum diameter of 17 μ; the shortest have an average stoutness of about 7 μ. Generally speaking, the longer spicules are less curved than the shorter, and are less bluntly rounded off at their extremities, so that very often they might more correctly be termed sub-strongyla, or even, at times, suboxea. Also, the shorter spicules are often somewhat angulately curved. Of the longer spicules, an occasional one is asymmetrical with regard to opposite ends, approximating to the form of a bluntly pointed stylus.

(*a*). The oxea also are more or less curved, though usually in less degree than the strongyla; and their curvature likewise is often slightly angulate. The greater degree of curvature and of angularity of curvature are, however, as in the case of the strongyla, more frequently shown by the shorter than by the longer spicules. They range in length, with increasing stoutness, from 30 to 255 μ, and attain a maximum diameter slightly exceeding 8 μ; the shortest vary in diameter from 2 to 4 μ. Intermediate forms between the oxea and strongyla, if they exist, are very rare.

Loc.—Port Jackson.

Remarks.—*Petrosia hebes* agrees in essential general features with *P. crassa* Carter, which, according to Lundbeck, is closely allied to *P. dura* Nardo, the type-species of the genus. The species is of interest, as it appears to afford indubitable proof of the very near relationship to *Petrosia* of the genus *Strongylophora* Dendy (**15**), which was placed by its author in the *Gelliinæ*, although regarded by him as being of somewhat doubtful systematic position. I am even inclined to think that the two genera will have to be united, though it is possible that their combined species may be found capable of separation into two genera upon a new basis of distinction. One finds that Thiele (**41**), prior to the establishment of Dendy's genus, has referred to the genus *Petrosia*, without comment, a species (*P. strongylata*), which possesses exactly the same peculiarities of spiculation as *Strongylophora durissima*; and these two species differ from *Petrosia hebes* apparently only in one noteworthy feature, viz., the uniformly small size of their dermal oxea.

HALICHONDRIA RUBRA.

As Whitelegge (**54**) has indicated, the specimens labelled as the types of this species and of its variety *digitata* are similar in skeletal characters to *Rhaphisia* (*Hemitedania*, g.nov) *anonyma* Carter; indeed, the only feature which at all distinguishes them is their tubular digitate habit (resembling that of *Siphonochalina*), and as other specimens occur in the collection which are intermediate between digitate and submassive in external form, this cannot be regarded as of specific value. Whitelegge makes it appear as if the specimens were quite satisfactory examples of *Halichondria rubra*, and actually mentions that one of them "appears to be a portion of the figured type of the variety"; the fact is, however, that although the specimens show many points of agreement with Lendenfeld's description, yet as regards external features, in one respect at least, they are absolutely incompatible with that description; for Lendenfeld states that the oscula "are scattered and of varying size, 2 to 5mm. in diameter," whereas the specimens have no oscula other than the openings at the extremities of their tubular branches. It is impossible to suppose that such a mistake could arise through inaccuracy of observation, and it is equally difficult to believe that the specimens are not in some way connected with the species they purport to represent—since (i.) they accord with the description as far as skeletal features are concerned; (ii.) they occur in the collection under several independent labels all bearing the same name; and (iii.) a fragment from the British Museum labelled "*Halichondria rubra* var. *tenella*" belongs to the same species. The only explanation seems to be that Lendenfeld's descriptions of *H. rubra* and its variety were derived each from two different species—the second paragraphs of the descriptions, relating to internal features, from specimens of *Hemitedania anonyma;* and the first paragraphs, having reference to external features, from specimens of some species (or, it may be, two species) quite distinct. What the latter species may have been, I am unable to suggest, and it is scarcely of importance to know: the name *Halichondria rubra*, including the varietal name *digitata*, must be considered to belong rather to the species exemplified by the type-specimens, and hence to be a synonym of *Hemitedania anonyma*. (*Vide* Appendix).

In connection with *H. rubra* var. *digitata*, conclusive proof is forthcoming that an additional serious mistake was made. Contrary to the statement of Whitelegge quoted above, the figure given in the Catalogue (Pl.ii., fig.1) is obviously not illustrative of *Hemitedania anonyma*, and at first I therefore thought it must portray the other species implied in the description. This, however, is not the case, for I have since found the actual specimen from which the figure was taken, and it is a comparatively quite small sponge; it is labelled in Lendenfeld's handwriting with a name ("*Renioclathria arbuscula*") which is given in the key-list as the manuscript synonym of *Clathriodendron arbuscula*, but even this information is incorrect, for it proves to be a new species of *Raspailia*—*R. agminata* (*vide* Appendix).

HALICHONDRIA MAMMILLATA.

In the case of this species, neither the ostensible type-specimen in the Australian Museum nor the specimen labelled as representing it in the British Museum is in the least capable of being reconciled with the description of the species; and, so far, I have met with no sponge to which the name *Halichondria mammillata* is, in my opinion, applicable. The specimens in question have already been referred to by Whitelegge, from whose remarks one would gain the impression that the former is undoubtedly a genuine example of the species and that therefore Lendenfeld's description simply is inaccurate with respect to the dimensions of the spicules. In point of fact, however, this specimen is quite as much at variance with the description in external as in internal features, being a tubular digitate sponge belonging to an (apparently undescribed) species of *Siphonochalina*. The British Museum specimen, on the other hand, has a skeleton consisting almost entirely of foreign spicule-fragments (but containing in addition proper spicules in the form of scattered slender strongyla and sigmata) and belongs to an undetermined species of *Chondropsis*. It is possible that the latter, of which I have seen only a fragment, is an example of the species described by Lendenfeld in his "Monograph of the Horny Sponges" under the name of *Sigmatella* (i.e., *Chondropsis*) *corticata* var. *mammillaris*, and accordingly that it possesses external features very similar in kind to those ascribed to *Halichondria mammillata*. If this should prove to be the case, there would be reason to suspect that the description of *Halichondria mammillata* was based partly on one, and partly on another, of two quite distinct species. For the present, in the absence of any proof to the contrary, the species should, I think, be looked upon as a correctly described and valid one, belonging—though perhaps doubtfully—to the genus to which Lendenfeld assigned it.

HALICHONDRIA CLATHRIFORMIS. (Text-fig.5).

Introductory.—Although Whitelegge(56) seems to have definitely accepted, as the type of this species, the Australian Museum specimen labelled as such, it is nevertheless obvious from his description of it that it cannot be an example of Lendenfeld's *Halichondria clathriformis*, for in no respect does it agree with the latter as described except in its possession of oscula of moderately large size. I find it to be of the same species as the sponge (of extremely common occurrence on our beaches after storms) which Whitelegge*(54) previously described under the name *Chalina finitima* Schmidt, believing it to be identical with the *Acervochalina finitima* recorded from the east coast of Australia by Ridley(34); this, however, it certainly is not, since unlike the latter it contains multiserially arranged spicules in the secondary fibres. What the correct name is I am unable to say, though I have reason to believe that the species will prove to be one of those described by Lendenfeld under the generic name *Chalinopora*. In order to prevent confusion, I would recommend that this sponge be known, for the present, as *Chalina finitima* Whitelegge (*non* Schmidt). A figure of the specimen referred to is shown on Pl.xviii.(fig.1).

On the other hand, the British Museum specimen (labelled *Halichondria clathriformis*) referred to by Whitelegge—a small piece of which I have had the opportunity of examining

* Whitelegge's failure to perceive this identity is attributable partly to the fact that the specimen is incomplete and lacking in a shape suggestive of the species, and partly to the fact that, unlike all other specimens known to him, it is preserved in alcohol with the soft tissues intact and in this condition does not display the peculiar looseness of texture of the skeleton nor the distinctive dermal pattern which are the two most noticeable features of the sponge in the dry state of preservation.

—presents features which, if allowance be made for probable errors of omission in the original description, afford very good reason for believing it to be a genuine example of the species. For not only do its megascleres mostly conform to the descrip-

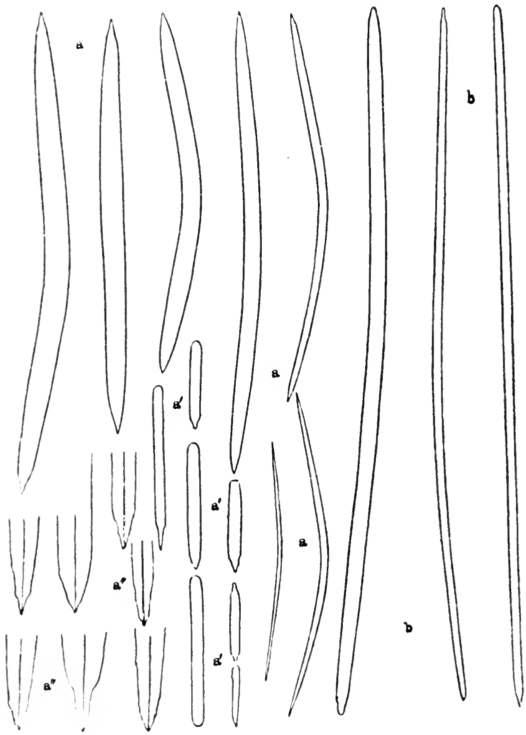

Fig. 5.—*Thrinacophora*(?) *clathriformis*. *a*, Principal oxea. *a'*, Strongylote spicules (presumably abortive forms of the preceding; exceedingly scarce). *a''*, Extremities of principal oxea. *b*, Interstitial oxea and styli.

tion, "oxystrongyla slightly curved in the middle and very slightly tapering towards the ends," but—what is especially significant—they also exhibit, at one or both extremities, "a very narrow and sharp spine." This last-mentioned peculiarity, however, is not as Lendenfeld's statement with regard thereto would imply, a feature of all the spicules, nor perhaps even of a majority of them; and also at variance with the description are the facts that the megascleres (which attain to considerably greater dimensions than stated either by Lendenfeld or Whitelegge) are of two kinds, and that microscleres are present in the form of trichodragmata. Yet to these discrepancies no importance can be attached, inasmuch as the trichodragmata, owing to their minuteness of size, and the megascleres of one kind, owing to their comparative fewness and not very marked difference in form from the others, could very easily escape detection, and, in fact, were overlooked by Whitelegge; while, as regards the matter of the size of the megascleres, it has to be borne in mind that the measurements given in the Catalogue are seldom accurate. Accordingly, I have no doubt that the British Museum specimen is correctly labelled, and propose that it be taken as the type of the species—now to be known as *Thrinacophora* (?) *clathriformis*.

Description.—For an account of the external features, one must depend, for the present, upon the rather meagre information afforded by the original description, which is as follows:—"Sponge lobose, massive, attaining to a height of 250 mm., erect, attached by a small base, with very large and conspicuous oscula, 10mm. wide, which lie scattered on the summits of the lobes, and a smooth surface." It is well to be reminded of the possibility, however, that this portion of Lendenfeld's description and the remaining portion of it having reference to the internal features may have been based respectively upon two different species.

The skeleton consists, in part, (i.) of a ramifying system of multispicular plumose "funes" (compound fibres), which are distinguishable into (*a*) stouter and more compact primary ones, 0·5 mm. to perhaps 1 mm. or more in diameter and relatively few in number, constituting the chief axes of the skeleton, and (*b*) slenderer secondary ones running off from these to the surface, usually with much branching and some amount of interconnection; and, in part, (ii.) of an irregular reticulation composed of thin pale-coloured horny fibres and of somewhat disorderly disposed spicules which for the most part are not enclosed within the horny fibres, but merely held together by them. The funes, also, are composed of reticulating horny fibres and spicules, but in them the meshes of the reticulation are much smaller and the spicules are much more uniformly oriented, the latter being in general not widely inclined from the longitudinal direction of the particular fune containing them; the funes are rendered plumose by the obliquely outward inclination of their most exteriorly situated spicules, some of which give rise to occasional short wispy strands.

In the single thick section* examined by me, these two types of skeleton-pattern—axinellid in the one case, somewhat approaching to halichondroid in the other—occur for the most part separately from each other. Thus, on the one side of a primary fune, which approximately coincides (probably merely by chance) with the mid-line of the section, the pattern is mainly of the former type; while on the opposite side of it, the pattern is mainly of the latter or more halichondroid type. The structure of the funes is such, however, that they might be interpreted simply as more condensed portions of the skeleton, in which at the same time the spicules tend towards a disposition in a common direction.

There is no dermal skeleton; and, furthermore, in a superficial layer of the sponge, varying from about 150 to 600 μ or so in width, no spicules occur except those composing the (somewhat distantly separated) extremities of the outwardly running fibres. As regards its histology, this layer (as seen in a

* In thin sections, as may easily be understood, the funes do not appear as such; and as a consequence, the arrangement of the skeleton seems to be rather confused. At first, having only examined such sections, I was disposed to regard as fairly satisfactory Lendenfeld's statement that "the skeleton consists of bundles of loosely disposed spicules, which are connected by very numerous others, scattered in such a way that the whole often appears like a dense mass of irregularly disposed spicules."

thin stained section) gradually assumes towards its exterior a structure somewhat resembling that of a stratified epithelium.

Spicules.—(*a*) The prevailing megasclere—that participating in the formation of the fibres—is a symmetrically curved, slightly fusiform, irregularly ended amphioxea, varying in length from about 240 μ (in the case of the slenderest) to slightly more than 500 μ, and in diameter from (seldom less than) 13 up to about 28 μ. The curvature when most pronounced is usually somewhat angulate. Except in the case of the slenderer (? immature) individuals, which for the most part (or perhaps exclusively) occur only between the fibres, the spicule narrows to its extremities as a rule, not by a continuous gradual tapering but by a series of more or less abrupt contractions that commence not farther than 30 μ from the extremities. The endmost contraction is frequently very pronounced, and the spicule is thereby rendered apiculate; the terminal portion of the spicule is then either sharp-pointed, resembling a mucro, or is rounded off at the point and nipple-shaped. A small proportion of the spicules are intermediate in the form of their extremities between oxea and strongyla, and rare styli also occur, the form of which clearly shows them to be the result of failure on the part of one of the actines of the oxea to attain to its normal development. In addition, there are present exceedingly scarce (apparently) abnormal, forms of cylindrical shape, either symmetrically ended (strongyla) or with one extremity abruptly narrowed, which range in length from less than 60 to (very rarely) upwards of 180 μ, and in stoutness from 8 to 14 μ; they recall the somewhat similar spicules of *Gellius rhaphidophora*, and should perhaps be reckoned as constituting a form distinct from the above spicules.

(*b*) The second form of megasclere is comparatively rare, and occurs scattered. Like the preceding, it is diactinal and very often exhibits some degree of irregularity in the formation of its extremities; but it differs in being of greater length and relatively slenderer, in having always more or less rounded extremities, and in being as a rule without curvature. The length, seldom if ever less than 500 μ, may attain to 810 μ; and the diameter, which is usually between 3 and 11 μ, may in rare instances be as great as 18 μ.

(*c*). The trichodragmata are fairly abundant, but are not readily detected owing to their small size; they measure 12 μ long by 6 μ or less in diameter. The trichites composing them are usually arranged in a somewhat confused fashion.

Loc.—Port Jackson.

Genus Reniochalina.

No species identifiable with either of the two (*R. stalagmites* and *R. lamella*) for which this genus was established, is known to me. The two specimens purporting to be their types, a brief description of which has been given by Whitelegge (who seems to have been satisfied to regard them as the genuine types), are quite irreconcilable with Lendenfeld's account of the species, either in external features or in skeleton: as they appear to me to be specifically identical (though possibly of different varieties) and not to be assignable to any hitherto established genus I have described them (in the Appendix to this paper) under the name *Axiamon folium*.

The specimens in question, it should perhaps be mentioned, are not labelled actually as *Reniochalina stalagmites* and *Reniochalina lamella*, but as "*Chalinodendron stalagmites*" and "*Renieroplax ianthella*"—the latter names being those given in the key-list as the manuscript synonyms of the former. However, among the fragments received from the British Museum there is one labelled "*Reniochalina stalagmites*," which is identically similar to "*Chalinodendron stalagmites*," as well as two others (of different species) labelled respectively "*Reniochalina arborea*" and "*Reniochalina spiculosa*," which also are examples of the genus *Axiamon*. In the face of these facts, I can only surmise that Lendenfeld originally intended to employ the name *Reniochalina* for a genus different from that for which finally he adopted it—and for which presumably he considered it more appropriate.

The genus *Reniochalina* was defined by Lendenfeld as follows:—"Lamellar, thin, branched, more or less flower-shaped

Renierinæ, with smooth surface and fibrous skeleton; the spicules are partly embedded in spongin." From the descriptions of the two species, we learn, further, that the skeleton consists of "three systems of fibres—one longitudinal extending from the base to the margin of the lamella, the second transverse, and the third perpendicular to the plane in which the other two extend"; that these fibres, thus forming a rectangular meshwork, consist of bundles of somewhat irregular spicules; and that the spicules are pointed diactinals of moderate size accompanied or not by relatively few styli. In the typical species, *R. stalagmites*, the spicules are oxea exclusively. It would appear, therefore, that *Reniochalina* is very similar to the genus *Axinosia* established by me in the present paper for *Axinella symbiotica* Whitelegge and like species, excepting that, in the latter, the spicules are predominantly styli. Several species (as yet undescribed) differing from *Axinosia* apparently only in the fact that their spicules are exclusively or almost exclusively oxeote are known to me; and for the accommodation of such species, I think, the genus *Reniochalina* might provisionally be made to serve. I am doubtful, however, whether these species will ultimately be found separable from the genus *Reniera*, unless on the additional ground of their lamellar external form.

It will be noticed in the case of *Reniochalina lamella* that the description which Lendenfeld gives of its external characters, wherein the surface of the sponge is stated to bear conuli, is contradictory to his definition of the genus. There is reason to suspect, therefore, that the external features ascribed to this species are those of a different sponge from that upon which the description of its skeletal characters was based and to which the name *Reniochalina lamella* was intended to apply.

Familia HETERORRHAPHIDÆ.

Subfamily STYLOTELLINÆ.

Under this subfamily, erected expressly for their reception, there are described in the Catalogue four species, for which

Lendenfeld introduces the new genus *Stylotella*. The *Stylotellinæ* are defined as *Heterorrhaphidæ* without differentiated microsclera, and without a hard spicular rind; and *Stylotella* is stated to have as its distinguishing characters: (i.) a very soft texture, and (ii.) megasclera in the form of styli, scattered and in bundles. Of the four species I am able to identify, with certainty, only two, *S. digitata* and *S. polymastia*. The latter of these proves to belong to the genus *Ciocalypta* (or perhaps to *Leucophlœus*); while the former, which was the first to be described and which I propose to regard as the type-species, is found to be identical with the earlier described *Hymeniacidon agminata* Ridley(33). This species, however, as will be seen from the description given below, differs considerably from typical species of *Hymeniacidon*, and undoubtedly requires to be placed elsewhere; for its reception the genus *Stylotella* may therefore be retained, with the following definition:—"Typically non-massive Suberitidæ(?), of comparatively soft consistency, with a well-defined dermal membrane which is provided with tangentially placed spicules and is underlain by subdermal spaces, and with a main skeleton composed of longitudinal spicule-fibres (devoid of spongin) and of scattered spicules. The spicules are typically of a single kind, styli or subtylostyli; microscleres are absent."

The genus, which is of doubtful systematic position, I refer to the *Suberitidæ* chiefly on account of the character of the skeleton, and the seemingly greater difficulty of justifying its inclusion in any other family. The serious objection to this is, of course, the absence of tylostylote spicules; but as regards the other features in which it departs from typical *Suberitidæ* it may be pointed out that the possession of a dermal membrane is characteristic of *Pseudosuberites* and *Caulospongia* (= *Plectodendron*), and that most species of *Semisuberites* and *Laxosuberites* are of soft consistency.

Lendenfeld's *Stylotella aplysillioides* appears, from its description, to belong to *Hymeniacidon;* and his fourth species, *S. rigida*, I regard (provisionally) as a synonym of *S. agminata*.

Of the several species which other authors have assigned to the genus, there is only one, I think, that can be permitted to remain therein, *viz.*, *S. digitata* var. *gracilis* Hentschel (21); and as this has the styli partially differentiated into two kinds, it may be looked upon as an independent species. Hentschel's *S. flabelliformis*, described in the same paper as the preceding, appears not to be referable to any hitherto established genus, and accordingly I propose to constitute it the type of a new genus, *Stylissa*, to be placed in the *Axinellidæ*. The species which Topsent (43) has referred to *Stylotella*, under the impression that his genus *Stylinos* was identical therewith, ought perhaps to be included in *Hymeniacidon*, as Dendy has maintained. It is very doubtful, however, whether *Stylinos jullieni*, the type species of Topsent's genus, can thus be disposed of. The so-called *Stylotella irregularis* Kirkpatrick (23), appears to be related to, and is perhaps truly congeneric with, the two species described by Whitelegge (57) under the names *Phakellia multiformis* and *Axinella symbiotica;* at any rate, these three species,—and also, I should say, *Axinella arborescens* R. & D.—might very well be referred tentatively to a single genus, and I, therefore, venture to create for them the genus *Axinosia* (with *Axinella symbiotica* as the type-species) which I would define thus: *Axinellidæ*, typically of ramose or lamellar habit, with a reticulate, subrenieroid, skeleton formed by plurispicular main fibres joined at more or less regular intervals by uni- or paucispicular transverse fibres. Spongin is comparatively scantily developed. The spicules are moderately small conical styli, together with typically fewer strongyla and (or) oxea, all of approximately the same dimensions. Microscleres are absent.

Stylotella digitata. (Pl. xix., figs.1-5; Pl. xx., fig.2; and text-fig.6).

Introductory.—This species, now to be known as *Stylotella agminata* Ridley, is represented in the collection of the Australian Museum by sixteen specimens, all from Port Jackson;

in addition to the single type-specimen, which is labelled "*Truncatella digitata*" and conforms closely to Lendenfeld's description, these also include the specimens labelled as the types of *Stylotella rigida*, *Tedania laxa*, and *T. tenuispina*—which three species, for reasons more clearly indicated in due course, I propose to regard as synonyms of *S. agminata*. Two further examples of the species occur also among the fragments of sponges received from the British Museum, one labelled "*Truncatella micropora*" (a MS. name), the other mistakenly labelled as "*Clathriodendron irregularis*." Among these fragments there is also one labelled "*Stylotella digitata*, Port Nelson, N.Z.," but this proves to belong to quite a different species; as a consequence there is reason to doubt Lendenfeld's correctness in recording the species from any locality other than Port Jackson.

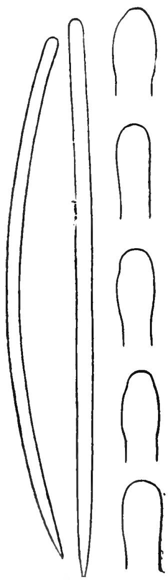

Fig. 6.
Stylotella agminata. *a*, Styli (or subtylostyli). *a'*, Basal extremities of subtylostyli.

Description.—The external features of the species have already been sufficiently described by Ridley and by Lendenfeld: in regard thereto, the latter author's descriptions of *Stylotella digitata* and *Tedania laxa* are applicable, but not strictly his descriptions of *S. rigida* and *T. tenuispina*. The oscula, concerning which these several descriptions are not quite in agreement, appear always to be few in number, scattered, and small; and usually to be more or less closed over by extensions of the dermal membrane. Ridley(33) has given a figure which conveys a very good idea of the form commonly assumed by erect specimens with cylindrical branches, and to this, I now add several others—one of which (Pl.xix., fig.3) shows an erect form, with crowded compressed parts due to imperfectly differentiated branches; while another (Pl.xix., fig.4) illustrates a more reticulately branched example of the species. The latter specimen, which consists of somewhat flattened, anastomosing branches forming a reticulate mass, approximates to Lendenfeld's description of *Tedania laxa*, though not so closely as do two other specimens which occur among the type-specimens of that species; and which, on account of their somewhat irregularly arranged skeleton, I at first thought to be specifically different from the rest. I mention this because, whereas Lendenfeld states that *Stylotella digitata* is intensely orange-coloured, and *Tedania tenuispina* bright orange-yellow in the living state, he states, of *Tedania laxa*, that "the colour of the living sponge is bright brick-red"; and it is possible, therefore, that two varieties of *S. agminata* occur, which differ in colour, and perhaps, to a slight extent also, in other respects.

The main skeleton (Pl.xx., fig.2) exhibits great variability in its precise mode of arangement, but always consists (i.) of longitudinally-running spicule-fibres, which are unconnected by cross-fibres, and from the most peripherally situated of which, short branches arise that pass outwards to the surface; and (ii.) of spicules which, though they are sometimes abundant, for the most part lie scattered singly. Diversity in the conformation of the skeleton results through variation in number of the scattered spicules, and through differences in stoutness of the main fibres, and in their distance apart. For descriptive purposes, four chief types of arrangement are distinguishable; but apparently all gradations between these occur, and different types may be found in different parts of one and the same specimen. (i.). The fibres are closely arranged, running parallel to one another at a distance apart, which may be even less than their own diameter; and scattered spicules are scarce or absent: this condition, which is uncommon, appears most usually to be met with in slender cylindrical branches. (ii.).The fibres are more widely separated, and scattered spicules occur in greater or less abundance, usually crossing one another in all directions so as to produce, when most abundant, the appearance of an irregular reticulation extending between the fibres; in this case, as in the preceding, the fibres are usually comparatively stout, being often as much as 130μ or more in diameter. (iii.). The arrangement of the scattered spicules is as in (ii.), but the fibres are slender, 20 to 70μ in diameter, and run sinuously, with frequent interosculation. (iv.) The fibres are rather slender and somewhat distantly separated from one another, while the scattered spicules are only moderately abundant, and are sometimes, in considerable proportion, disposed more or less longitudinally.

The first-mentioned type of arrangement is shown to best advantage by the British Museum fragment above referred to, labelled *"Clathriodendron irregularis"*; the second, by certain of the type-specimens of *Tedania laxa;* the third, also by specimens of *T. laxa;* and the fourth, by the type-specimen of *Stylotella digitata*. The third type of arrangement, or something intermediate between it and the first, is the commonest and most typical.

The dermal membrane overlies wide subdermal spaces, and is supported upon the extremities of short fibres—branches from the outermost of the longitudinal fibres—which are directed towards it more or less perpendicularly. The dermal skeleton consists of horizontally disposed spicules which, in general, are either loosely scattered without order, or are arranged somewhat in an irregular paucispicular network; around the oscula, however, they become more numerous and are disposed radiately. Occasionally, fibres from the main skeleton enter and run in the dermal membrane for a short distance before terminating.

The spicules are of a single kind, subtylostyli, usually with only a very slightly developed oblongish head, which is marked off by a scarcely perceptible constriction; occasionally the head is rendered more pronounced by a subterminal annular enlargement. They are cylindrical throughout the greater part of their length, taper gradually to a sharp point, and vary from straight to curved (or sometimes flexuous); usually the curvature is slight, and the proportion of straight to curved spicules about equal; but, at times, most of the spicules are curved, and some of them much curved. Their maximum size varies in different specimens, from 286 by 6 μ to 305 by 9 μ; while the shortest spicules in any given specimen are of between one-half and two-thirds the length of the longest.

Loc.—Port Jackson.

STYLOTELLA POLYMASTIA. (Text-fig.7).

Introductory.—The species is represented in the collection of the Australian Museum apparently only by a tiny fragment, labelled "*Truncatella polymastia,*" received from the British Museum. Judged by its spiculation, the fragment is undoubtedly a genuine example of the species, but unfortunately it is so small, that scarcely any information is obtainable from it concerning other characters. Nevertheless, it enables one to say that the species is certainly not assignable to the genus *Stylotella* as defined above, but, in all probability, belongs to *Ciocalypta*—under which genus I propose to bring it.

In connection with the figure which appears in the Catalogue (Pl.iv., fig.i.) in representation of this species, a serious error has been made. As I already have had occasion to mention, the actual specimen, from which this figure was taken, is still in existence (labelled in Lendenfeld's handwriting *Sideroderma navicelligerum* R.&D.), and belongs to a hitherto unknown species of *Histoderma*, described, in the Appendix hereto, as *H. actinioides.* One can see, on comparing the figure in question with Lendenfeld's description of *Stylotella polymastia*, that the two are not compatible, although showing in some respects an apparent agreement.

In order to make the following description of the species as complete as possible, I have repeated Lendenfeld's description of its external features: but it should be borne in mind that, possibly, this description is not applicable. In consequence of the small size of the fragment, I have not succeeded in securing sections cut in the proper direction to enable me to determine the exact arrangement of the skeleton, and my description of this is consequently to be regarded as only approximately correct.

Description.—"Massive sponges with numerous, irregular, mostly fistular processes arising from the upper surface. The sponge is attached by a broad base and attains a maximum diameter of 300mm. The oscula are situated terminally on the summits of the processes."

The main skeleton consists of dendritically branching, and occasionally interuniting, stout, plumose "funes"; and of numerous scattered spicules, the latter here and there forming dense masses connecting the "funes." The "funes" are either single fibres, or are composed each of several intimately associated fibres; these fibres consist of a spongin-axis, usually enclosing some longitudinally disposed spicules, and of numerous spicules which project from this axis at varying angles, some of them directed almost perpendicularly outwards in an echinating fashion. At the surface, the columns pass into broad, dense brushes of almost parallel spicules, the outer ends of which, apparently, give support to a dermal membrane; intermingled with the spicules of the brushes, are, sometimes, numerous irregularly disposed spicules. Whether there is a special dermal skeleton, is not quite certain; but, here and there, lying upon the outer ends of the brushes, horizontally directed spicules, forming a thin layer, were observed.

Spicules.—(*a*). The spicules which chiefly compose the fibres are straight or very slightly curved, gradually sharp-pointed, fusiform styli with a narrow handle-like basal end, of diameter sometimes less than half that of the thickest portion of the shaft, measuring from about 400 to 720 μ in length, by rarely more than 25 μ in maximum diameter. The longest spicules (those, say, of length exceeding 600 μ) are seldom, if ever, more than 20 μ in diameter; are always less distinctly narrowed at their basal end than the shorter, and relatively stouter spicules; and are connected by spicules of every intermediate grade with (*b*). Straight or slightly curved, gradually sharp-pointed, usually slightly fusiform styli, abundant in the superficial skeleton and scattered throughout the interior. These, which range in size from less than 300 by 5 μ to upwards of 650 by 15 μ, are probably not at all separable from

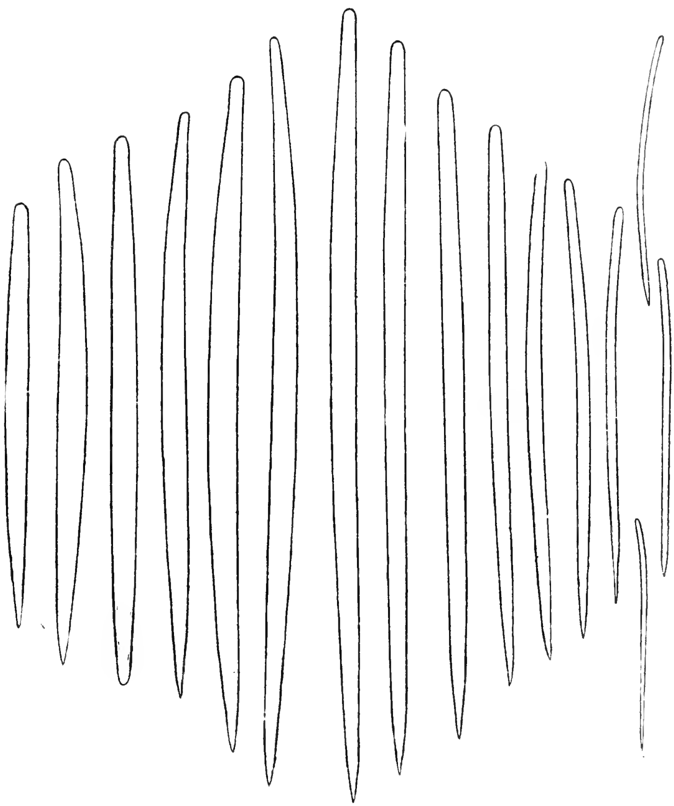

Fig.7,—*Ciocalypta polymastia.* Styli, showing transitions from one form to another.

(*c*). More or less curved styli, comparatively few in number, apparently occurring only as scattered spicules, ranging in length from 160 to upwards of 300 μ and measuring, at most, 8 μ in diameter.

Rare oxea, of the size of the smallest styli, were observed, which possibly are of foreign origin, since no intermediates between them and the styli were observed. The larger spicules, however, are certainly never oxea, nor do they ever approach to an oxeote form; though occasionally, through rounding off at their apical end, they may pass into strongyla.

Loc.—East coast of Australia.

Remarks.—In the form of its spicules, *Ciocalypta polymastia* somewhat resembles the type-species of *Leucophlœus*—i.e., *massalis* Carter(**6**); and it appears to agree with the latter also in certain features of the skeleton. I am inclined to think, therefore, that the two species are congeneric. What the precise arrangement of the skeleton is, in the latter species, however, Carter's description does not make quite clear; and subsequent writers, acquainted with the species, have omitted to state explicitly. Ridley and Dendy(**34a**) expressed the opinion that *Leucophlœus* cannot be distinguished from *Hymeniacidon;* but, at a later date, Dendy(**14**) states that *Leucophlœus massalis* is identical with *Ciocalypta penicillus* (the type-species of *Ciocalypta*), and mentions that, since the resemblance between these two species was pointed out by Carter himself, he is unable to understand why the genus *Leucophlœus* should have been proposed. In view of this, I am at a loss to understand why, subsequently, Dendy(**15**) recognised *Leucophlœus* as a distinct genus, related to *Hymeniacidon*. If it be correct that *L. massalis* approaches rather to *Hymeniacidon* than to *Ciocalypta* in the character of its skeleton, then, beyond question, the species described above is not assignable to *Leucophlœus*, since its fibres are decidedly of the axinellid type.

Topsent (**44**) in a paper which I have not seen, has apparently wrongly recorded, as *Stylotella polymastia*, a sponge from Amboina; for Kirkpatrick(**23**), speaking with reference to *Hymeniacidon conulosum* Topsent, mentions that "the nearly related species *Stylotella polymastia* Lendenfeld, referred to by Topsent (*l.c.*, p.466), is synonymous with *Hymeniacidon fenestratum* (Ridley)."

Stylotella rigida.

The specimen labelled as the type of this species (under the MS. name "*Truncatella rigida*"), as well as a fragment labelled *Stylotella rigida* from the British Museum, are specifically the same; and, in skeletal characters, accord with Lendenfeld's description; but in one conspicuous feature attributed to *Stylotella rigida*—*viz.*, the possession of oscula 1 to 3mm. in width, and situated at the extremities of the digitate processes—they are completely lacking. As a matter of fact, they are examples of *Stylotella agminata* Ridley. One is justified in concluding, therefore, that the description of *Stylotella rigida* confounds the external features of one species with the internal features of another, the latter being that represented by the type-specimen; and as the former is unknown and indeterminable, we may, accordingly, look upon *S. rigida* as, in effect, a synonym of *S. agminata*. An independent reason for suspecting that some such mistake as this was made in connection with *S. rigida*, is afforded by its specific name, the implication of which is in direct contradiction to Lendenfeld's definition of the genus *Stylotella* as "Heterorrhaphidæ of very soft texture."

Dendy(14) has mistakenly referred to this species, under the name *Hymeniacidon rigida*, a sponge from Port Phillip. As the description given of the latter is sufficient for its identification, I propose that it be called *Hymeniacidon victoriana*.

Stylotella aplysillioides.

The specimen preserved in the Australian Museum as the supposed type of this species—for the reason that it is labelled, in Lendenfeld's handwriting, with the name ("*Truncatellina cinerea*") given in the key-list as the manuscript synonym of *Stylotella aplysillioides*—is a small, very thinly incrusting sponge, apparently belonging to the genus *Mycale*, with a thin dermal layer of foreign particles, and a main skeleton consisting (i.) of unconnected ascending fibres composed of foreign (mostly spicule-) fragments, (ii.) of sparsely scattered subtylostyli measuring rarely as much as 130 by 3·5μ and (iii.) of a very few, scattered, slender toxa and anisochelæ, the latter measuring, at most, 17μ long. It is quite a different type of sponge, therefore, from that denoted by Lendenfeld's description, having no feature of resemblance thereto except an incrusting habit of growth, and even in this respect being not quite similar, since the layer it forms is only about 1mm. in thickness. Accordingly, in my opinion, it cannot possibly be accepted as the type-specimen.

A fragment from the British Museum, labelled *Stylotella aplysillioides*, is also totally unlike the described sponge of that name, and belongs to the genus *Dendoricella*—its spicules being skeletal oxea, dermal tylota, isochelæ arcuatæ, and two sizes of sigmata.

Hence we are left with no clue as to the identity of *Stylotella aplysillioides* except its rather brief description, which, if it can be relied upon, indicates that the correct position of the species is in the genus *Hymeniacidon*. To this genus, then, the species may, for the present, be regarded as belonging. The only other species of *Hymeniacidon* known from Port Jackson, is that recorded by Ridley(**33**) under the name *H. caruncula* Bowerbank; this is also a horizontally extended sponge with surface-elevations, but its spicules are stated to attain a size of 290 by 8μ, while those of *H. aplysillioides*, according to Lendenfeld, measure only 130 by 6μ.

Subfamilia PHLŒODICTYINÆ.

RHIZOCHALINA RAMSAYI. (Pl. xx., figs.2-5; Pl. xxi., fig.4; and text-fig.8).

The types consist of three half-specimens (derived by vertical bisection of the originals), and a thick, median, vertical slice of a fourth specimen. The sponge is massive, more or less globose, provided on its upper aspect with numerous thin-walled erect fistulæ, and below with few (sometimes only one) or many, usually branched, stout, root-like processes. The fistulæ are, almost without exception, widely open at their distal end, though this appears to be due to their having had the extremity broken off. The roots are tapered, and convey the impression that they serve the function of anchoring the sponge in mud; according to the original description, they may attain to a length of 300mm. The largest specimen (Pl. xx., fig.2) is of comparatively irregular form, being elongated in one horizontal direction, and compressed at right angles thereto; it measures 230mm. in length, by 180mm. in height; and (though only a half-specimen) is provided with about a dozen roots.

The original description states that, in addition to fistulæ, there occur on the upper surface of the sponge, at its centre, two to five much wider and shorter tubes, 20mm. wide and only 25mm. high, the cavities of which are occupied by a reticular structure: unfortunately, in the type-specimens, owing no doubt to their not being symmetrical halves of the originals, none of these tubes are present. It happens, however, that the trawling steamer "Endeavour" has recently obtained, from off the coast of New South Wales several specimens of a sponge closely related to *Phlœodictyon ramsayi*—I propose to designate it a variety, *pyriformis*, of this species—which provides the clue to the nature of these tubes.

The variety is a stoutish, pear-shaped sponge without roots, which evidently, in life, was attached by its narrower end to a hard substratum. The fistulæ, which are short and stout, are usually not numerous, and may be altgether absent; as, in the only specimens so far obtained, they are all more or less damaged, it is not known whether their extremities are open or closed. A characteristic feature of the sponge is the arrangement of its oscula (Pl.xx., fig.3), which open side by side to the number of between 50 and 100, together forming a slightly depressed, oval or circular, honeycombed area occupying the centre of the upper surface. This oscular sieve differs from that of the typical form of the species, as described by Lendenfeld, in the fact that its margin is not prolonged upward into a tube, but is level with the surrounding surface. The oscular canals are arranged in a manner conforming with the general symmetry (Pl.xx., fig.4): a few run upwards axially from the stalk, separated from one another only by thin partitions, while the remainder—which start from different points quite close beneath the surface—traverse the sponge radiately, in such manner as to come into parallelism with the axial direction before the oscula are reached. Other canals also occur, each of which is continuous with the lumen of a fistula.

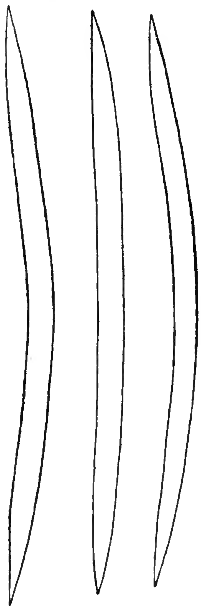

Fig. 8.
Phlœodictyon ramsayi.
Oxea.

As far as can be judged from the incomplete specimens of the typical form of the species, the arrangement of its canals is much the same as in the variety. (The probability is that the canals, which connect with the fistulæ, are inhalant in function).

The structure of the skeleton also is very similar in both forms, except that, in the root-like processes of the type, the main skeleton consists almost entirely of stout longitudinal fibres (50 to 200 μ in diameter) closely arranged like the strands of a rope; while, in the peduncle of the variety, the corresponding fibres are much more widely separated, and the intervening spaces are occupied by a renieroid, for the most part unispicular, reticulation, similar to that which is general throughout the body of the sponge. The fibres of the roots or peduncle, as the case may be, continue into the body of the sponge and spread dendritically through it, at a considerable average distance apart; here and there, they are connected by cross-fibres. Between the fibres, as already indicated, the skeleton consists of a renieroid reticulation. The fibres are composed of very closely packed, parallel spicules, which, apparently, are held together by a minute quantity of spongin.

The bast-layer consists of an irregular, unilamellar reticulation (Pl.xx., figs.4,5) of stout fibres immediately underlying the dermal membrane, and of numerous, inwardly directed, short, lamellar extensions of the same. The dermal skeleton proper is a single layer of horizontally disposed spicules crossing each other in all directions, and thus producing a somewhat lattice-like pattern.

The spicules are the same in all parts of the sponge—oxea, slightly and somewhat angularly curved, nearly cylindrical throughout the greater part of their length, and gradually tapering to sharp points. In the typical form of the species, their maximum size is 195 by 8μ, and their length ranges from 130 to 195 μ (but is very rarely less than 150 μ); in the variety, the spicules are a little larger, attaining to a size of 220 by 9·5 μ.

The typical form of the species comes from Port Jackson.

RHIZOCHALINA PETROSIA. (Text-fig.9).

The evidence indicates, beyond reasonable doubt, that, under this name, Lendenfeld has combined portions of the descriptions of two quite different species. In the Australian Museum, labelled, in that author's handwriting, with the MS. name corresponding (according to his key-list) to *Rhizochalina petrosia*, is a small, gauzy-textured, branch-shaped sponge, apparently belonging to the genus *Ciocalypta*, the spicules of which are oxea of exactly the dimensions stated in the description, *viz.*, 700 by 15 μ; and from the British Museum comes a small fragment labelled *Rhizochalina petrosia*, which both belongs to the genus *Rhizochalina* (i.e., *Phloeodictyon*) and exhibits skeletal characters such as render the specific name *petrosia* extremely appropriate, but in which the oxea are, at most, only 165 by 8·5 μ in size. Thus the former specimen possesses the skeletal features ascribed to the species, but is entirely different to it in external form: while the British Museum specimen (the external form of which I do not know), in spite of the above-mentioned serious disagreement with the description, affords practically indisputable reason for believ- it to exemplify the species to which the name *R. petrosia* was intended to apply. The question, as to which of these specimens is to be considered the type of the species, appears to me one that might be decided quite well by the toss of a coin; but as the latter best accords with the name, I propose that it be taken as the type—the species thus requiring to be called *Phlœodictyon petrosia.*

An adequate description of *Ph. petrosia* cannot, at present, be given, as the small fragment at my disposal consists of scarcely more than a portion of the rind. As far as can be judged from this, however, the species is distinct from any other that has been described. The rind is usually well-developed, attaining to a thickness of nearly 2 μ; its skeleton consists of an approximately rectangular, coarse reticulation of stout fibres, measuring up to 150 μ in diameter, composed of closely and not very regularly packed oxea uncemented by spongin. The skeleton bears a marked resemblance to that which is characteristic of many species of *Petrosia.* A dermal skeleton proper, external to the rind, appears to be absent. What little of the main skeleton is shown, consists mainly of scattered spicules exhibiting a tendency towards an arrangement in an irregular subrenieroid manner; but there also occur, at intervals, very stout fibres, similar to those of the rind, which apparently belong to inwardly-directed extensions of the latter, such as have been noticed in *Ph. ramsayi.* The spicules, which are the same in the rind as in the main skeleton, are somewhat angulately curved and abruptly sharp-pointed oxea, ranging in length from 130 to 165 μ, and measuring seldom less than 6 and not more than 8·5 μ in stoutness.

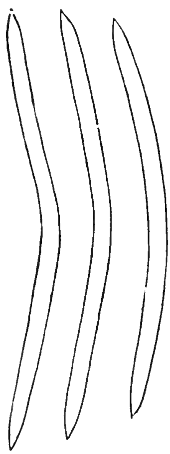

Fig. 9.
Phlœodictyon petrosia.
Oxea.

Loc.—Port Jackson.

Subfamilia Gellinæ.

Gellius panis.

The species is without a type-specimen, and, so far, I have met with no sponge identifiable with it. There appears to be no reason to doubt that the species belongs to the genus to which Lendenfeld has referred it.

Loc.—Port Jackson.

Gellius raphidiophora. (Text-fig.10).

Introductory.—The type-specimen conforms recognisably to the description, but the latter is at fault regarding the size of the sigmata and the maximum stoutness (which is 9·5, not 6 μ) attained by the oxea, and also omits to mention that the oxea are of three kinds, two of which—hence rather to be termed raphides—occur in dragmata: that raphides, however, were present in the original specimen, is both indicated by the description and implied by the specific name.

I have lately collected three specimens (from the underside of rocks exposed at low tide, near Port Jackson), which apparently in no way differ from the type of the species, excepting that their spicules are much slenderer, the stoutest oxea having (as it happens) only about the same diameter as that stated by Lendenfeld. As these specimens differ also among themselves (to the extent of 1·5 μ) in the diameter of their stoutest spicules, it is practically certain that they are not varietally distinct from the typical form, and, therefore, I have taken them into account in drawing up the following description.

Description.—Sponge massive, depressed, basally encrusting. Surface even or slightly undulated, smooth, very minutely reticulate (owing to the dermal skeleton). Oscula few, scattered, marginally flush with the general surface, measuring up to 3 mm. in diameter. Colour in life, bright yellow; in alcohol, light yellowish-grey. Consistency fairly soft and friable. The interior is traversed in various directions by many canals measuring up to 2 or 3 mm. wide; otherwise the structure is fairly compact.

Of the four specimens at hand, the largest measures 100 mm. long, by 70 mm. broad, and from 2 to 15 mm. in thickness; according to the original description, the sponge may grow to a thickness of 50 mm.

The main skeleton is an irregularly renieroid, paucispicular reticulation, the pattern of which usually appears much confused owing to the great number of scattered bundles of raphides: spongin is present in minute quantity, though apparently only at the angles of the meshes. In the most superficial region, loose polyspicular strands of spicules occur, which run perpendicularly to the surface and terminate in slightly projecting tufts coinciding in position with the nodes of the dermal reticulation. The dermal reticulation, for the most part, is triangular in pattern, and has the sides of its meshes formed of from two to five roughly parallel spicules.

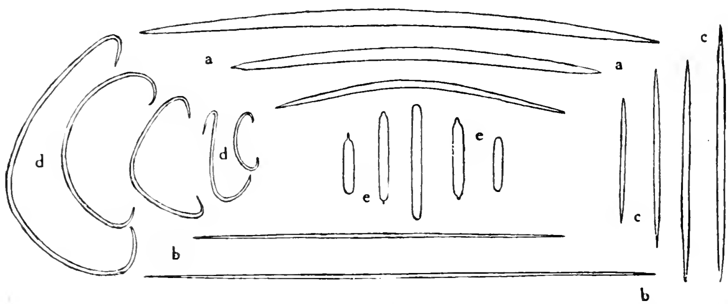

Fig. 10.—*Gellius raphidiophora*. *a*, Oxea. *b*, Sigmata. *c*, Longer raphides. *d*, Shorter raphides. *e*, Microstrongyles.

Spicules.—(*a*) Slightly curved oxea, very nearly cylindrical throughout the greater part of their length, and tapering gradually to sharp points. Size*: (*i*) 150 to 215 by 9·5 μ; (*ii*) 120 to 195 by 5 μ.

* The two sets of measurements—which refer to the range in length of the spicules, and to their maximum stoutness—are taken from the specimens whose spicules are the most different in point of size; the former measurements are those of the type-specimen.

(*b*) Longer raphides, occurring only in dragmata, straight, cylindrical, gradually sharp-pointed, and slightly dilated at intervals. Size: (*i*) 130 to 255 by 2·5 μ; (*ii*) 120 to 245 by 1·5 μ.

(*c*) Shorter raphides, occurring only in dragmata; straight, fusiform. Size: (*i*) 45 to 120 by 4·5 μ; (*ii*) 40 to 95 by 2·5 μ.

(*d*) Sigmata, very variable in size, but apparently not separable into two groups; the larger, as well as many of the smaller, are intermediate in shape between ordinary and flagellate sigmata. Length: (*i*) 15 to 76 μ; (*ii*) 15 to 70 μ. Stoutness: (*i*) 3·7 μ; (*ii*) 1·5 μ.

(*e*) Microstongyles, often somewhat pointed at one or both extremities; rare, but occurring in all specimens. Size: 16 to 50 by (*i*) 3 to (*ii*) 4 μ.

Loc.—Port Jackson.

Remarks.—On the evidence of a single specimen from Port Phillip, which I identify as *Gellius phillipensis* Dendy(**12**), this latter species is not more than a variety of *G. raphidiophora,* from which it differs chiefly in the fact that its longer raphides are immeasurably fine. In the specimen referred to, microstrongyles also occur, but are exceedingly rare, only a single example having been found in two slide-preparations.

G. raphidiophora is distinguished from all other species of the genus, not only in having two sorts of raphides, but also in the possession of microstrongyles; its sigmata, too, are of unusual form, and recall those of certain species of *Biemna*—e.g., *B. chilensis* Thiele(**42**), and *B. hamifera* Lundbeck(**31**). This fact concerning the sigmata seems not unworthy of notice, since also in *Biemna* the microscleres may include raphides and—if not microstrongyles exactly—siliceous globules. Actual microstrongyles, in association with raphides and sigmata, are elsewhere known to occur only in the somewhat aberrant *Tylodesma microstrongyla* Hentschel(**21**), and *Allantophora plicata* Whitelegge(**57**), two species which, I think, are allied to one another, though scarcely to be regarded as congeneric; but whether these microstrongyles (showing as they do some trace of centrotylosis) are homologous with those of *G. raphidiophora,* it is at present impossible to say.

TEDANIA RUBICUNDA. (Pl. xvii., fig.4; and text-fig.11).

Introductory.—The type-specimen—labelled "*Pellina rubicunda*"—although somewhat at variance with the description as regards spiculation, is so closely in agreement therewith, in most other respects, that any doubt as to its genuineness is quite precluded. The spicules are not, as Lendenfeld has stated, mainly *tylota,* but mainly styli—the former being abundant only in the dermal layer; furthermore, oxea are entirely absent, the tylota have conspicuously spined extremities, and the trichites are minutely spinulous. Thus, the spiculation—and, I might add, the general arrangement of the skeleton also—conform to those of *T. digitata,* of which species, therefore, *T. rubicunda* may, for the present, be considered a variety.

Description.—The single specimen (Pl. xvii., fig. 4) is a sessile, massive sponge, with a somewhat cylindriform, stoutish body, about 80 mm. in diameter and 100 mm. in height; which divides above into two larger, and is provided also, towards its upper aspect, with several smaller, digitiform, tapering lobes or processes. There is a well-defined dermal membrane, and the surface generally, except where bruised and damaged, is smooth and glabrous; the processes, however, show a few, usually quite shallow, longitudinal furrows or wrinkles. According to the original description, the processes are traversed by a central oscular tube, and have, at their summit, a number of small oscula. The first part, at least, of this statement is not strictly correct; except in their lower portion, the processes are traversed by distantly separated canals, and these are of small size, usually less than 1 mm. in diameter. These canals run longitudinally, gradually converging as the process becomes narrower, and (perhaps not in all cases) finally unite, at a variable distance from the extremity of the process, to form a single fairly wide canal. This terminal canal, no doubt, communicates with the exterior at the apex of the process, though the manner of accomplishment of this is not apparent in the present specimen; if it is by means of oscula, as is probably the case, these must be very small. The chief excurrent canals, both in the processes and in the body of the sponge, are surrounded by a relatively very broad layer or wall of collenchymatous tissue, which, to the naked eye, has a somewhat gelatinous and translucent appearance as compared with the surrounding denser tissue. The specimen, which is preserved in alcohol, is of a dull yellowish-white colour; it is of rather soft consistency, and is very easily torn asunder. In the living state, according to the original description, the colour is a bright orange-red, which is more pronounced and intense on the surface than in the interior.

In the body of the sponge, the main skeleton consists of a rather dense and confused, somewhat renieroid, reticulation of single spicules and of spicule-bundles (or short, paucispicular fibres), traversed at close intervals by well-defined, multispicular fibres (usually less than 50μ in stoutness) running, for the most part, in a surfaceward direction; scattered through the reticulation are raphides, which occur both singly and in bundles. In the processes, however, in correspondence with an increase in development of the multispicular fibres, the reticular component of the skeleton is more or less reduced, and, in their more central region, may occasionally disappear altogether; in the latter case, the skeleton consists almost exclusively of closely approximated, longitudinally-running fibres, the diameter of the stoutest of which may exceed 200μ. The fibres are everywhere composed of loosely aggregated, parallel styli, together with a small proportion of tylota. Spongin is entirely absent. In the extensively developed collenchyma surrounding the canals, the only skeletal elements are singly scattered raphides and tylota, the former abundant, the latter usually scarce. The ectosomal skeleton consists of closely approximated, slightly divergent, vertical tufts of tylota, with numerous raphides scattered between; the tufts often, though not usually, are prolonged inwards into loose straggling strands (of tylota) connecting with the multispicular fibres of the main skeleton; but in many places, especially where the dermal layer is immediately underlain by collenchyma, a discontinuity exists between the dermal and main skeletons, which is very marked.

Spicules.—(*a*) The styli are (as a rule, slightly) curved, or rarely straight spicules, of nearly uniform diameter throughout their entire length except for a distance of about 5 μ (or less) through which they taper to a sharp point; proceeding towards the basal end, however, they usually undergo a slight contraction, and then usually expand again, though only very slightly, at their extremity. Their length, which very rarely falls below 160 μ, may attain to 215 μ, and, on the average, is nearer to the latter figure than to the former; the diameter of the stoutest is 6 μ.

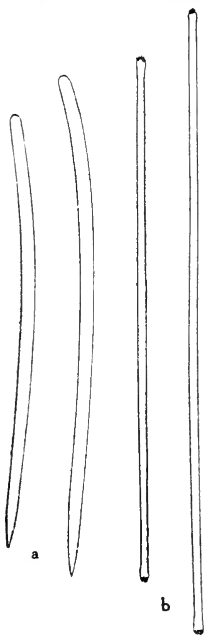

Fig. 11.
T. digitata var. *rubicunda*. *a*, Styli. *b*, Tylota. (Onychetæ not figured; similar in spinulation to those of *T. digitata* var. *rubra*).

(*b*) The tylota are straight or nearly so, with cylindrical or slightly fusiform shaft, and with elongate narrow heads, the extremities of which are truncate, and provided with about a dozen spines, averaging, say, 2 μ long; they range between 190 and 240 μ, and are seldom less than 210 μ in length, while their diameter is rarely, if ever, more than 3·5 μ.

(*c*) The raphides (onychetæ) are straight, asymmetrically fusiform, stylote, tapering gradually to a fine point at one end and to a truncated extremity at the other; their region of maximum stoutness lies nearer to the latter or basal end. Their base is frequently rendered apiculate by a minute spine situated at its edge, *i.e.*, outside the line of continuation of the axis of the spicule; sometimes there appear to be two such spines. The basal moiety (only) of the spicule is covered with minute spinules, which decrease in size towards the middle of the spicule and, gradually becoming indistinct, finally give place to a scarcely more than perceptible roughness of the surface. The raphides are, at most, 1·8 μ in diameter, and vary in length from 35 to 130 μ; individuals of length between 60 and 90 μ, however, are rare, thus indicating a partial differentiation of the spicules into two groups. The smaller raphides are scarce, except in the dermal skeleton, where their number equals, if it does not exceed, that of the longer ones.

Loc.—Port Jackson.

Remarks.—In the aggregate of its characters, *T. digitata* var. *rubicunda* appears to be well distinguished from any hitherto described variety of the species, and, in many respects, diverges so widely from the typical form as almost to justify its recognition as an independent species; possibly, however, it may prove to be identical with the insufficiently described *T. digitata* var. *fibrosa*, R. and D., which is recorded from the same locality (Port Jackson). Its chief diagnostic features are the digitate, massive, external form; the well-defined asponginous fibres; the considerable range in length, and partial separation into two groups of the raphides; and the character of the extremities of the tylota.

Hentschel(**20**), misled by Lendenfeld's description of *Tedania rubicunda*, has briefly described, under that name, a sponge, from the west coast of Australia, in which the dermal spicules are amphistrongyla (apparently with non-spinose extremities), and which, in other respects also, differs markedly from the sponge here redescribed.

TEDANIA LAXA.

Labelled in Lendenfeld's handwriting "Truncatella laxa"—the MS. synonym of *Tedania laxa*—there are, in all, twelve specimens, eleven occurring together in one jar, and one separately. They vary very considerably in their exact external form, though all are much alike in colour, consistency, and surface-appearance; and all agree in being composed of clustered, usually more or less inter-united, moderately slender branches. Some, for example, have the branches very intimately intergrown and partially fused with one another, in such a way as to give rise to a rather compact reticulate mass, and are thus, as regards external form, apparently in close agreement with the description of the species; whereas others are more erect and arborescent, and include among them several that exhibit a conspicuous resemblance to the type-specimen of *Stylotella digitata* (= *S. agminata*). While external examination of the specimens afforded no reason to doubt that at least the more massive-looking would be found in complete conformity with the description of *T. laxa*, microscopical examination yielded, in every case, the same result, and showed them to be no more than a series of forms of *Stylotella agminata*. Yet, at the same time, there was presented the very striking coincidence that, in the arrangement of their skeleton and approximate size of their spicules, the specimens actually do agree with the description of *T. laxa*, almost perfectly. In the face of such evidence, a contention that the specimens are other than examples of this species cannot well be sustained; and one has to conclude that *Tedania laxa* is no more than a synonym of *Stylotella agminata*. The probability of the correctness of this conclusion is supported by other considerations, as follows:—According to its description, *T. laxa* differs from *S. agminata* only in the following particulars: the sponge grows to a comparatively large size (nearly twice that of the largest specimen of *S. agminata* in the collection); oscula are not apparent; the colour of the living sponge is bright brick-red; and the spicules, in addition to styli, include tylota, oxea, and rare trichites. But the difference in mere size of the sponges is of very doubtful importance, as also is their difference in colour; the oscula of *S. agminata* are often very difficult to make out (owing apparently to their becoming closed over, as a result of contraction, by the dermal membrane); and there is present, in this species, a small proportion of slender megascleres which, without critical inspection, could very easily be mistaken for trichites. Also, allowance must be made for the fact that, in regard to matters of spiculation, the Catalogue is often seriously at fault; and of especial significance in this connection is the erroneous spiculation ascribed to *Tedania rubicunda* and *T. rubra*. And, finally, it is to be noted that the pattern of the skeleton of *S. agminata* bears no inconsiderable resemblance to that (in certain parts) of *T. rubicunda*, and, indeed, might be described in precisely the same terms as Lendenfeld, in his description of the latter species, employs.

TEDANIA RUBRA. (Text-fig.12).

Introductory.—Although the specimen which I describe hereunder, is far from satisfactorily agreeing with the original description, yet, as it is labelled in Lendenfeld's handwriting with the name ("Truncatella renieroides"), given in the key-list as the MS. equivalent of *T. rubra,* and as it actually is a *Tedania,* the balance of evidence undoubtedly points to its being a genuine example of the species, and justifies the conclusion that the original description is inaccurate. The latter states, among other things, that oscula are present, which measure 2 to 3 mm. in width; that the fibres consist (only) of spicules; and that the spicules are styli measuring on the average $200 \times 6 \mu$, tylota, oxea, and irregularly curved, hair-like spicules. In the specimen, on the other hand, there are no evident oscula (though scattered over the exterior, there is a number of small oscula-like openings, due to the presence of operculate cirripedes close beneath the surface); the fibres are composed of spicules cemented and usually also ensheathed by spongin; oxea are entirely absent; the styli measure at most $205 \times 6 \mu$; the "tylota" have spined, and scarcely at all expanded, extremities; and the hair-like spicules (spinulous raphides) are almost invariably straight. As an indication of the limited importance attachable to these discrepancies, it may be remarked, firstly, that those in connection with the spiculation are almost exactly the same as have been found to occur in the case of *Tedania rubicunda,* and, secondly, that the actual mistake of describing, as oscula, holes caused by symbiotic cirripedes, was made by Lendenfeld in the case of *Cliona lutea* and of *Spirastrella ramulosa.*

The megascleres (and, at first sight, also the raphides) of *T. rubra* resemble so very closely those of *T. digitata* var. *rubicunda,* that had I examined no more than preparations of their spicules, I should certainly have pronounced the two sponges to be specifically identical; in view of its well-developed spongin-fibre, however, the like of which apparently has not been met with in any other of the numerous known forms of *T. digitata,* it seems necessary that *T. rubra* should be ranked as an independent variety.

Description.—The single specimen is a solid massive sponge, of somewhat brick-shaped form (but with rounded angles and partly uneven surface), measuring 55 mm. in height, and 45 mm. by 30 mm. in cross-section; the inequalities of the surface are mostly restricted to the upper aspect of the sponge, and take the form of conical, dome-shaped, or papilliform elevations of small size, the largest (which is of exceptional size) measuring 6 mm. in height, and 5 mm. across at its base. There is a well-developed, non-separable, dermal membrane, with smooth, almost glabrous, surface. Oscula of minute size, certainly less than 0·5 mm. in width, are probably present, and, judging by the direction of the main excurrent canals, occur on the upper surface, generally (though apparently not exclusively) at the summits of the elevations; as, however, the canals are of very small size (being rarely as much as 1 mm. in diameter), and are not traceable, owing to their partial collapse, all the way to the surface, the existence of undoubted oscula could not be demonstrated.

The colour in alcohol is yellowish within, and dull white on the surface. In consistency, the sponge is moderately firm, yet compressible, and, by reason of its fibrous skeleton, is resilient and fairly tough.

The main skeleton is a reticulation of spiculo-spongin fibres between which there lie scattered, without recognisable order and in varying abundance, usually not numerous megascleres and raphides, the latter occurring both singly and in bundles; entering into its composition also, but not contributing to form the reticulation, are occasional (yet constantly occurring) continuous strands of loosely associated, parallel spicules uncemented by spongin. The spicules of the spongious fibres are styli and tylota, the latter relatively very scarce except in the ectosomal region; in the asponginous fibres, on the other hand, the tylota may predominate over the styli, and also a few raphides make their appearance. The scattered megascleres are chiefly tylota. The skeleton-reticulation consists chiefly of multispicular main fibres (with compact spicule-core, on the average less than ten spicules broad) running irregularly, usually not much more than a spicule's length apart, and with occasional branching and anastomosis, in a general surface-ward-direction; the connecting fibres, which vary from unispicular to rarely multispicular, occur at rather variable intervals, and, where the main fibres are more widely separated, from between them an irregular inter-reticulation. As the surface is nearly approached, the connecting fibres disappear, and the outwardly-running fibres become split up into numerous closely-arranged and parallel strands of loosely-associated tylota, ending at the surface, each in a slightly penicillate tuft; in the dermal skeleton thus constituted, there occur in addition to the vertically arranged spicule-strands only a very few scattered raphides. In places—though this seems to be exceptional—the dermal skeleton, while otherwise unchanged in character, appears not to be in continuity with the main skeleton. The extent to which spongin is developed in connection with the fibres, varies considerably in different parts; frequently it forms a quite conspicuous sheath which, in thickness, may exceed the diameter of the spicule-core, the fibre as a consequence attaining sometimes to a stoutness of 40μ or more; usually, however, it is barely more than sufficient to hold the spicules together; while towards the surface, it further diminishes in quantity and finally disappears. The main excurrent canals are surrounded by a narrow layer of collenchymatous tissue in which the only skeletal elements are scattered tylota and raphides.

Spicules.—The megascleres, as already stated, are hardly distinguishable from those of *T. digitata* var. *rubicunda*—even in size being not materially different. The styli (when full-grown) vary in length from 155 to 200μ, and are at most 6μ in diameter; the tylota are never less than 175μ in length, and attain a maximum size of $230 \times 4\ \mu$. The very slenderest immature tylota, it was noticed, have the axial canal open at one end, and, at that end, their spines are less advanced in development than at the other.

Raphides (onychetæ) occur of all lengths between 20 and 155μ, but those exceeding 135 μ are scarce; there is also a rarity of individuals of certain intermediate sizes, with the consequence that, roughly, three groups are recognisable, having the following approximate ranges of length: (i.) 20-40 μ; (ii.) 55-70 μ; (iii.)

90-155μ. Those of the third group are the most abundant, while those of medium size, which are the least frequent, are comparatively very scarce. Besides differing in size, the raphides of the three groups exhibit, as a general rule, certain appreciable differences in other respects also, though all agree in being very gradually sharp-pointed at one extremity, and abruptly truncated at the other, in being more or less spinulous, and in having the spinules pointing in the direction of, and progressively increasing in size towards, the truncated or basal end of the spicule. (i.) The smallest raphides are conical in shape, tapering gradually from base to apex; are spinulous over their entire extent; and are usually much less than 1 μ in diameter. (ii.) The rather rare raphides of intermediate size are fusiform, with the region of greatest stoutness nearer to the basal end than to the middle of their length; are provided over their whole length with spinules which attain to a larger size than those of either (i.) or (iii.); and are always relatively stout in proportion to their length, their diameter being seldom much less than 2 μ. (iii.) The longest raphides are slightly fusiform, with the region of greatest stoutness situated nearer to the middle of their length than to the basal end; have a merely roughened surface, or (as a rule, only in the case of the stoutest) are perceptibly spinulous over their basal moiety only; are commonly terminated at their truncated end by a slender spine; and vary in stoutness from less than 1 μ to slightly more than 2 μ.

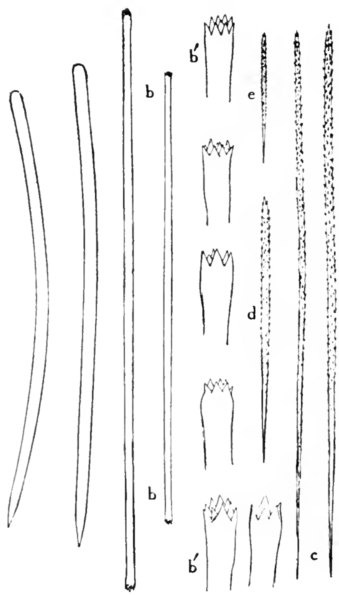

Fig. 12.
T. digitata var. *rubra*. *a*, Styli. *b*, Tylota. *c*, Onychetæ.

Loc.—Port Jackson.

Tedania tenuispina.

The specimen purporting to be the type of this species—and, moreover, the only specimen, either in the collection of the Australian Museum or among the fragments received from the British Museum, which is labelled as representing the species—is considerably at variance with the description of *Tedania tenuispina* in regard to its outward form, and departs therefrom also in some other respects,—being, in fact, an example of *Stylotella agminata.* Nevertheless, in skeletal characters it exhibits, on the whole, a very considerable degree of correspondence with that description; and were the specimen but possessed of the external habit ascribed to *T. tenuispina,* one would not hesitate at all to accept it as an example thereof. Accordingly, the question presents itself as to whether the alleged type-specimen should be rejected as wrongly labelled, and as having no relation whatsoever to the species under consideration; or whether the description should be regarded as an erroneous one, combining an account of the external features of one species with that of the internal features of another, the latter species being that which is exemplified by the type-specimen. The evidence is insufficient to enable one to decide positively; but, for the following reasons, I am disposed to give preference to the view that the description confuses two species, one of which is *Stylotella agminata.* In the first place, the external form ascribed to *T. tenuispina* is opposed to the likelihood of its belonging to *Tedania,* inasmuch as the species of that genus appear always to be more or less massive in habit; and it is an admissible assumption, therefore, that the species has been either generically misnamed or else misdescribed in respect of its external characters. Secondly, the description is open to suspicion owing to an apparent incongruity; for, in the paragraph relating to the outward characters of the sponge, it is stated that the surface is "roughened by projecting spicules"—which would seem unlikely except in the case of a sponge having spicules of fair length, say, 0·5 mm. or more; whereas, according to the latter part of the description, the spicules have a length of only 220 μ. Thirdly, no reliance can be placed upon the statement that, in addition to styli, "a few tylota and oxea are also found"; for Lendenfeld has erroneously also attributed all these three kinds of megascleres to each of the other three species assigned by him to *Tedania*. Fourthly, the description is not in accordance with Lendenfeld's definition of *Tedania,* inasmuch as it contains no mention of the occurrence of raphides in the species. And, lastly, owing to the doubt which thus attaches to the account given of the spiculation of *Tedania tenuispina,* it is impossible to assert that the ostensible type-specimen is *not* an example of the species upon which the description of the skeletal characters of *Tedania tenuispina* was based, for in other respects, it agrees with that description sufficiently well.

I propose, therefore, to regard *Tedania tenuispina* as practically synonymous with *Stylotella agminata.*

For Reference List of Literature, see *antea*, pp.310-313.

For Explanation of Plates xv.-xxiv., see *antea*, pp.313-315

FURTHER NOTES ON THE BOTANY OF LORD HOWE ISLAND.

(Fifth Paper.*)

By J. H. Maiden.

(Plate xxviii.)

Additional Bibliographical Notes.

1. McGillivray, J.—Letters from, in Hooker's New Journ. of Botany, vi., 353 (1854).
2. Rev. W. B. Clarke's Presidential Address. Proc. Roy. Soc. N.S.W., iv., 37 (1870).

The following extract from a letter, written by Mr. Charles Hedley, on the island during his visit in September, 1908, is very interesting. Both he and Mr. W. S. Dun collected botanical specimens freely, and presented the whole of their collections to the National Herbarium, Sydney.

"When I asked what I could do for you on Lord Howe Island, you replied that material from the high ground would be particularly acceptable.

"Mt. Gower forms a massive block, the flat summit of which, according to the guides, is only accessible by a spur running from the head of Erskine Valley, and as far as we could see, except at this point, the mountain is surrounded by tiers of huge wall-like precipices. It will illustrate the steepness of the track to say that the wild pigs have never been able to reach the summit, and that a dog, which accompanied us, had to be handed up from ledge to ledge over what the islanders call the 'getting-up places.'

"The summit is a plateau of about 200 acres, which at a distance appears almost level. Actually, several small streams

* The other papers will be found in these Proceedings, xxiii., 112(1898); xxiv., 381(1899); xxvi., 156(1901); xxvii., 347(1902).

excavate the plateau into shallow valleys, and then discharge in waterfalls over tremendous cliffs. These little dells have a beneficent effect on the vegetation, since the plants here escape distortion and hedging by the wind, and grow in shelter to their natural proportions,

"Low trees about 20 feet in height, and shrubs, grow densely; the ground is hidden by interlacing bowers, and progress through them by stooping and crawling is slow and awkward. The tallest tree is *Dracophyllum* (*Fitzgeraldi*) which reaches a maximum height of 40 feet. Tree-ferns and palms, which are equally abundant. overtop the level of the scrub. Whereas the palms of the low lands are markedly gregarious, sometimes occupying tracts to the exclusion of other plants, the mountain palms grow here and there sporadically among the other trees.

"Abundant moisture was a dominant expression of the flora. 'Here are cool mosses deep,' though we cannot finish the Tennysonian verse. Trunks, particularly of tree-ferns, appeared as green columns, so clothed were they with moss or *Hymenophyllum*. Epiphytes straggled everywhere, and a large proportion of trees threw out adventitious roots. Ferns grew luxuriantly, taking the place of herbs. Indeed, a *Plantago* (*Hedleyi*, n.sp., J.H.M.) on the track, and a straggling large-leaved plant with composite flower-heads in the axils (*Elatostemma reticulatum*) were almost the only herbs seen.

"The lowland flora had, of course, almost disappeared, the banyan (*Ficus columnaris*) goes a short distance up the hill. The last stunted *Pandanus* (*Forsteri*) was left about the 2,000 feet zone. The *Exocarpus* (*homoclada*) is one of the few species I recognised as having an uninterrupted range from top to bottom. But the coast-flora has representatives. A small orchid replaces the beach-congener. A pepper grows taller, and has a larger, rounder leaf. Wilson says the mountain 'kava' has a red seed, but the lowland one a yellow." (*Piper excelsum* is the only known kava).

Specimens of the following plants were brought from the summit of Mt. Gower :—*Drimys Howeana* F.v.M.; *Pittosporum erioloma* F.v.M. & C. Moore; *Dysoxylon pachyphyllum* Hemsl.;

Metrosideros nervulosa C. Moore & F.v.M., a bush about 10 ft. (foliage only); *Coprosma putida* F.v.M. & Moore; *Randia stipularis* Ch. Moore & F.v.M.; *Brachycome segmentosa* F.v.M., about 600 feet below; *Olearia Balli* F.v.M.; *Olearia Mooneyi* F.v.M., (tree 15 feet, up to 8 inches diameter); *Senecio insularis* Benth.; *Tecoma austro-caledonica* Burm.; *Negria rhabdothamnoides* F.v.M., (about 10 feet; common on summit); *Plantago Hedleyi*, n.sp.; *Piper excelsum* Forst., (10 feet); *Exocarpus homoclada* Ch. Moore & F.v.M.; *Elatostemma reticulatum* Wedd.,(this, and the Plantago, the only herbs growing on the summit); *Dendrobium gracilicaule* F.v.M.; *Luzula longiflora* Benth.; *Clinostigma Mooreanum* F.v.M., together with ferns.

Admiralty Islets.

Mr. Hedley writes:—"Hemsley* notes the lack of information on the flora of Ball's Pyramid and the Admiralty Islands. We landed on the largest of the Admiralty Islands for the purpose of gathering sea-birds' eggs. The flora proved uninteresting. There are no trees, but a few shrubs, not in flower, clinging to the steep north side. The southern slopes are set with scattered grass-tussocks among which the Wideawakes (*Sterna fuliginosa*) and Gannets (*Sula cyanops*) were laying their eggs. The grass happened to be in flower. Among the tussocks trailed the New Zealand Spinach and a *Mesembryanthemum*. There was a salt-bush, a giant sedge; and *Sonchus oleraceus* had established itself."

The plants collected by Mr. Hedley on the Admiralty Islet are :—*Lepidium foliosum* Desv., *Erechtites quadridentata* DC., *Mesembryanthemum æquilaterale* Haw., *Tetragonia expansa* Murr., (N.Z. Spinach), *Cyperus hæmatodes* Endl., *Poa cæspitosa* Forst., the common tussocky grass of the islands.

The following species is deemed to be new :—

PLANTAGINACEÆ.

PLANTAGO HEDLEYI, n.sp.

Slopes of Mount Gower, April, 1898. Leaf only(J.H.M.).

"Common on rocky ledges on the crest of Mt. Gower, 2,840ft." September, 1908 (C. Hedley and W. S. Dun).

* Annals of Botany, x., p.230(1896).

Top of Mt. Gower. December, 1910 (Dr. T. Harvey Johnston). (The type).

Eastern face of Mt. Lidgbird. August, 1911 (Rev. W. W. Watts).

Herba perennis, radice lignosâ. Folia lanceolato-spathulata, 5-23 cm. longa, circa 3 cm. lata, superne basi pilosa parte majore glabra. Flores in spica 4-8 cm. longa, bractea exteriore carinata, margine ciliata, 5-6 mm. longa, superne basi pilosa. Sepala 4, margine scariosa, carinata, circiter 4 mm. longa. Corollæ tubus 4-locularis, nervo medio, margine leniter scariosâ, tubo corollæ lobis circiter bis æquilongo. Stamina 4, filamentis corollæ circiter bis æquilongis. Stylus simplex, breve pilosus, petala valde superans.

Capsulam maturam non vidi, operculo cum stylo persistente deciduente, ovulis placentæ liberæ centrali compressæ irregulariter spathulatæ adhærentibus.

A perennial with a woody root-stock.

Leaves lanceolate-spathulate, 2 to 9 inches long (say 5 to 23 cm.) with an average width, in the lanceolate portion, of 1 to 1½ inch (2½-4 cm.). The base of the leaf has tufts of long hairs on the inner side. The leaves as a whole are glabrous, with the exception of a slight sprinkling of silky hairs on some of them. *Flower-stalk* long and glabrous, with a few silky hairs under the spike, the spike exceeding the leaves. *Flowers*: spike 4-8 cm. long, outer bract keeled, with ciliate edge, from 5-6 mm. long with tuft of hairs at base inside. *Sepals* 4, with scarious margins, keeled, about 4 mm. long. *Corolla-tube* 4-lobed, with a central nerve and very slightly scarious margins. The tube is about twice as long as the corolla-lobes. *Stamens* 4, with filaments about twice as long as the corolla. Anthers cordate, the connective pointed at the top. *Style* simple, besprinkled with short hairs, greatly exceeding the petals. *Immature capsule* (ripe capsule not seen) opens circumsciss, the opercular portion falling off with the long persistent style, leaving the ovules attached to a compressed, irregularly spathulate, free central placenta.

Affinity.—It seems to come nearest to *P. aucklandica* Hook. f., a New Zealand species, but the latter seems to differ from *P.*

Hedleyi in the length of the leaves, which are only 5-10cm. long, obscurely sinuate-dentate in *P. aucklandica* instead of entire, and usually much longer as in the new species.

The leaves of *P. aucklandica* are also ovate and obovate.

The ovarium in *P. Hedleyi* is much shorter than the calyx, and 5-7 seeded, instead of (?) twice the length of the calyx and 2-seeded in *P. aucklandica*. The placenta is also different in shape in *P. aucklandica*.

The circumsciss line is always visible round the ovarium in the new species.

CRUCIFERÆ.

Capsella Bursa-Pastoris Mœnch.

Mr. Hedley writes:—"In view of your note on *Capsella Bursa-Pastoris* (Proc. Linn. Soc. N. S. Wales, xxiii., 1898, p.121, foot-note), I looked out for it. What seemed to be this, is marked as from Waterhouse's cultivation paddock." Mr. Hedley's surmise is correct.

Lepidium foliosum Desv. (also on Ball's Pyramid) of my former paper (*op. cit.*, xxiii., p.123), is in A. Thellung's "Die Gattung Lepidium (L.) R.Br." (Zurich, 1906), called *L. Howei-insulæ* Thell., n.sp.

VIOLACEÆ.

Hymenanthera novæ-zelandiæ Hemsl., Kew Bulletin, 1908, p.96.

The species hitherto recorded for Lord Howe Island as *H. latifolia* Endl. (See Hemsley, Ann. Bot., x., 231).

Hemsley states that it differs from the New Zealand specimens in having apparently thinner leaves, as seen in the dried condition at least. The flowers are exactly the same.

ELÆOCARPACEÆ (formerly in Tiliaceæ).

Elæocarpus sp. (These Proceedings, xxvii., 1902, 347).

"Mueller (Fragm., ix., 77) includes the genus *Elæocarpus* (Tiliaceæ): 'Elæocarpus foliatione, quæ tantum nota, E. foveolato similis,' but there is no specimen in any of the collections received at Kew." Hemsley, Ann. Bot., x., 232.

I had overlooked the above reference. We still have not sufficient material to determine this plant specifically.

MELIACEÆ.

Dysoxylon pachyphyllum Hemsley.

The plant recorded as *D. Fraserianum* Benth., (*loc. cit.*, p.124) has been described by Hemsley as a new species. See Hemsley in Icones Plantarum, t.2827, and my Forest Flora of New South Wales, Part xxv., p.82, and Part xxx., p.173.

SAPINDACEÆ.

Dodonæa viscosa L.

D. lanceolata F.v.M., of Hemsley, *loc. cit.*, p.234, should be *D. viscosa* L., according to Prof. Radlköfer in a letter to me.

MYRTACEÆ.

Acicalyptus Fullagari F.v.M.

Further on the road (Erskine Valley—lower road) where the aneroid gave a level of 700-1800 feet, Mr. Hedley notes the "Scaly Bark" as fine large trees.

PRIMULACEÆ.

Anagallis arvensis L.

Collected on the Island by Mr. Hedley. It is a new record.

OLEACEÆ.

Notelæa quadristaminea Hemsl.

On entering the Erskine Valley by the "lower road," *i.e.*, the track along the Lidgbird cliffs, we came on a forest of Blue Plum (These Proceedings, xxiv., 1899, p.381).

BIGNONIACEÆ.

Tecoma austro-caledonica Burm.

Mr. Hedley writes :—"In view of your note (These Proceedings, xxiii., 1898, p.132) on *Tecoma*, I put in a few flowers. Mr. Dun verified my observation that the Island plant is without any smell. I believe *T. australis* has an unpleasant odour." The Australian plants placed under the name *T. australis* R.Br., require further examination, and will probably be found to include more than one species. The coastal (Australian) form has sweet-scented flowers. The flowers of specimens from Mudgee, Werris Creek, and some other New South Wales localities, have an offensive smell, attracting blow-flies.

PIPERACEÆ.

PEPEROMIA AFFINIS Domin, in Queensland Agric. Journ. xxiv., 222, 1910.

Prof. Domin told me verbally that the plant attributed to *P. reflexa* A. Dietr., from Lord Howe Island (see Hemsley, Ann. Bot., x., 249) is his *P. affinis*.

PALMEÆ

HEDYSCEPE CANTERBURYANA F.v.M.

This Palm fruited for the first time in the Botanic Gardens, Sydney, in August, 1913. See a note of its flowering, together with a photograph, in these Proceedings, xxiv., 1899, p.382.

HOWEA BELMOREANA Becc. (These Proceedings, xxiii., 1898, p.137.

See a paper "Dichogamie Protérandre chez le Kentia (Howea) Belmoreana", par J. Daveau (Journal de Botanique, 16 Janvier, 1896).

PANDANACEÆ.

PANDANUS FORSTERI F.v.M. and C. Moore. (These Proceedings, xxiii., 1898, p.140.)

Warburg, in his monograph,* synonymised *P. Moorei* F.v.M., with *P. Forsteri*, as I had surmised. So that there is only one species on the island. He figures a drupe (Fig.13,E).

GRAMINEÆ.

PASPALUM DISTICHUM L.

In These Proceedings, xxiii., 1898, p.143, I pointed out that, in this grass, we had three and even four spikes, and suggested the name *anomalum* for this form. Mr. W. B. Hemsley (then of Kew) writes: "The production of three spikes is not a rare occurrence, and hardly justifies the distinction of this form as a variety."

FILICES.

The Rev. W. W. Watts has published a paper† on "The Ferns of Lord Howe Island," and I propose to leave the critical revision of the species to him.

* "Das Pflanzenreich" (Pandanaceæ).

† These Proceedings, xxxvii., 1912, 395.

I desire to thank Mr. E. Cheel for kind assistance in the preparation of this paper.

EXPLANATION OF PLATE XXVIII.

Plantago Hedleyi, n.sp.

A, Small plant, natural size, showing woody root-stalk.

B, Flower. The calyx-lobes have scarious edges and a narrow keel; *c*, one lobe removed. The anthers cordate, the connective pointed at the top.

D, Bract, ciliate edge, tuft of hairs at the base inside; broadly keeled.

E, Flower-tube opened out, showing the attachment of the filaments between the lobes of the corolla.

F, Pistil.

G, Immature capsule.

H, The upper opercular portion of the capsule separated from the lower part, in which remains the free central placenta with from 5 to 7 ovules.

I, The placenta, showing the depressions where the ovules were attached.

K, Part of leaf from a larger plant, showing tufts of long hair at the base, on the upper side of the leaf.

A STUDY OF THE LEAF-ANATOMY OF SOME NATIVE SPECIES OF THE GENUS *ANDROPOGON*.

[N.O. GRAMINEÆ.]

By E. BREAKWELL, B.A., B.Sc.

(Plates xxix. xxxiii.)

The microscopic anatomical examination of the leaves of some native species of the genus *Andropogon*, as discussed in the following pages, was made for two purposes. Firstly, to investigate any similarities or differences that may exist in the general and detailed internal structure of the leaves of different species: and, secondly, to investigate any œcological characteristics in the structure of the leaf, which may be associated with, and accompany, the general habit and habitat of the plant in question.

The method adopted, in preparing the sections, was briefly as follows. The fresh leaves, in small pieces, were fixed in picro-acetic acid. Great difficulty was at first experienced in eliminating the siliceous elements from the leaves; but, eventually, a successful method was found in soaking them, for some considerable time, ranging from 8 to 12 hours, in a 50 per cent. solution of hydrofluoric acid and water.

The embedding, cutting, staining, and mounting were performed by Mr. W. A. Birmingham, of the Biological Branch of the Department of Agriculture, to whom I am much indebted for the really excellent manner in which he prepared the specimens. My thanks are also due to Mr. G. P. Darnell Smith, B.Sc., F.I.C., F.C.S., Biologist, for his courtesy, and for permission to use the biological apparatus. The stains used were hæmatoxylin and erythrosin. It was found necessary to decolourise after staining in hæmatoxylin. These two stains appear to give a fairly good differentiation. The methods adopted, in embedding and mounting, were similar to those used in ordinary microtechnique.

ANDROPOGON INTERMEDIUS R.Br. (Plate xxx.).

In the widest portion of the leaf, there are nine primary bundles, *i.e.*, bundles in which the sclerenchyma is in direct contact with the phloem or xylem, or separated from the latter by thin-walled cells only. The primary bundle of the midrib is the largest. There are 33 secondary bundles, *i.e.*, bundles in which phloem and xylem are completely surrounded by chlorophyll-bearing cells. There are also present six bundles of an intermediate type. In these bundles, the sclerenchyma is developed under the bundle, but separated from the phloem and xylem of the bundle. The primary bundles are surrounded by thick-walled cells—the mestome sheath. On the outer side of these are thin-walled parenchyma-cells which, in this case, are very indistinct.

Midrib.—In the widest portion of the midrib there are three primary bundles, and these are open above and below. The chlorophyll-bearing parenchyma-cells, surrounding the middle bundle, are smaller than those surrounding the mestome bundles. The sclerenchyma on the lower surface of the midrib is well developed, but that on the upper surface consists of but few cells, which are in direct contact with the epidermal cells. The sclerenchyma on the superior surface of the other two primary bundles is much better developed than that of the middle primary bundle. The phloem tissue is extremely well developed in all the primary bundles, and this also applies to the xylem tissue. Xylem and phloem tissue are also developed in the secondary bundles, the former preponderating.

The epidermal cells on the lower surface are extremely irregular in size. The cuticle, by which they are protected, is not particularly thick, except over the primary bundles, and at the edges of the leaf. The epidermal cells on the upper surface are as small as those on the lower surface only under the secondary bundles. In all other cases, they are considerably extended in size, penetrating deeply into the mesophyll-tissue. These cells, termed by Warming hinge-cells, and known in American literature as bulliform cells, are not fan-shaped, but in rows ranging in series from 5 to 8, and situated between the primary bundles. Stomata are found on both surfaces of the leaf, the proportion on the lower surface to that on the upper surface being approximately as 3 : 1. They appear on the upper surface at the edges of the series of bulliform cells, and also occasionally about the centre of the series.

Andropogon affinis R.Br. (Plate xxix., fig.2).

In the widest portion of the leaf, there are eight primary bundles, forty-four secondary bundles, and three intermediate bundles.

In the midrib proper, there is only one primary bundle. On each edge of the midrib, there is also a primary bundle, and that of the midrib is not as large as the others. The chlorophyll-bearing cells of the midprimary bundle are irregular in size, and smaller than those of the other bundles. As in *A. intermedius*, they are not continued right round the bundle, but are interrupted, on both the superior and inferior surfaces, by sclerenchyma. The chlorophyll-bearing cells of the secondary bundles are much larger than those of the primary bundles, and the mesophyll-sheath is very distinct. The sclerenchyma on the inferior surface of the primary bundle is not as well developed as in *A. intermedius*, nor is that on the superior surface. The sclerenchyma on the superior surface of the primary bundles at the edge of the midrib is better developed than in any of the other primary bundles, and is in direct contact with the bundles. Generally speaking, there is not the same development of sclerenchyma right throughout the leaf as in *A. intermedius*.

The epidermal cells on the inferior surface are irregular in size, and are protected by a thin cuticle, which, however, is not nearly so well developed as that of *A. intermedius*. The epidermal cells on the superior surface are bulliform in character, with the exception of those over the primary bundles. They penetrate the mesophyll-tissue more than do those of *A. intermedius*, are distinctly fan-shaped in character, and arranged in series of 5 to

7. The stomata are present on both the inferior and superior surfaces, and in about the same proportion, approximately 3 : 1. Occasional trichomes can be seen on the inferior surface.

Andropogon sericeus R.Br. (Plate xxix., fig.1).

Leaves of this grass, from two widely divergent localities, viz., Nyngan and the Botanic Gardens, were examined, but no essential differences between them could be found. In the widest portion of the leaf, there are five primary bundles, thirty-two secondary bundles, two intermediate bundles, and ten bundles of a secondary type, but which have sclerenchyma developed on the inferior surface.

As in *A. affinis* and *A. intermedius*, there is only one primary bundle in the midrib proper. The sclerenchyma, both on the superior and inferior surfaces of this bundle, is much better developed than is that of *A. affinis*. The development of sclerenchyma throughout the leaf, is much greater than in *A. affinis*, but not so great as in *A. ischæmum*.

The epidermal cells on the inferior surface are very irregular in character, and very many are papilliform. The epidermal cells on the superior surface partake of the character of bulliform cells except, as in *A. affinis*, above the primary bundles. They are more numerous, however, than in *A. affinis*, in series of 7 to 9, and decidedly fan-shaped in character. Trichomes and stomata are numerous on the inferior surface, and a few of the latter may be seen on the superior surface. Those on the inferior surface are, as a rule, guarded by papilla-like cells. The cuticle is comparatively thin, and, unlike *A. ischæmum*, of uniform consistency throughout.

Andropogon ischæmum Linn. (Plate xxxi.).

In a transverse section, there may be seen four types of bundles, namely, primary, secondary, intermediate, and a fourth type, which has sclerenchyma developed on both the superior and inferior surfaces, but not in direct contact with it. In the widest portion of the leaf, there are eleven primary bundles, forty-six secondary bundles, twenty of an intermediate type, and two of the fourth type.

There are three primary bundles in the midrib. The middle primary bundle has sclerenchyma well developed, on both the superior and inferior surfaces. The middle primary bundle is not larger than the other two primary bundles of the midrib. Each lateral primary bundle has sclerenchyma better developed than in most of the other species. A characteristic feature of this grass is the extreme development of the sclerenchyma on the superior surface of the midrib, extending the greater part of the distance between the primary bundles. Generally speaking, the secondary and intermediate bundles of this species are more crowded and more numerous than those of the other species.

The epidermal cells on the inferior surface are very irregular in size, some being exceptionally large. The cuticle is much thicker than in *A. affinis*, *A. sericeus*, and *A. intermedius*, and is more developed under the midrib and at the leaf-edges. The cells on the superior surface are mostly bulliform in character. They differ, however, from the bulliform cells of the species previously cited, in being much wider, not fan-shaped, and protected by a well developed cuticle. Stomata are very numerous on the inferior surface, but are not as plentiful on the superior surface as in *A. affinis*, *A. intermedius*, and *A. sericeus*. Trichomes are numerous.

Andropogon refractus R.Br. (Plate xxxii.).

In a transverse section of the widest portion of the leaf, there may be seen nine primary bundles. The secondary bundles are not so numerous as those cited in the other species, being only twenty in number. The intermediate bundles are very numerous, there being twenty-one of these.

The midrib is very wide, embracing bodily three primary bundles, and extending so that two other primary bundles border it at the edges. The middle primary bundle has well developed sclerenchyma on the inferior surface, somewhat wedge-shaped in character, and projecting well beyond the level of the epidermis. It also encircles the greater part of the phloem-tissue. On the superior surface, it extends from the epidermis to the xylem-tissue, and surrounds the latter throughout the greater part of its extent. The extreme development of sclerenchymatous tissue results in the elimination of many of the chlorophyll-bearing cells, so that the latter are only few in number.

All the primary bundles have the sclerenchyma well developed, and in direct contact with the phloem- and xylem-tissue. It does not, however, surround the phloem- and xylem-tissue as in the case of the primary bundle; and, consequently, the chlorophyll-bearing cells are more numerous and more regular in size than in the case of that bundle. The intermediate bundles are completely surrounded by chlorophyll-bearing parenchyma, but the sclerenchyma is extremely well developed on the inferior surface, and projects well beyond the level of the epidermis.

The epidermal cells on the inferior surface are uniform in size. Over many of the primary and intermediate bundles, they become more or less lignified, and take on the character of sclerenchyma-cells. Between the masses of sclerenchyma mentioned above, the epidermal cells are arranged in grooves. In some cases, the apical cell of the conical masses of projecting sclerenchyma is extremely large. Throughout the whole of the inferior surface, the epidermal cells are protected by an extremely thin cuticle. The epidermal cells on the superior surface take on the character of bulliform cells. These are noteworthy inasmuch as they form a double row of cells, the bottom row being much larger than that above. These cells extend throughout the whole space between the primary bundles, and have not the fan-shaped characteristics present in the other species. The stomata are numerous on the inferior face, and, in most cases, are sunk in the epidermal grooves between the masses of sclerenchymatous tissue. A few stomata may be seen on the superior face, but they are not as plentiful as in the other species.

ANDROPOGON BOMBYCINUS R.Br. (Plate xxxiii.).

The anatomical structure of a leaf closely resembles that of *A. refractus*. The principal points of difference are :—

(1.) The number of secondary bundles is smaller.

(2.) The sclerenchymatous masses developed under the primary and intermediate bundles are larger.

(3.) The epidermal cells on the superior surface have subimposed two, three, and sometimes four layers of similar uncoloured parenchymatous cells.

(4.) No stomata can be perceived on the superior surface.

(5.) A girdle-canal is present.

From an anatomical standpoint, the species under discussion may be divided into three groups, viz.:—

Group i. { *Andropogon intermedius.* / *A. affinis.* / *A. sericeus.* }

Group ii. *Andropogon ischæmum.*

Group iii. { *Andropogon refractus.* / *A. intermedius.* }

In considering the first group, it may be seen that there are certain well defined points of difference between *A. intermedius* and the other two species; and also less defined differences between *A. affinis* and *A. sericeus.* In *A. intermedius*, there are more primary bundles in the midrib, than in *A. affinis* or *A. sericeus.* The intermediate bundles, with a corresponding development of sclerenchyma, are also more numerous than those of the other two species; and the bulliform cells are not as distinctly fan-shaped. *A. sericeus* differs from *A. affinis* only in the slightly greater development of the sclerenchyma, and in the slightly greater number of bulliform cells in each series.

A. ischæmum differs from the first group in the much greater development of the sclerenchymatous tissue, which, however, is not as great as that of the third group. The cuticle is also much thicker, on both the superior and inferior surfaces, than that of the previous species. Another characteristic difference is the nature of the vascular bundles, which are much more numerous, and more densely crowded than in any of the other species.

A. refractus and *A. bombycinus* differ widely from any of the species of the other two groups. The extreme development of sclerenchymatous tissue, the thick nature of the cuticle on both the superior and inferior surfaces, and the arrangement of stomata in grooves on the inferior surface, are well marked characteristics, which are not seen in any of the other species.

Ecological characteristics.

The morphological structure of the leaves of *A. refractus* and *A bombycinus* shows well marked xerophytic characteristics. The well developed sclerenchymatous tissue, besides aiding in the mechanical strength of the leaf, also has a connection with the dry environment (*see* Warming, Ecology of Plants). The cuticle is also extremely thick on both the superior and inferior surfaces, thus depressing transpiration.

The presence of strata of water-storing cells, on the superior surface, is also a well marked xerophytic characteristic. Whether the bottom layer functions as hinge-cells, curling up the leaves on losing their turgescence, is uncertain. It has been pointed out by Warming and others, that, when hinge-cells occur and function in rolling the leaf when diminished transpiration is necessary, the stomata mainly occur on the superior surface, and are thus protected. The stomata, in the two species in question, are mostly confined to the inferior surface; and it is difficult to see what advantage the leaf would have, so far as the stomata are concerned, if it were rolled up. The stomata, being arranged mostly in grooves, are well protected, when the leaf is in the flat position. This xerophytic stomatal arrangement is also referred to by T. Holm* in discussing some of the lowland species of the Rocky Mountains, Colorado,

The presence of "girdle-canals" in *A. bombycinus* is also probably a xerophytic characteristic, designed to depress transpiration. These are referred to by Giltay, as occurring in some arenicolous grasses.

The habitat of these two species corresponds, to a very large extent, with their xerophytic characteristics. *A. refractus* is distributed over a great part of New South Wales, and is commonly foumd in sandy and rocky situations *A. bombycinus* is confined mostly to the interior, and is often found on sand-hills.

In *A. ischæmum*, the xerophytic characteristics are not as well marked as are those of *A. refractus* or *A. bombycinus*, but it may be considered more xerophytic than *A. intermedius*, *A. affinis*,

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* Botanical Gazette, Vol. xlvi.

or *A. sericeus.* This is seen in the crowded vascular bundles, the amount of sclerenchymatous tissue, and in the thick cuticle. Although the bulliform or hinge-cells on the upper surface are distinctly fan-shaped, the advantage in the folding of the leaf is somewhat uncertain, as most of the stomata are confined to the inferior surface.

A. ischæmum is a grass well adapted to sandy and rocky situations. In "L'Herb. Bossier" (vi., 971), it is mentioned as occurring commonly in sandy places in the Geneva Valley; and also in rocky places on the side of the Alps. In Australia, it grows on the Drummond Ranges in West Australia

A. intermedius, *A. affinis*, and *A. sericeus* do not show, in their structure, any well marked xerophytic characteristics, and are inclined to be more mesophytic in their nature. This is seen in the comparatively small amount of sclerenchymatous tissue, the comparatively thin cuticle, and in the distribution of the stomata, which are numerous on both faces of the leaf.

A. intermedius is spoken of as thriving best on river-banks in New South Wales. In Africa, a variety of this grass is also mentioned by Stapf as commonly occurring on the banks of rivers.

A. sericeus, however, is commonly spoken of as a drought-resistant grass; but I cannot reconcile this view with my practical experience with it. Rather does its habit correspond more to the mesophytic type. The grass has died out at Cowra, Wagga, and Bathurst Experiment Farms; and although a good catch was secured, under moist conditions, at Nyngan Demonstration Farm, the plot is always quick to show the effect of dry weather. On the other hand, the structure of the leaf, with its numerous stomata and comparatively thin cuticle, indicates the possible adaptability of the grass to irrigable conditions. This has been practically demonstrated at Bathurst Experiment Farm, where the grass made a profuse and succulent growth under irrigation. As soon as the effects of the latter were removed, the grass quickly died out.

My experience has also been that, in its natural state, it is more commonly found on the better and moister soils; and that, even in the plains of the interior, although it responds readily to rain, it will quickly "brown-up" under dry weather-conditions.

EXPLANATION OF PLATES XXIX.-XXXIII.

Explanation of References.

S, Stereome—P, Phloem—X, Xylem—C.P, Chlorophyll-bearing Parenchyma—B, Bulliform cells—M.S, Mestome-sheath- St, Stoma—U.P, Uncoloured Parenchyma—$M.B_1$, Primary Mestome-sheath—$M.B_2$, Special form of secondary bundle—$M.B_3$, Secondary Mestome-bundle—$M.B_4$, Intermediate Mestome-bundle.

Transverse sections of leaves of species of *Andropogon*.

Plate xxix.

Fig. 1.—*Andropogon sericeus* R. Br.
Fig. 2.—*A. affinis* R. Br.

Plate xxx.

A. intermedius R. Br.

Plate xxxi.

A. ischæmum Linn.

Plate xxxii.

A. refractus R. Br.

Plate xxxiii.

A. bombycinus R. Br.

ORDINARY MONTHLY MEETING.

AUGUST 26th, 1914.

Mr. W. S. Dun, President, in the Chair.

The President referred to the decease of Sir Normand MacLaurin on 24th inst., the senior surviving Original Member of the Society, enrolled in 1874. After perusing the well-deserved tributes to Sir Normand's worth, in many capacities, in the newspapers of the last two days, the President said that Members would be able to realise afresh his kindness in attending the Meeting of the Society in June of last year, to unveil a portrait of his old friend, the late Professor W. J. Stephens, painted and presented by Miss Stephens. Speaking from personal knowledge of the men by whom, and the circumstances under which, the Society was launched nearly forty years ago, and under the stimulating influence of an appreciative audience and a congenial subject, Sir Normand, by his genial presence and by his admirable address, contributed in greatest measure to the success of one of the most notable Meetings the Society had ever held.

On the motion of the President, it was resolved, that an expression of the Society's regret, of its appreciation of Sir Normand's long connection with the Society, and of sympathy should be tendered to Dr. Charles M. MacLaurin.

The Donations and Exchanges received since the previous Monthly Meeting (29th July, 1914), amounting to 16 Vols., 67 Parts or Nos., 6 Bulletins, and 1 Pamphlet, received from 53 Societies, etc., were laid upon the table.

NOTES AND EXHIBITS.

Mr. W. W. Froggatt showed a number of loose plates from "Gould's Mammals of Australia"; and a series of Loranths from the interior.

Mr. H. L. White, of Belltrees, sent, for exhibition, four fossil vertebræ from about the median portion of the dorsal region of *Cimoliosaurus australis* Owen, found about 50 miles west of Richmond, Queensland, where an extensive deposit of fossil remains is said to occur. There are three known types of these Ichthyopterygians in the Lower Cretaceous of Australia, viz., *Cimoliosaurus*, *Ichthyosaurus*, and *Plesiosaurus*, remains of which have been found in Queensland and New South Wales.

Mr. E. Cheel exhibited fresh specimens of the common groundsel (*Senecio vulgaris* L.) attacked with *Puccinia tasmanica* Diet., collected at Gordon by Mr. A. H. S. Lucas. For previous records, see the Society's Proceedings, 1910, xxxv., pp.524 and 805.

Mr. G. A. Waterhouse exhibited a long series of the five described geographical races of *Tisiphone abeona* Don.

Mr. A. A. Hamilton showed a series of specimens from the National Herbarium, including (1)*Hypochæris* sp.(West Maitland; W. M. Carne; April, 1914), showing prolification of the inflorescence. In the initial stages, the ray-florets are suppressed, the achenes attenuated, and the pappus contorted, the capitula being finally reduced to a series of bracts. In the more complicated case, a lateral stem arises from the base of the primary plant, bearing a second plant, which, in its turn, has produced a third, the two latter having the appearance of stolons but not rooting. From the primary capitula of the intermediate plant, peduncles are produced, upon which abortive florets are situated, one above the other at short distances apart, the stems continuing through them, and terminating in secondary capitula in which the process is repeated, the secondary peduncle also perforating one or more florets.—(2)*Primula vulgaris* Huds., [Sydney Botanic Gardens (cult.); W. Challis; October, 1913] exhibiting prolification of the inflorescence accompanied by fasciation. A few flowers ascend in the usual manner from the short caudex, which has elongated and become fasciated; upon the apex of this secondary stem, an abnormal number of involucral bracts are produced, indicating that several scapes are represented; a second series of flowers arise among the bracts, some of which consist of a calyx, while the remainder are seen to be in various stages of imperfection.—(3) *Velleya paradoxa* R.Br.,(Dubbo; J. L. Boorman; January, 1914) showing foliar prolification of the inflorescence accompanied by fasciation and spiral torsion. Stems bearing tufts of leaves, together with abbreviated racemes of mostly abortive flowers, are noted rising from the floral bracts, which are in some cases represented by radical leaves.—(4) In Moore's "Handbook of the Flora of N.S. Wales," one of the characters relied on for the separation of *Scaevola suaveolens* R.Br., from *S. microcarpa* Cav., is the size of the leaves, which are stated to be often large in the former and rather small in the latter. In the specimens exhibited (those of *S. suaveolens* being the largest to be found on Lady Robinson's Beach) this character is reversed.—(5) *Acacia elongata* Sieb., (Waterfall; A. A. Hamilton; June, 1914), a series of examples (including suckers) from an individual plant, showing variation in length and habit of foliage, the suckers exhibiting juvenile leaves and attenuated phyllodes.—(6) *Grevillea sericea* R.Br., (Lawson; A. A. Hamilton; November, 1913), an example with an exceptionally elongated raceme, consisting of some thirty flowers, the normal raceme seldom comprising more than half that number.—(7) *Tecoma australis* R.Br., (Cook's River; A. A. Hamilton; November, 1913), showing leaf-variation. The number of leaflets ranges from one to thirteen: they vary greatly in size, and the margins may be either entire or serrate.—(8) Four cyperaceous plants not recorded previously for the localities mentioned : *Heleocharis multicaulis* Sm., Newcastle (A. A. Hamilton; October, 1911); *Tricostularia pauciflora* Benth., Otford (A. A. Hamilton; November, 1911); *Lepidosperma Neesii* Kunth, Wentworth Falls (A. A. Hamilton; April, 1914); and *Mesomelæna deusta* Benth., Leura (A. A. Hamilton; April, 1914).

A REVISION OF THE MONAXONID SPECIES DESCRIBED AS NEW IN LENDENFELD'S "CATALOGUE OF THE SPONGES IN THE AUSTRALIAN MUSEUM." Part iii.

By E. F. Hallmann, B.Sc., Linnean Macleay Fellow of the Society in Zoology.

(Plates xv.-xxiv.)

Familia DESMACIDONIDÆ.

Subfamilia Esperellinæ.

Under this subfamily, Lendenfeld describes four new species, one of which—wrongly named *Sideroderma zittelii*—is found to belong elsewhere; the other three, he correctly assigned to the genus *Esperella*. In addition, he records *Sideroderma navicelligerum* R. & D., from Port Jackson; but, for reasons stated in connection with my remarks on *Sideroderma zittelii*, I consider this record too doubtful for acceptance. One of these species of *Esperella* (or *Mycale*, as it is now called), namely *E. penicillium*, belongs to the small group of related species for which Dendy(**15**) has proposed the genus *Paresperella*. Concerning the necessity for this genus, there is room for difference of opinion; and Hentschel(**20**), the only author who has since had occasion to deal with a *Paresperella*-species, does not recognise nor even mention it. I propose to take a middle course, and to regard *Paresperella* as a subgenus of *Mycale*. As the species of *Mycale* number considerably over one hundred, and comprise a wide diversity of forms, it is much to be hoped that a subdivision of the genus, into a number of subgenera, will be found possible. One other group, at least, which seems deserving of subgeneric rank is that comprising the species characterised by the possession of pore-grooves, viz., *M. lingua* Bow., *M.*

*artica** Frstdt., *M. placoides* Cart., *M. murrayi* R. & D., and *M. dendyi* Row; and for this group, of which *M. lingua* would be considered the type, the name *Raphiodesma* Bow.(1) stands available. Also it is probable, in virtue of the peculiarities of their chelæ, that *M. parasitica* Cart., and the closely related *M. ancorina* Whtlg.(57),† —for the former of which Carter(8) introduced the genus *Pseudoesperia*—are entitled to subgeneric distinction. A figure of a chela, that undoubtedly came from a *Pseudoesperia*-species, is given in Bowerbank's Monograph(Vol. i., fig.135) with the information, "from a circular group on the interstitial membranes of an undescribed species of *Hymeniacidon*, from Fremantle, Australia." For this undescribed sponge, although known to him only from a single spicule, Gray(17) proposed the generic name *Grapelia;* and this, being of older date than *Pseudoesperia,* would perhaps require to be employed if the subgenus were adopted. Another possibly admissible subgenus of *Mycale* is *Protoesperia,* proposed by Czerniavsky (10) for certain species from the Black Sea; and, as I have lately made known (18), it was for a species of *Mycale,* of somewhat divergent type, that Lendenfeld introduced the genus *Arenochalina.*

In the event of its being considered advisable to establish other subgenera, the possible validity of certain names proposed by Gray (e.g., *Corybas* for *M. lobata*, *Aegagropila* for *M. aegagropila*, and *Carmia* for *M. macilenta*) should receive consideration.

I might here record the fact that *Cladorhiza waitei* Whtlg.(57) belongs to the genus *Mycale.*

* *M. lingua* Bow., var. *artica* Fristedt, which, as it differs from *M. lingua* in the dimensions of its spicules, must be an independent species according to Lundbeck(31a).

† I am acquainted with a species from Port Phillip (provided, like *M. ancorina*, with anisochele-rosettes of *two* kinds) which I formerly believed to be *M. parasitica*, having assumed that the non-mention of the occurrence of rosettes of a second kind in Carter's and in Dendy's account of that species was due to an omission. But recently Hentschel(20) has described, from Western Australia, *Mycale parasitica* var. *arenosa*, in which, also, rosettes of one kind only are said to be present. It is possible, therefore, that *M. parasitica* has been correctly described in regard to its spiculation, and that the species above referred to is a new one.

SIDERODERMA ZITTELII. (Pl.xv., fig.6).

The description of this sponge, which atttributes to it a unique combination of the spicular characters, proves to be erroneous in two vital particulars; the trichites, mentioned therein as forming the cortical skeleton, are, in reality, small tylostyli, and chelæ are absent; also, there are no oxea present, though some of the principal megascleres are so narrowed at the base as closely to resemble oxea. The general characters of the species are, in fact, distinctly those of the genus *Polymastia;* and this, it would appear, was subsequently discovered by Lendenfeld himself, for, among the fragments received from the British Museum, there are two of this species, one labelled actually *Polymastia zittelii,* the other bearing the MS. name *"Polymastia australis."* There is only one specimen (Pl. xv., fig. 6) of the species in the Australian Museum, the claim of which to be considered the type-specimen rests on the fact that it is labelled, in Lendenfeld's handwriting, with the manuscript name *"Zittelia digitata,"* the published equivalent of which is given in the key-list as *Sideroderma zittelii;* and on the fact that, except in the mentioned particulars and in some minor points in relation to the dimensions of the spicules, it corresponds in every way exactly with the description. One can only suppose that the chelæ, mentioned by Lendenfeld as occurring in the outer layer of the cortex, were foreign; and the other errors are explicable on the supposition that the spicules were examined and measured only *in situ.*

The species is nearly related to *P. insidis* Thiele(**42**), and perhaps also to *P. affinis* Thiele(**42**), both of which it resembles in this respect, namely, that the largest or fibre-forming spicules frequently exhibit bulbous dilatations of their shaft. The following brief account of the spiculation, taken along with Lendenfeld's description of the external features and (*vide infra*) his figure of the sponge (**27**, Pl. ii., fig. 2), will be sufficient to enable one to identify the species.

Spicules.—These are: (1) Elongated, fusiform styli; forming the fibres and also scattered between; frequently polytylote; sharp-pointed at the apex; narrowing much (sometimes almost pointed), at the base; with a maximum diameter of 22 μ, and a length which, usually exceeding 900μ, ranges from (rarely less than) 500μ up to 1200μ (ii) Small tylostyli; composing the cortical skeleton and scattered in the choanosome; as a rule, slightly curved; 85 to 135μ long, and seldom as much as 4·5μ in diameter. (iii) Larger tylostyli; occurring only in the choanosome; closely resembling the preceding in shape, and possibly connected with them by intermediate forms; 145 to 210μ in length, and up to 7μ in diameter.

It remains to be mentioned, that the type-specimen of *Polymastia zittelii* bears a likeness so extremely close to the figure given in the Catalogue (Pl. ii., fig. 2), with the title *Sideroderma navicelligerum* R. & D., as to enable one to say, with the utmost positiveness, that the original of the figure actually was a specimen of *P. zittelii.* Moreover, I am inclined to doubt, on the evidence available, whether Lendenfeld really had a specimen of *Sideroderma navicelligerum* at his disposal. The only specimen in the Australian Museum bearing Lendenfeld's label certifying it to be one identified by him as such, namely, a specimen labelled "*Desmacidon polymastia*" (which name is given in the key-list as the MS. synonym of *S. navicelligerum*), is found to be an example of a new species of *Histoderma—H. actinioides* (*vide* Appendix). This exhibits so many analogies with *S. navicelligerum* as to render quite possible its having been mistaken for that species, at any rate by so careless an observer as Lendenfeld was at the time of writing the Catalogue; and, moreover, there is reason to believe that Lendenfeld did not examine his "*Sideroderma navicelligerum*" very critically, since his description of it, practically word for word, even to the minutest details regarding the spicule-measurements, is copied from Ridley and Dendy's preliminary account of *S. navicelligerum*(**34**). But most remarkable to relate, in connection with this specimen, labelled "*Desmacidon polymastia*," is the fact that it is figured in the Catalogue (Pl. iv., fig. 1) as an example of *Stylotella polymastia!*

Taking everything into consideration, I think we are justified in regarding Lendenfeld's *Sideroderma navicelligerum* as a synonym of *Histoderma actinioides.*

Ridley and Dendy (**34a**), in their remarks on *Sideroderma,* refer to the fact of their having been enabled "through the kindness of Dr. R. v. Lendenfeld, to examine a second species (of the genus) which occurs in his large collection of Australian sponges." Probably this species has generally been thought to be *Sideroderma zitelii,* but one must now conclude that it has never been described.

ESPERELLA RIDLEYI. (Text-fig.13.)

Introductory.—The species is represented in the collection by two specimens, one of which is that figured in the Catalogue in illustration of the variety *robusta,* while the other is labelled as the type of the variety *intermedia.* As the two are exactly alike in all but details of shape, it would seem as if the latter were incorrectly labelled—for, according to description, the variety *intermedia* should be distinguished by a much softer and more elastic consistency, due to its fewer spicules and finer fibres; however, a British Museum specimen, labelled as belonging to this same variety, is (at any rate in its spiculation) likewise precisely similar to the variety *robusta.* Under the circumstances, and in view of the fact also that the only stated differences between them are insufficient as a basis for distinction, we may reasonably and safely assume that the two so-called varieties are identical.

A British Museum specimen labelled with the MS. name "*Esperella ridleyi* var. *mollis*" (and, indeed, bearing a certain degree of outward resemblance to the present species, due to its trabecular structure) proves to belong to a species of *Echinochalina,* with spiculation similar to that of *Echinochalina intermedia* Whitelegge (*vide* **18**).

Of the several errors needing correction in the original description, there is one that calls for special mention. This is the statement that, among the microscleres, diancistra occur, which are rare and confined to the surface. The occurrence of diancistra along with anisochelæ—of which we have no instance except in the very doubtful case of Schmidt's *Vomerula tibicen*—would be of great interest as affording conclusive evidence of a relationship between the genera *Mycale* and *Hamacantha*. After the most thorough search, however, I have failed to find any such spicules, and am confident, therefore, in the assertion that those observed by Lendenfeld must have been of foreign origin. In support of this also is the fact of the very close correspondence in spiculation between *M. ridleyi* and certain other species of *Mycale*, which we well know to be without diancistra.

Both specimens are dry, and bear every appearance of having undergone complete maceration; here and there only, they show the faintest traces of what was probably a continuous and well-defined dermal membrane. The specimens were in this same condition, no doubt, when Lendenfeld described them—as may be judged from the figure he has given of the type-specimen. Accordingly, in relying upon that figure and the following description of external features of the species as aids to its identification, one must allow for the possibility that the therein indicated trabecular structure of the sponge may be wholly internal, and, in the undamaged specimen, concealed from view by the dermal membrane.

Description.—The sponge, which is probably semi-encrusting or submassive at the outset of its growth, grows up into one or several, usually branching, stout stems, which may attain a height of 500 mm. These stems (and their branches) are made up of anastomosing trabeculæ. The latter are roughly circular in cross-section, and measure from 3 mm. to (rarely) 7 mm. in diameter; their surface (in the absence of dermal membrane) is highly rugose. In the more central portion of the stems, especially in the older parts of the sponge, the trabeculæ become more or less fused together, thus to a great extent losing their individual outline, and tending in some measure to give rise to a solid axis; the (simple or branched) superficial trabeculæ, for the most part, project separately outwards, in an obliquely upward direction. The characteristic appearance of the sponge is well portrayed in the figure which Lendenfeld has given of the type-specimen. This, which is much less stoutly proportioned than the second specimen, measures 380 mm. in height, and has attached to it, near the top, three large bivalve shells, over the surface of which it has formed a thin crust.

The main skeleton is a very irregular, small-meshed reticulation of stout, spicular fibre, of diameter often exceeding 100 mm. The spicules of the fibres are closely packed together side by side, while the spongin-cement, which unites them, is inconspicuous on account of its pale colour, and, only in connection with the slenderer connecting fibres, forms a visible sheath. Owing to the washed-out condition of the specimens, scarcely any interfibral substance

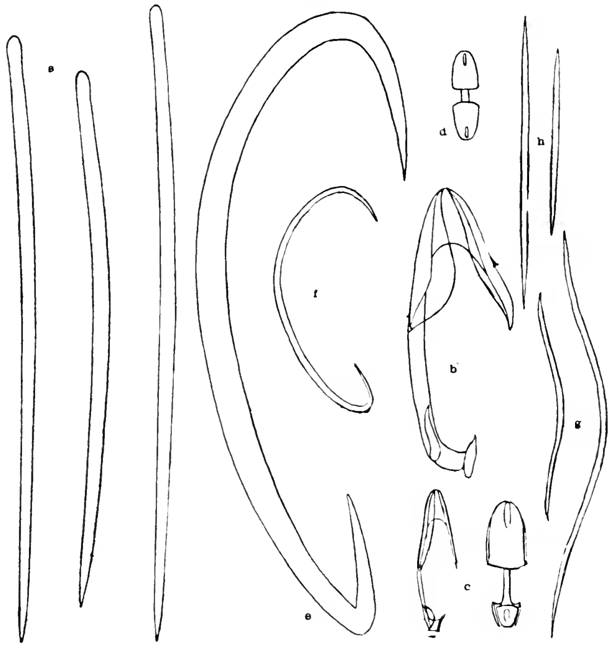

Fig. 13.—*Mycale ridleyi.* *a*, Styli. *b*, Larger anisochelæ. *c*, Smaller anisochelæ. *d*, Isochelæ. *e*, Larger sigma. *f*, Smaller sigma. *g*, Toxa. *h*, Microxea (trichites).

remains; but what little there is, serves to show that, in all probability, microscleres were abundantly scattered everywhere through the tissues. The dermal skeleton is a more or less confused, somewhat lattice-like, reticulation, formed by the branching and anastomosing of strands of loosely associated subtylostyli similar to those of the main skeleton; also, there occur, in the dermal membrane, microscleres in great abundance, and the most numerous of these are the smaller anisochelæ, the isochelæ, and the smaller sigmata, while the larger sigmata are the rarest.

Spicules.—(*a*) Subtylostyli; with elongated oval heads, narrower than the middle of the shaft; typically straight, though often, in slight degree, variously curved; gradually sharp-pointed; slightly fusiform, with the apical half of their shaft of greater average stoutness than the basal. Length, 250 μ to 305 μ; maximum stoutness, 9 or 10 μ.

(*b*). Larger anisochelæ; 40-45 μ long, 13-17 μ wide;* 15-18·5 μ broad; occurring singly and in rosettes. The upper alæ and palm are of equal length, approximately one-half that of the spicule; the upper tuberculum is 7·5-11 μ long, and about one-fourth of this in breadth; the distance between the free ends of the two palms is about 15 μ. Rosettes appear to be rare and always composed of comparatively very few chelæ; they were found only in the dermal membrane, and the greatest observed number of spicules composing any one of them was eight.

(*c*). Smaller anisochelæ; 18-22·5 μ long, 6-7·5 μ wide, 4·5-8 μ broad; occurring singly. The upper alæ and palm are about equal in length, which is approximately three-fifths that of the spicule; the distance between the free ends of the palms is about 3·5 μ.

(*d*). Isochelæ palmatæ; 7·5-12 μ long, at most 3 μ wide, and 3-3·5 μ broad. These are the most abundant of the microscleres, at any rate in the dermal membrane.

(*e*). Larger sigmata; 72 μ to (rarely) 20 μ in length from bend to bend; and, at most, slightly over 6 μ in stoutness.

(*f*). Smaller sigmata; very slender; varying in length from 15 μ to 35 μ.

* In using, for convenience' sake, the ordinarily synonymous terms *wide* and *broad* in order to express the two principal transverse dimensions of a chela, I imply by the former the maximum cross-measurement of the spicule as seen in profile, or, more precisely, the distance from the free or distal end of the (in case of anisochelæ, major) palm to the posterior edge of the shaft; and by the latter, the maximum cross-measurement of the spicule as seen from the front.

(*g*). Slender toxa, 30-63 μ long; occurring singly and in dragmata.

(*h*). Slender microxea, 20-35 μ long; occurring in dragmata, and also singly.

Loc.—Western Australia.

Remarks.—*M. ridleyi* is the fifth species of the genus known to possess isochelæ, the other four being *M. plumosa* Carter, *M. parishi* Bowk., *M. isochela* Hentschel(**20**), and *M. pectinicola* Hentschel(**20**); an undescribed sixth is represented in the British Museum by a specimen labelled (by Lendenfeld) with the MS. name "*Esperella australis.*" On the assumption that the toxa observed by Ridley(**33**) in Bowerbank's preparations of *M. pectinicola* were proper, all these species likewise agree in the possession of toxa, besides showing a very close correspondence (with each other) in the remaining features of their spiculation.

ESPERELLA SERPENS. (Pl.xxiv., fig.6; and text-fig.14).

Description.—The single type-specimen (as also a fragment labelled *Esperella serpens* from the British Museum) corresponds satisfactorily to Lendenfeld's description of the species. It is a cake-shaped sessile sponge, measuring 80 mm. in length, 50 mm. in breadth, and about 25 mm. in height, the visible external portion of which is formed by confusedly anastomosing irregular lax processes, usually more or less round in cross-section and averaging 2 or 3 mm. in diameter. On cutting through the specimen, the more compact—and, at first sight, seemingly solid—interior is found to have a structure affording reason for believing it to have resulted through the very complete and intimate fusion of what originally were similar processes. In alcohol (perhaps largely owing to imperfect preservation) the consistency is soft, almost pulpy; and the whole sponge is exceedingly fragile. The colour is a dull faintly yellowish pale grey. The dermal membrane is thin and delicate. Oscula were not observed.

The main skeleton is exceedingly reduced, being composed almost entirely of sparsely and quite irregularly scattered slender tylostyli. The dermal skeleton, although much better developed, is also comparatively scanty; it consists of ramifying spicular fibres, seldom more than 20 μ broad, which here and there are partially connected by loose spicule-bundles. The dermal megascleres are similar to those of the interior. Scattered microscleres—anisochelæ, sigmata, and trichodragmata—are comparatively scarce; the chelæ do not form rosettes. In the dermal membrane, chelæ and sigmata are more frequent than in the choanosome, and trichodragmata apparently do not occur.

Scattered through the sponge are small patches of foreign material, comprising sand-grains, spicule-fragments, foraminifera, etc.; and immediately surrounding each of these patches there occur a few fibres and spicule-bundles such as elsewhere are seldom met with except in the superficial (*i.e.*, the dermal) skeleton. These patches presumably occupy spaces (*lacunæ relictæ*) originally due to, and now almost obliterated by, the fusion of once separate processes of the sponge, as suggested above—or, in other words, are, strictly speaking, external to the sponge—and, on this view, the spicule-bundles and fibres referred to, that occur seemingly within the sponge, are really portions of the dermal skeleton. To a misconception arising from the presence of such fibres and bundles in the preparations examined by him, was probably due Lendenfeld's incorrect description of the main skeleton as consisting of "longitudinal spicule-bundles,* which are on an average . . . . 0·15 mm. apart," etc.

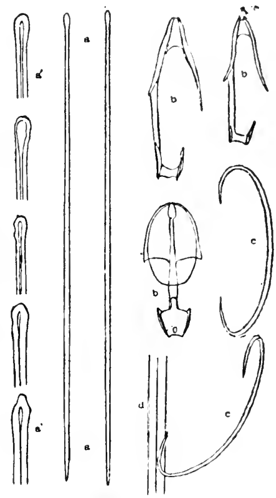

Fig. 14.—*Mycale serpens.* *a*, Tylostyli. *a′*, Basal ends of tylostyli. *b*, Anisochelæ. *c*, Sigmata. *d*, Trichites.

Spicules.—(*a*) The tylostyli are straight or (less frequently) variously curved, gradually sharp-pointed, slender spicules with a well-developed elongated phyma; the shaft is slightly narrower

* By "spicule-bundles," Lendenfeld always (in the "Catalogue") means "fibres composed solely of spicules"; this is most clearly shown in his description of *Sideroderma zittelii.*

towards the base than at the middle. They measure from 220 μ to 295 μ in length and are seldom as much as 5 μ in diameter.

(*b*) The anisochelæ are of the ordinary form; they are variable in stoutness and range in length from 18 to 27 μ.

(*c*) The sigmata are very slender, seldom much more than 1 μ in diameter; they are simple and contort, and vary from 18·5 to 29 μ in length, measured from bend to bend.

(*d*) The trichodragmata are 12 to 25 μ long, and usually less than 5 μ in stoutness. The trichites composing them are sometimes partially fused, so that the dragma remains intact even after boiling in nitric acid, and are sometimes differentiated into separate microxea. Microxea also occur scattered singly, but as such are extremely rare.

Embryos.—The examined portion of the sponge teems with aspiculous embryos of approximately spherical form, the largest of which measured 150 μ in diameter.

Loc.—Port Jackson.

Remarks.—The species that seems most closely related to *M. serpens* is *M. fistulifera* Row(**35**). In the latter, trichodragmata have not been observed and the processes bear each an osculum at the summit. If similarly located oscula occur in *M. serpens*, they must be extremely small; but I am unable to say positively they are absent, owing to the poor preservation and pulpy condition of the specimen.

ESPERELLA PENICILLIUM. (Pl.xxiv., fig.1; and text-fig.15).

Introductory.—As the specimen which I take to be the type of this species is not entirely in agreement with the description of the species, I might mention that its claim to be so considered is proven, both by the fact that it is labelled in Lendenfeld's handwriting with a manuscript name—"*Esperia incrustans*"—which according to the key-list stands for *Esperella penicillium*—and by the fact, also, that it agrees in all essential respects with a British Museum specimen labelled *Esperella penicillium*. The species belongs to the subgenus *Paresperella* and is related to *P. moluccensis* Thiele(**41**), *P. bidentata* Dendy(**15**), *P. repens* Whitelegge(**57**), and *P. dichela* Hentschel(**20**)—apparently more closely to the two last mentioned, because like them and unlike the others (as described), it possesses smaller, scattered anisochelæ in addition to those which form rosettes.

The type-specimen consists of only a few ill-preserved scraps attached to pieces of shell and other débris. This condition of the specimen would lead one to suppose that the species is of encrusting habit, and the manuscript specific name "*incrustans*" implies the same. According to Lendenfeld's description, however, the sponge is "composed of anastomosing branches on an average 7 mm. thick." One might conclude, therefore, that the sponge is variable in habit; but, for the present, I think it would be as well to disregard altogether what has been stated concerning the outward features of the species, and, for its identification, to rely solely upon skeletal characters.

Unfortunately, owing to the fragmentary condition of the specimen, several points in connection with the skeleton, of possible diagnostic value, have not admitted of elucidation; among other things, it could not be determined whether, as Lendenfeld's description implies, the reticulate character of the skeleton results simply through the interosculation of dendritically branching longitudinal fibres, or whether it is due to the union of longitudinal by means of transverse fibres.

Description.—The main skeleton is a loose reticulation of spicule-fibres devoid of spongin, the stoutest of which exceed 150μ in diameter. Close beneath the surface, the outwardly-running fibres subdivide each into a number of divergent strands, whose penicillately outspread extremities support the dermal membrane. The dermal skeleton is a wide-meshed, somewhat lattice-like reticulation, the meshes of which, formed by interconnecting, branched, paucispicular fibres, are, as a rule, sparingly subdivided by independent short spicule-strands, and single spicules. There are also present in the dermal membrane a few scattered microscleres of the same three kinds as occur interiorly.

Spicules.—(*a*). The megascleres in general agree exactly in form with those of *P. bidentata*(**15**); in rare cases, however, the small apical tines are wanting, and the spicule is then a subtylostrongyle. These tines are usually two in number, occasionally three: when one only is developed, it is situated not centrally, *i.e.*, not in continuity with the axis of the spicule, but laterally. The spicules are from 325 to 410 μ long by 8 μ at most in diameter.

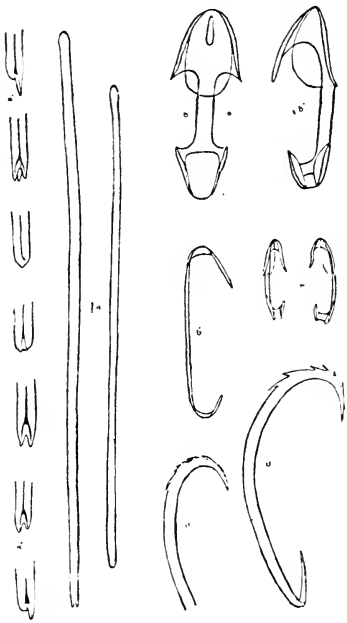

Fig. 15.
Mycale (*Paresperella*) *penicillium*. *a*, Subtylostyli. *a'*, Apical ends of subtylostyli. *b*, Larger anisochelæ. *b'*, Developmental form of preceding. *c*, Smaller anisochelæ. *d*, Sigmata.

(*b*) Larger anisochelæ, occurring fairly abundantly in rosettes, and in lesser number scattered singly; they closely resemble in form those of *P. bidentata*, but are larger, measuring from 34 to 39μ in length.

(*c*). Smaller, scattered anisochelæ, in form much like the preceding, measuring from 18 to 22·5 μ in length; they are about as numerous as the scattered larger chelæ.

(*d*). Sigmata, similar to those of *P. bidentata*; fairly abundant; measuring 44 to 48 μ long from bend to bend, by at most 3 μ thick in the middle.

Loc.—Port Jackson.

Remarks.—From the same locality as *P. penicillium*, comes *P. repens* Whitelegge. The latter, judging from its description—for I have been unable to find any specimen or mounted slide of it—differs from *P. penicillium* in quite a number of points, but the differences are of degree rather than of kind, and may be due to nothing more than individual variation. Whether this is so, it is not yet possible to decide, since both species are known only from single specimens.

The several species, *P. penicillium*, *P. moluccensis*, *P. bidentata*, *P. repens*, and *P. dichela*—enumerating them in the order in which they were described—are obviously so closely related that they might be ranked as varieties of a single species. The second and third mentioned, however, according to their descriptions, are lacking in the smaller chelæ found in the others; if this be so, one might regard these two as varieties of one species, *P. moluccensis*, and the remaining three as varieties of a second species, *P. penicillium*.

Subfamilia Ectyoninæ.

With the exception of *Lissodendoryx jacksoniana*, described below, all the species which I have so far succeeded in identifying of the Ectyoninæ described in the Catalogue have already been dealt with, at least sufficiently to render possible their identification, in my former paper. The fuller treatment of such of them as require further description, I propose to defer until a suitable opportunity offers itself of my undertaking a general revision of the Australian *Desmacidonidæ*.

It is necessary here to refer, however, to certain alterations which a knowledge of additional facts has led me to consider advisable in the conclusions I expressed regarding the four species, *Echinonema levis*, *E. rubra*, *Clathria macropora*, and *C. australis*. As already stated, the specimens labelled as the types* of the first-mentioned three (as also the specimens representing them in the British Museum) are examples of a single variety of *Crella incrustans*, while those of the fourth species belong to another variety of the same—the variety *arenacea* Carter; and thus, although corresponding exactly—except (in one important particular) those of *Clathria macropora*—with the descriptions of the species they respectively purport to represent as regards external features, they are all rather considerably at variance therewith in the matter of spiculation. Nevertheless, except in the case of *Clathria australis* (which is described as possessing only *scarce* acanthostyles) the latter discrepancies are such as might conceivably be

* They are labelled as the types by Mr. Whitelegge. Their original labels in Lendenfeld's handwriting bear only the MS. names "*Clathria levis*," "*Clathria rubra*," "*Clathria macropora*," and "*Clathria flabellum*" respectively.

due to carelessness of observation; and hence I decided to accept as correctly labelled the ostensible specimens of *Echinonema levis* and *E. rubra*, and to reject as bogus those of *Clathria macropora* and *C. australis*. It is now my opinion that the descriptions of *E. levis*, *E. rubra*, and perhaps also *Clathria australis* combine each a description of the outward characters of one species with one of the inward characters of another—the former of which species is alone represented by the specimens; and that the chief ground of my rejection of the specimens labelled '*Clathria macropora*—namely, the unlikeliness of Lendenfeld's having mistaken for oscula, holes produced by crustaceans—is untenable, inasmuch as such mistakes actually have since been found to have been made by him in connection with *Cliona hixoni*, *C. lutea*, and apparently also *Tedania rubra*. Consequently, as synonyms of the sponge which I described in my previous paper as *Crella incrustans* var. *levis*, I would now write *Clathria macropora*, *Echinonema levis* (? pars), and *Echinonema rubra* (? pars); and should a Port Jackson species possessing the skeletal characters ascribed by Lendenfeld to *Echinonema levis* prove to be existent, I think it would be preferable to give to the former sponge the name *Crella incrustans* var. *macropora*, and to employ the specific name *levis* for the latter.

Those of the remaining species not yet identified are: *Clathrissa elegans*, *Clathriodendron irregularis*, *Plectispa macropora* (the type of *Plectispa*), *P. elegans*, *Thalassodendron typica* (the type of *Thalassodendron*), *T. digitata*, and, lastly, the three which through some misconception Lendenfeld described as varieties of *Echinonema anchoratum* Carter. The last mentioned are nominally represented in the Australian Museum by specimens which, while labelled with the names that the key-list indicates to be the MS. synonyms of their published names, accord neither in external nor internal features with their descriptions;—the variety *ramosa* being represented by an imperfect example (labelled "*Ceraospina arbuscula*") of *Clathriodendron arbuscula*, and the two varieties *dura* and *lamellosa* by specimens (labelled "*Antherospongia dura*" and "*Ceraospina flabellum*") of the species which(18) I have named respectively *Clathria indurata* and *C. spicata*. Also, *Plectispa elegans* is falsely represented by a specimen of *Echinoclathria arborea*.* But with these exceptions no example labelled with the name of any of the species enumerated above is to be found either in the Australian Museum or among the fragments from the British Museum. Occurring among the latter, however, there is an unattached label inscribed with the name *Clathriodendron irregularis*, so that this species is in all probability represented by an example in the British Museum.

Myxilla jacksoniana. (Text-fig.16).

Introductory.—As the type of this species I take the sponge representing it in the British Museum, which agrees fairly closely with the original description; the ostensible type-specimen in the Australian Museum is mislabelled, being in reality an example of a species of *Gellius*, closely related to *G. raphidiophora*. Having only a small fragment at my disposal I am unable to say anything concerning the outward characters of the species. The original description states in reference thereto merely that the sponge is massive, lobose, and provided with conspicuous oscula; but it may be that this statement is incorrect, since it is one that would apply very well to the false type-specimen.

Description.—The skeleton is a renieroid reticulation with for the most part quadrangular and triangular meshes, the sides of which are formed each of one to three (or rarely more) spicules; the spicules have a not very orderly arrangement, and in many places, as a consequence, the reticular pattern is ill-defined. Definite fibres are apparently not developed, and spongin is indiscernible. The spicules of the mesh-work are styli, together with a very appreciable proportion of shorter and stouter strongyla which undoubtedly are derivatives of the styli. Occurring scattered

* That my identification of this species with Lendenfeld's *Plectispa arborea* is correct, is supported by the fact that the MS. synonym of *Plectispa arborea* is, according to the key-list, "*Plectochalina halme*"—a name which would be more appropriate in its application to *Echinoclathria arborea* (owing to the species' resemblance in reticulate structure to *Halme nidus-vesparum*) than to any other species described in the Catalogue.

are very few tylota and moderately abundant chelæ and sigmata, the last-mentioned predominating. The microscleres are most numerous surrounding the canals. The dermal skeleton appears to be developed interruptedly, but this may be in consequence of the

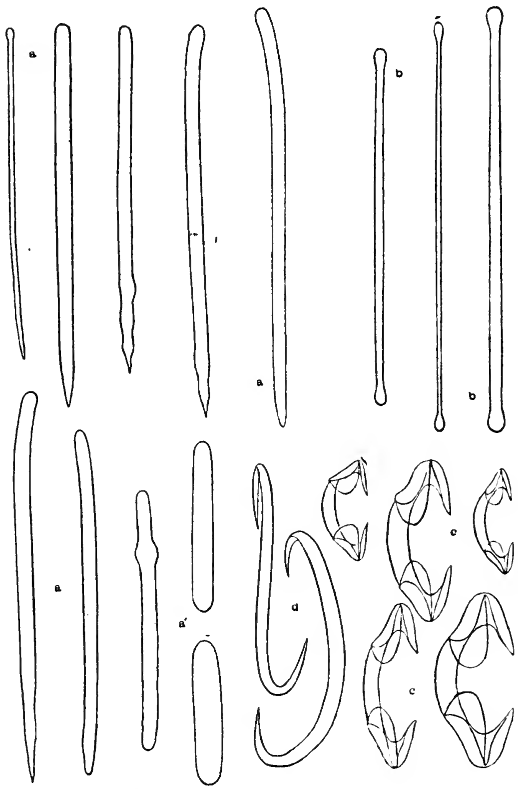

Fig. 16.—*Lissodendoryx jacksoniana*. *a*, Principal styli. *a'*, Strongyliform modifications of principal spicules. *b*, Auxiliary tylota. *c*, Isochelæ arcuatæ. *d*, Sigmata.

abrasion of portions of the original surface; here and there, in patches, closely-arranged short strands of tylota occur, disposed vertically to the surface; while in the relatively broad intervals between these groups of strands the main skeleton extends almost or quite to the surface, and in the outermost layer a few scattered tylota only, mostly more or less vertically directed, are to be seen.

Spicules.—(*a*) The principal megascleres are smooth styli and strongyla, the former being about ten times as numerous as the latter. The styli, which vary from (rarely less than) 140 to about 185 μ in length, and very seldom exceed 7 μ in diameter, are straight or slightly curved (more especially near the basal end), often very faintly dilated at the base, nearly cylindrical throughout the greater part of their length, and, as a rule, gradually sharp-pointed; the pointed end almost invariably exhibits irregularities such as are commonly shown by spicules of the Axinellidæ, and in extremely rare cases is provided with a few minute spines, less rarely an odd spine is to be observed on other portions of the shaft. The slenderest forms are tylostyli, which are equal in length to the fully-grown spicules. The strongyla range in length from about 50 to upwards of 160 μ, and their maximum stoutness, which is attained only by the shorter spicules, is 9·5 μ; they not infrequently show a deformity in the shape of a bulbous swelling. Spicules of intermediate form between the longest strongyla and the styli occur, but are rather rare.

(*b*) Straight tylota, with nearly cylindrical shaft (often slightly narrower at one end), and well-developed oval heads; measuring from 155 to 195 μ long and at most 5·5 μ in stoutness.

(*c*) Isochelæ arcuatæ of ordinary shape; with well curved shaft, slightly antero-posteriorly compressed; varying in length from 12 to 23 μ. Individuals of medium length are rare in proportion to those of greater and of lesser length.

(*d*) Sigmata; simple and contort; measuring between 19 and 36 μ in length from bend to bend, and up to 3 μ in stoutness.

Embryos.—Deeply brownish-tinted embryos of oval shape, the largest measuring 320 by 270 μ, were present, and most of them contained spicules. The spicules were always of three kinds, viz., straight or (very often) flexuous slender tylota, exceedingly slender sigmata, and developmental chelæ. Usually the tylota, like the microscleres, were scattered; but in a few instances they were arranged in a radiating bundle placed towards one end of the embryo.

Remarks.—Lundbeck has noted the embryonic spiculation in quite a number of Myxillinæ, but in every case observed by him, contrary to what happens in the present species, the basical megascleres make their appearance in advance of the auxiliary. In reference to *Grayella pyrula* and *Grayella gelida*, Lundbeck(**31b**, p. 33), says: "It is worthy of notice that the first occurring spicules here are the spined dermal spicules, while elsewhere in the Myxilleæ it is the skeletal spicules which occur first." These exceptions, however, are only apparent, since, as I have previously pointed out(**18**), the dermal spicules of *Grayella* undoubtedly correspond morphologically to the skeletal spicules of normal Myxillinæ, and *vice versâ*.

L. jacksoniana is probably most nearly related to the species recorded from Port Phillip by Carter(**7**) as *Halichondria isodictyalis* and by Dendy(**13**) as *Myxilla isodictyalis*; but it is hardly likely that the two are identical, since in the case of the latter no mention has been made of the occurrence of strongylote modifications of the skeletal spicules. The original *Lissodendoryx isodictyalis* Carter(**5**), comes from Puerto Cabello, Venezuela, and probably is not identical with the Port Phillip sponge.

Familia AXINELLIDÆ.

Under this, the final family dealt with in the Catalogue, Lendenfeld describes six species, five of which are referred to the genus *Axinella*, and one to a new genus *Spirophorella*. Each of these, with the exception of the last-mentioned, is (nominally) represented in the Australian Museum by a specimen duly labelled in Lendenfeld's handwriting, but only in the case of one, *Axinella aurantiaca,* is it possible to reconcile the specimen with the description. It seems quite beyond doubt, however, that the descriptions of two of the species—namely, those designated varieties of *A. hispida* Montagu—are erroneous, the probability being that each is made up of portions of the descriptions of two entirely different species. For in the diagnosis introductory to these descriptions, we are told that the spiculation is composed of "large and long styli and spined oxea," together with "microsclera" in the form of "styli and oxea, long and very slender, in bundles (trichites)"; whereas in the descriptions themselves, in contradiction to this, we find it stated, in the case of one variety, merely that "the spicules of the supporting skeleton are 0·14 mm. long and 0·005 mm. thick," and in the case of the other, that "the spicules of the supporting skeleton are chiefly styli, 0·2 mm. long and 0·005 mm. thick. Nor are these contradictory statements the only indication of error; the diagnosis referred to is clearly only an intended copy, with a few alterations in terms, of the description of *Dictyocylindrus hispidus* given by Bowerbank(**2**), yet, in Bowerbank's description, no mention is made of "spined oxea," but only of spined styli, and no warrant is to be found for the statement that the "styli and oxea, long and very slender" occur in bundles It is unaccountable also why Lendenfeld calls the last-mentioned spicules microsclera, especially since he states, in his definition of *Axinella,* that the genus is without microsclera. Because of these anomalies, and as the specimens left by Lendenfeld to represent his varieties of *Axinella hispida* agree in some measure with the descriptions so far as external features are concerned, and actually are examples of species of *Raspailia,* I have thought it proper to regard them as the types. I consider the specimens to be representative of two distinct species to be designated *Raspailia gracilis* and *R. tenella* respectively.

Axinella hispida, var. gracilis. (Pl. xxiii., fig.1; Pl. xxii., fig.7; and text-fig.17).

Description.—Sponge erect, arborescent; with dichotomous and polytomous branches, seldom uniting by anastomosis. The branches are short, stiff, cylindrical, or slightly tapered, and sometimes sharply pointed at their end. Surface hispid with spicules, which project 1 mm. or so beyond it. Oscula apparently absent. Colour in spirit pale grey, for the most part with a faint tinge of purple. Consistency fairly tough, compressible, and resilient.

The single specimen (Pl. xxiii., fig. 1), 80 mm. in height, is attached to a stone by an expanded disc-like base, from which two short stalks, each about 5 mm. in diameter, and each with its own "head" of branches, arise independently. The stoutest branches are 4 to 5 mm. in diameter; the slenderest, about 2 mm.

The skeleton, as seen in section, presents quite different aspects according as the mounting medium is balsam or glycerin. In the latter medium, the spicules being thereby rendered almost indiscernible, it appears as if mainly consisting of a small meshed irregular reticulation of colourless, or (in older parts of the sponge) faintly yellowish-tinted, spongin fibres, of diameter seldom exceeding 50 or 60μ; the reticulation, which is not more condensed in the axial than in the peripheral region of the branches, and in pattern bears a certain slight resemblance to that of the skeleton of *Euspongia,* is formed by longitudinal main fibres pauciserially cored by principal spicules and by a network of connecting fibres which are without contained spicules.

On the other hand, in sections mounted in balsam, the spongin fibres are difficult to perceive, and may even be quite invisible; and the skeleton then shows itself as a lattice-like interlacement of longitudinally-running (or, if near to the surface, slightly outwardly-trending), mostly paucispicular, loose strands of principal spicules, interspersed between which, in comparatively small number, are single spicules likewise with a generally longitudinal orientation. In addition, isolated single spicules constantly occur, which are disposed transversely to the prevailing direction, and are consequently very noticeable even although comparatively few. The interlacing spicule-strands are constituted partly by the spicules which core the main spongin-fibres and partly by spicules which lie extra-fibrally; some of the latter are directed with their apex pointing to the contrary direction, *i.e.*, towards the base of the sponge Echinating acanthostyli occur only sparsely and irregularly upon the fibres of the interior; and since (in balsam) the fibres themselves are not readily perceived, these acanthostyli appear at first sight as if scattered. On the other hand, in connection with the superficial fibres (comprising not only those situated most externally, *i.e.*, in immediate juxtaposition to the dermal layer, but usually also most of the longitudinal fibres running near to the surface) acanthostyles are abundantly developed; these superficial acanthostyles are located entirely upon the external aspect of the fibres supporting them, and are thus directed perpendicularly to the surface with their apices outwards.

In the outermost region of the main skeleton, a considerable proportion of the short spongin-fibres, whose disposition is more or less at right angles to the surface, ensheathe each the basal portion of one or several of the outwardly-projecting long tylostyli to which is due the already-mentioned hispidity of the surface. The dermal skeleton proper consists of scattered clusters and bundles of styli and oxea (auxiliary spicules), which are mostly directed more or less parallel to the surface, and, contrary to what usually is the case in *Raspailia*, are never disposed in outwardly-directed divergent tufts situated around the points of exit of the long projecting spicules.

Spicules.—(a) The principal megascleres are styli and tylostyli and intermediate forms, together with relatively very few oxea. The styli and tylostyli (the latter of which are the more numerous) are sharp-pointed and more or less curved spicules, typically with the curvature most pronounced in, and often restricted to, their basal moiety; the very slenderest are not infrequently flexuously curved (flagelliform). They range from about 420 to 1580 μ in length, and attain a maximum diameter of 15 μ. The two forms, styli and tylostyli, show some degree of differentiation from each other, but not sufficient to admit of their separation into two groups. The styli are, in general, the shorter and relatively stouter spicules (being rarely less than 11 μ in diameter), and, unlike the tylostyli, are usually a trifle stouter towards the middle of their length than at the base. The tylostyli, which usually have only a slightly developed phyma, are very variable in stoutness (the slenderest of them being less than 3 μ in diameter), and are seldom below 800 μ, and rarely, if ever, below 500 μ in length. The slenderest spicules are usually not expanded at the extreme base, but at some short distance above it, and then not as a rule bulbously, but elongately and somewhat irregularly; and a consider-

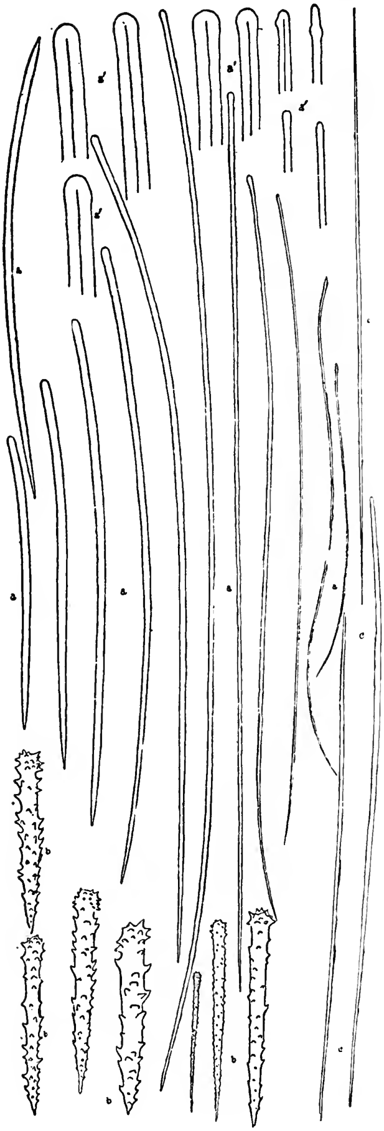

Fig. 17.—*Raspailia gracilis.* *a*, Principal spicules; styli, subtylostyli, and scarce oxea. *a'*, Basal ends of principal spicules. *b*, Acanthostyli. *c*, Auxiliary styli and oxea.

able proportion of them exhibit no basal enlargement at all. It is to be noted that styli are unrepresented among the spicules which project from the surface, while they comprise almost all of those spicules above-mentioned which are disposed transversely to the longitudinal direction.

The oxea are curved fusiform spicules varying in length from 430 to 1040 μ, and in diameter from (seldom less than) 7 up to 12 μ. At a rough estimate, they number somewhere between one and five per cent. of the principal megascleres.

(*b*) The acanthostyles, when fully developed, are conical spicules with recurved spines (about 3 μ high), measuring from 65 μ to 102 μ in length, and at their base 10 μ in diameter exclusive of spines; the spines are scattered uniformly and pretty closely over the whole surface. A considerable number of immature acanthostyles also occur—of only slightly lesser length than the fully developed—which are usually provided with a slight basal knob and are more and more minutely spined in proportion as they are slender.

(*c*) The auxiliary spicules are straight or slightly curved oxea and styli (together with intermediate forms), which are approximately equal in size and number,—the styli being, if anything, somewhat the stouter and more numerous. They measure from 260 to about 410μ in length, and, at most, 3·5μ in diameter. The longest of the styli are scarcely, if at all, distinguishable from certain of the shortest and slenderest of the principal spicules. The auxiliary spicules are chiefly confined to the dermal layer, where, as previously stated, they are disposed in bundles; in the interior they lie scattered, either singly or (more usually) in pairs.

Loc.—Port Jackson.

AXINELLA HISPIDA, var. TENELLA. (Pl. xxiii., figs.2, 3; Pl. xxii., fig.6; and text-fig,18).

Description.—Sponge erect, ramose, stipitate; of small size; with the branches disposed in one plane or in overlapping planes. Branches compressed in the plane of branching, and usually increasing in breadth upwards; stalk relatively very slender, and cylindrical or only slightly compressed. Surface hispid with spicules, which often project more than 1 mm. beyond it. Oscula apparently absent. Colour in spirit pale grey. Consistency firm, tough and elastic.

Of the two type-specimens, the larger and more robust (Pl. xxiii., fig. 2) measures 60 mm. in height and 1·5 mm. in diameter of stalk, and for the most part has only slightly compressed branches, which spread in the one plane. The slightly smaller, and more profusely-branched specimen (Pl. xxiii., fig. 3) has the branches very much flattened, and in consequence of the bifurcation of the stalk, is biflabellate; as, also, the branches are somewhat curled, it assumes a slightly aborescent form. Both specimens are (in alcohol) of a light yellowish-grey colour.

The main skeleton is composed in exactly the same way as in *R. gracilis,* but the longitudinally-directed extra-fibral spicules are more numerous in the present species, and they thus (unless the sections examined be fairly thin) tend to obscure the lattice-like pattern due to the interlacement of the spicule-strands. The spongin-fibres are colourless and (in balsam) quite invisible.

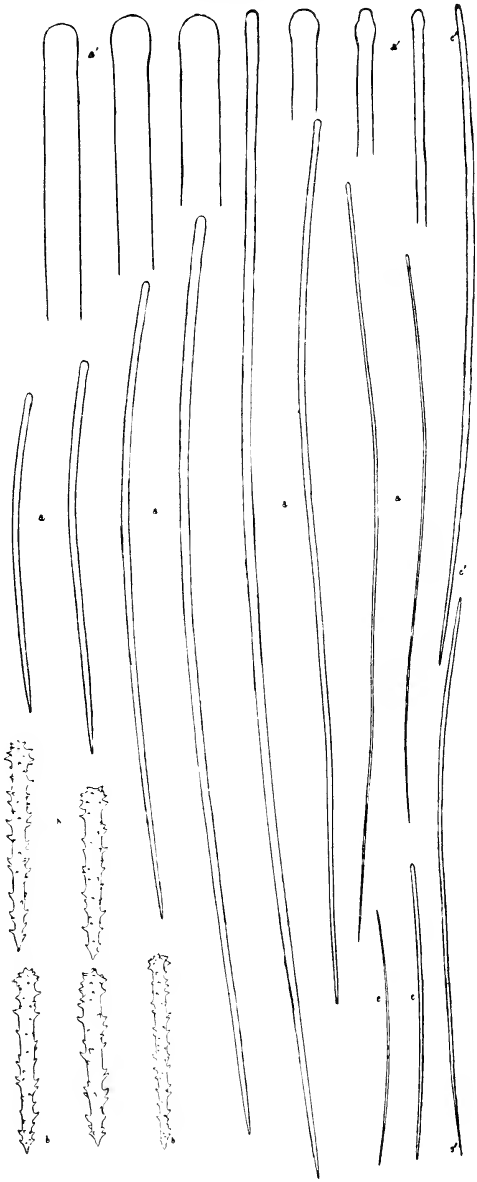

Fig. 18.—*Raspailia tenella*. *a*, Principal spicules; styli and subtylostyli. *a′*, Basal ends of principal spicules. *b*, Acanthostyli. *c*, Auxiliary oxea and styli; *c′*, the same, drawn to a larger scale.

The dermal skeleton, on the other hand, is quite different from that of *R. gracilis* and very closely resembles that of *R. viminalis* as depicted by Pick (**32**, Pl. iii., fig. 1). Externally to the fibres and the spicules of the main skeleton is a soft-tissued dermal layer, usually not less than 300 μ in thickness, and almost entirely free from scattered spicules; and this layer, which is crossed by the deeply-embedded long tylostyli which project beyond the surface, gives support superficially to elegantly radiate projecting tufts of auxiliary spicules. These tufts occur not only at the points of emergence of the tylostyli, but also between them.

Spicules.—(*a*) The principal megascleres are exclusively styli and tylostyli, which are similar in form and about equal in stoutness to the corresponding spicules of *R. gracilis,* and, like them (though to a less appreciable extent), exhibit some degree of differentiation into two groups; they range in length from about 380 to 1970 μ and obtain a diameter of 18 μ.

(*b*) The acanthostyles, when full-grown, are conically or slightly basally-knobbed spicules, with recurved spines (about 3 μ high), measuring 63 to 85 μ in length, and at their base 8 μ at most in diameter; the spines are scattered uniformly and pretty closely over the entire surface. The slender immature spicules range in length from less than 30μ to upwards of 60μ; the slenderest have almost invisibly minute spines, and are provided with a well-developed basal knob.

(*c*) The auxiliary spicules are styli and oxea; intermediate forms between these are rare or absent. The styli, which are by far the more abundant, are straight or (more usually) slightly curved, and taper towards the base; they vary between 280 and 410μ in length, and attain to 4·5μ in diameter. The oxea are shorter and slender, being very rarely more than 340μ in length, or more than 3μ in diameter. Apparently the latter occur only as single and paired scattered spicules in the interior; while the styli are found both in the interior (nearly always in pairs) and in the dermal tufts.

Loc.—Port Jackson.

Axinella aurantiaca. (Pl. xxii., fig.1; and text-fig.19).

Introductory.—Fortunately Lendenfeld has furnished us with a figure of this species, and the actual specimen from which the figure was taken is extant. Otherwise, owing to a mistake in the original description,—wherein the spicules are stated to be styli, instead of oxea (with only occasional styli) and flexuous strongyla—the species in all probability could never have been identified. But, with this exception, the description is fairly appropriate; and the omission from it of any mention of strongyla is attributable to the fact that these spicules are sometimes sufficiently scarce to be easily overlooked. The inaccuracies in this case, therefore, are to be explained as due to careless observation, and not to the commingling of the descriptions of two different species.

Description.—Sponge arborescent, erect, stipitate; with cylindrical pointed branches, which multiply by frequent dichotomy and occasionally anastomose at points of contact. The branches increase in stoutness towards the base, and may there attain a diameter of 12 mm. The surface is minutely granular, owing to the impingement upon it at very close intervals of outwardly running skeletal fibres. There is present a very thin, but well-defined dermal membrane, which remains intact when the sponge is carefully macerated with caustic potash solution. Small oscula, about 1 mm. in diameter, occur scattered at rather distant intervals. The canals leading into the oscula,—not only the main canals which open into the oscula, but also their chief tributaries—run for some distance immediately beneath the dermal membrane, and are faintly discernible through it. The specimen of Lendenfeld's figure measures 120 mm. in height, and is in an unusual degree profusely branched; large specimens may attain a height of 200 mm. The colour in life, according to the original description, is bright orange; spirit specimens are yellowish-grey, and those preserved in the dry state whitish. Except for a soft superficial layer about 1·5 mm. in thickness, the consistency is in alcohol very firm and tough, particularly in the older portions of the sponge. Dry specimens vary in consistency and texture, and present a very different appearance, according to the extent to which the fleshy substance has been removed. Those dried without previous maceration are slightly shrunken, have a rough, granular, usually uncracked surface, and are hard and brittle; on the other hand, well macerated and washed-out specimens, which are moderately flexible, show in each of the branches a dense core, and from this numerous short fibres stand out like bristles, producing an appearance not unlike that of a worn-down bottle-brush. The skeleton consists (i.) axially, of a stout, densely spicular, core occupying the whole interior of the branches to within about 1·5 mm. of the surface; and (ii.) extra-axially, of non-plumose, sometimes slightly wispy multispicular fibres, which, issuing in an obliquely upward direction from the core, run outwards at fairly regular distances apart, gradually curving on the way, to meet the surface almost at right angles. These fibres, which are composed of oxea held together by a barely discernible amount of spongin, usually remain unbranched, and are not connected by transverse fibres. Scattered spicules occurring between the fibres are extremely rare in the more superficial, canal-traversed, region of the sponge, but become more numerous in proximity to the core, and are there sometimes rather abundant. It is apparently owing to the gradual addition to the core, as growth proceeds, of the innermost of these spicules, (oxea) lying circum-

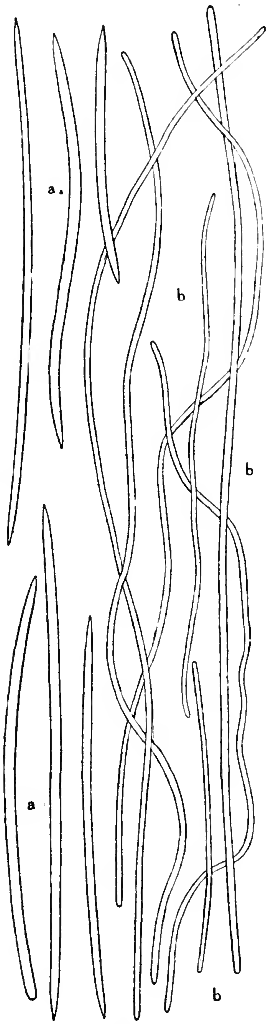

Fig. 19—*Axinella aurantiaca.* *a*, Oxea and occasional styli. *b*, Strongyla.

jacent to it, that the core becomes stouter with age; for one finds, in the older portions of the sponge, that the core consists of an outer (secondarily formed) layer composed of fairly closely packed oxea, and of an axial region which is differently constituted. In spite of the increase in size of the core, no appreciable reduction occurs in the width of the layer extending between it and the surface, nor does there seem to be any marked diminution in the number of the scattered spicules. The axial or first-formed region of the core, as seen in sections of an appropriate thickness, exhibits a structure very similar to that figured by Vosmaer(52) in illustration of the skeleton of the type-species of *Axinella.* It consists of: (i.) numerous longitudinally-running, and interlacing, multispicular fibres ("funicles"), which are similar in character to the already mentioned fibres that run out to the surface, and form a kind of reticulation with narrow elongated meshes; (ii.) intermingled with these, numerous slenderer diffuse strands, likewise composed of oxea, and usually more or less oblique to the axial direction; and (iii.) singly-occurring elongated flexuous strongyles,* which are interwoven with the fibres.

Spicules.—In different specimens, one finds differences in the sizes of the spicules, more particularly of the oxea, the differences being chiefly in stoutness and in average length. The maximum length, both of the oxea and the strongyla, appears to be fairly constant; but the relative number of spicules which attain to this varies considerably, and may sometimes be extremely small. The spicules which, throughout the description, have been referred to simply as oxea, include also a number of styli; these styli are usually rare, but, in one of several slides prepared from different parts of the type-specimen, they were met with rather frequently. Variability is shown also in the relative abundance of the

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* Whitelegge(54) says regarding the arrangement of the strongyles that they are "usually disposed at right angles to the columns of oxeote spicules in the main fibres." On the contrary, it seems to be the rule that, like almost all the other spicules composing the core, they have a more or less longitudinal disposition.

strongyles, which, always far fewer than the oxea, are sometimes very scarce. The characters of the spicules are as follows:—

(*a*) The oxea (and occasional styli) are in general slightly curved; are cylindrical to within a short distance (at most 40 μ) of their extremities; and taper, either evenly or somewhat irregularly, to usually sharp points. They range in length from about 220 to 500μ, occasionally to as much as 600μ; in some specimens, relatively very few exceed 400μ. The stoutest are sometimes not more than 12μ in diameter, and even so may be comparatively scarce; but, in other cases, spicules exceeding 12μ in stoutness are quite plentiful, and a diameter of as much as 17 μ may be attained. Spicules of all degrees of stoutness down to 2 μ, and even less, are present.

(*b*) The strongyla are cylindrical and, in general, variously and irregularly flexuous. They vary in length, independently of diameter, from about 300 to upwards of 900μ; the longest observed in any specimen measured 1120 μ. The maximum stoutness is usually between 6 and 8 μ, but in occasional specimens may reach 11 μ. According to Whitelegge's measurements, the strongyla may attain a length of 1500 μ, but apparently this is an overstatement.

Loc.—Port Jackson and neighbourhood.

Axinella inflata.

I have failed to find, either in the collection of the Australian Museum or among the fragments received from the British Museum, any species which—in skeletal characters, at any rate—conforms to the description of *Axinella inflata* even in a remote way. An ostensible type-specimen (labelled "Dictyocylindrus inflata") does, indeed occur, and, in certain outward features, it exhibits points of agreement with the description; thus it is of "ramifying" habit, attains approximately to "a height of 100 mm.," and is also of "soft and resilient consistency"; but these resemblances are clearly only accidental, inasmuch as the branches are not "cylindrical," but more or less compressed, and are not terminally inflated, but, on the contrary, are much flattened at the extremities. The specimen (Pl. xxiii., fig. 5), which possesses a sparse reticulate skeleton of slender horny fibres cored with small strongyla, is identically similar to a fragment from the British Museum labelled *Chalinodendron dendrilla,*—and to that species it undoubtedly belongs.

For the identification of *Axinella inflata,* accordingly, one will have to depend solely on the scanty description of the species. If this description is correct, the species does not belong to *Axinella* in the strict sense, but to a new genus apparently possessing affinity with *Axinosia* (vide p.349). Until it is rediscovered, however, and its precise nature known, and while the genus *Axinella* still remains "a receptacle for all Axinellidæ which do not belong to more clearly defined genera," the species perhaps had better remain known, for the present, by its original name.

Axinella obtusa.

The same remarks apply to this species as have been made above in the first sentence and concluding paragraph of my remarks in reference to *Axinella inflata,* to which species *A. obtusa* appears, from its description, to be very closely related. A specimen labelled in Lendenfeld's handwriting, *"Dictyocylindrus obtusa,"* the MS. name corresponding to *A. obtusa,* according to the key-list—occurs in the Australian Museum, but neither in external nor internal features does it comply with the description of the species; it belongs to an undescribed species of *Raspailia,* similar to *R. tenella,* in the size and form of its spicules, and also in the possession of radiate tufts of dermal spicules, but approaching rather to *R. gracilis* in the precise pattern of its skeleton. In its external shape, however, irrespective of its relatively small size and slender proportions, the specimen exhibits a very considerable degree of correspondence with the description; and it is just possible, therefore, that the outward description of *A. obtusa* was based upon a much larger and more stoutly proportioned specimen of the same Raspailia species. Consequently, if, as seems not unlikely, this species should be found to grow to the size to which *A. obtusa* is stated to attain, there would be justification for regarding the latter species as synonymous partly with the former (which would then have to be called *Raspailia obtusa*) and partly with *Axinella inflata.*

Spirophorella digitata.

In the absence of a type-specimen, it is impossible to speak with certainty regarding this species; but there are peculiar circumstances surrounding it, which justify the suspicion that some serious mistake in connection therewith has been made. In the first place, one is at a loss to understand why a new genus was introduced for its reception, for, apart from the fact that Carter had some years previously proposed the genus *Trachycladus* for a species with essentially similar spiculation, Lendenfeld, in his paper on the Australian Chalininæ—published just immediately in advance of the Catalogue—had himself already proposed a genus *Spirophora,* whose definition and that of *Spirophorella* are virtually identical. Besides this, the identity of *Spirophora* with *Trachycladus* had been pointed out by Dendy, in his criticism of the paper above referred to, prior to the publication of the Catalogue. If it be suggested, in explanation, that Lendenfeld must have considered the slight differences to be of generic value which he ascribed to the species respectively assigned by him to *Spirophora* and to *Spirophorella,* the further question needs to be answered as to why he referred the two genera to different families, and having done so, why he has omitted, in his remarks on the latter, to make any reference whatsoever to the former, while yet deeming it of sufficient importance to observe that *Spirophorella* "appears very similar to *Spiretta,*"—a Tetractinellid genus having no other special point of agreement with the genus in question than the possession of spiral microscleres. One cannot suppose that the idea of a relationship between his species of *Spirophora* and *Spirophorella* did not occur to Lendenfeld, since evidently the one generic name is coined from the other; and, furthermore, it would seem as if he shortly afterwards decided to regard the two genera as identical, for in his paper(28) published but a year later than the Catalogue, in which a complete classification of the sponges is proposed, only one of these genera, viz., *Spirophorella,* receives mention. Hence one would have thought that, as a precaution, in view of the possibility of its becoming necessary later to unite the genera, the author would have avoided using similar specific names in the two cases; yet we find that the first-described of the two species of *Spirophora* and the single species of *Spirophorella* are both designated *digitata,* a name which moreover, is altogether inappropriate as applied to the latter, since the species is, according to description, "irregular, massive." The explanation of these anomalies, I think, must in some way be connected with the fact that the manuscripts of the Catalogue and of the paper on the Chalininæ were in course of preparation at one and the same time. It is possible that Lendenfeld, having at first intended to refer the the genus *Spirophora* to the Gelliinæ, and having described two species of it for inclusion in his paper on the Chalininæ, afterwards decided to refer the genus to the *Axinellidæ*, and to introduce it in the Catalogue, but through an oversight omitted to delete the paragraphs relating thereto from the manuscript of the former paper; hence, that *Spirophorella* is merely another spelling for *Spirophora*—preferred perhaps on account of the similarity between the names *Spirophora* and *Spiriphora;* and that *Spirophorella digitata* is nothing more than *Spirophora digitata* wrongly described in respect of its external characters. Support to this suggested explanation is provided by the fact that, in the key-list of Lendenfeld's manuscript names, *Spirophora digitata* is written as the MS. synonym of *Spirophorella digitata.*

Several specimens labelled *Spirophora digitata,* in Lendenfeld's handwriting, occur in the Australian Museum, and these I regard as correctly representing that species, which must now be called *Trachycladus digitatus.* Contrary to Lendenfeld's description, however, the megascleres are not styli, but almost exclusively oxea, and the microscleres are of two kinds, spirulæ and microstrongyles. A description of this, and of some other species of *Trachycladus,* will be given in my next paper.

APPENDIX.

Hemitedania, gen.nov.

Tedaniinæ in which the skeleton is a reticulation of spiculo-spongin fibre, and the only megascleres are smooth oxea or tornota. The raphides are spinulous, and are typically provided, near one extremity, with a bulbous dilatation.

The raphides of *Amorphina anonyma*, I find, exhibit characters which render it certain that the species is closely allied to *Tedania*, and particularly to such species as *T. pectinicola* and *T. fuegiensis* Thiele(**42**); and as its possession of well-defined sponginous fibres is additional reason against the inclusion of this species in the genus *Rhaphisia*, to which Dendy referred it (and which, by the way, Lundbeck(**31**) with some justification regards as a synonym of *Gellius*), I accordingly propose for its reception a new genus, *Hemitedania.*

Spinulous raphides—or onychetæ, as Topsent(**48**) has termed them—peculiar in having a subterminal bulb, occur also in two undescribed species (represented by specimens in the Australian Museum) in which the megascleres are styli and strongyla, and which, in skeletal structure, differ markedly both from typical species of *Tedania* and from each other. One of these species, for which a new genus will certainly be required, is remarkable in possessing peculiar acanthostyle-like spicules, which undoubtedly are derivatives of onychetæ, but attain a size of 115 by 6 μ; they have a slightly roughened surface, a subfusiform shape, and an abruptly truncated base provided with a central mucro and a circumferential whorl of minute spines. Another species, which I consider to be related to *Tedania*, and for which a new genus is probably necessary, is that described by Kirkpatrick(**24**) under the name *Oceanapia tantula.*

Concerning the systematic position of *Tedania* and its allies, there is not yet agreement of opinion, though generally they are placed along with the genera formerly included in the subfamily Dendoricinæ; Dendy, however, has always favoured the recognition of a subfamily Tedaniinæ which he would include in the *Haploscleridæ.* In view of the difficulty in classification occasioned by the genus *Hemitedania,* it seems to me advisable, if not necessary, to retain the family Tedaniinæ, though, at present, I am unable to form an opinion as to whether it should be placed under the *Haploscleridæ* or the *Desmacidonidæ*. A very considerable resemblance certainly exists between *Trachytedania* and certain Myxilline genera like *Lissodendoryx*, but inasmuch as no form of spicule, affording evidence of an homology with the onycheta, is known in any of these genera, there is no sufficient warrant for regarding the resemblance as other than the result of convergent evolution.

HEMITEDANIA ANONYMA Carter. (Pl. xviii., fig.4; Pl. xix., figs.1-5; Pl. xxiv., figs.3-5; and text-fig.20).

1886. *Amorphina anonyma*; Carter(**7**), p.49.
1895. *Rhaphisia anonyma*; Dendy(**12**), p.256.
1888. *Reniera pandæa*(partim); Lendenfeld(**27**), p.79.
——. *Halichondria rubra*(partim); Lendenfeld(**27**), p.81.
——. *Halichondria rubra* var. *digitata*(partim); Lendenfeld(**27**), p.81; not Pl. ii., fig.1(= *Raspailia agminata*, sp.n.).
1901. *Rhaphisia rubra*; Whitelegge(**54**), p 77.
1902. *Rhaphisia pandæa*; Whitelegge(**56**), p.281.

The material at my disposal comprises some twenty specimens from Port Jackson and neighbouring localities; a specimen from Port Phillip; and a slide-preparation of *Rhaphisia anonyma*, presented to the Australian Museum by Prof. Dendy.

Description.—In the simplest form, the sponge is an irregularly digitate cluster of stout branch-like parts (Pl. xix., figs.1-4), which are united below, forming a sessile base; the branches are tubular, with a single osculum at the summit, are cylindrical and slightly tapered, may attain to a length of 200 mm or more, and, while ordinarily not much less than 20 mm. in diameter, vary in stoutness in different specimens from 10 to 30 mm. More usually, however, a formation into separate tubes is only partially effected, and the sponge accordingly consists, in part, of more or less flabellate portions with marginal oscula (Pl. xix., fig.5). Finally, the branching habit is often almost entirely suppressed, and the sponge is then lobose, semi-massive, as a rule more or less compressed, with the oscula situated on the uppermost and prominent parts. The surface is free from characteristic inequalities, and, in general, is smooth and even; a dermal membrane is present, and, though thin, is usually well-defined. The oscular tubes, whose diameter varies from 3 to (rarely) 10 mm., are lined by a stouter and tougher membrane, which also forms numerous diaphragm-like dissepiments stretching across their lumen. Concerning the life-colour, which is known with certainty only in the case of Port Phillip specimens, Dendy states that "orange is the prevailing tint and there are no very great deviations from this"; the colour in spirit ranges from dull yellowish-white to a pale brown. Well preserved specimens are of firm, sometimes slightly cartilaginous, moderately tough consistency, and are brittle rather than flexible; but apparently the sponge readily undergoes some amount of maceration, with the result that, as a rule, spirit-specimens are comparatively soft, compressible, and resilient. The consistency depends to some extent upon the degree of coarseness of the fibres, which is variable. Specimens dried in the ordinary way (without previous removal of the sarcode) are light, open, and somewhat bread-like in texture, and, considering their horny fibrous skeleton, are somewhat brittle. The fibrous reticulate skeleton, obtained by treatment with caustic potash, presents certain constant features, but, in different specimens, varies greatly in the closeness of its texture and in elasticity, and to some extent also in colour and pattern. A dense irregular network of stouter (primary) fibres bounds each of the oscular tubes, and from this—taking the (simple) case of a separate branch - dendritically branching, secondary fibres run out (in a slightly upward direction) to the surface; these secondary fibres, which to within a short distance of their outer extremities are connected together by (usually plexus-forming) cross-fibres, are disposed in such a way that the skeleton, viewed from the exterior, presents a very imperfectly honeycomb-like structure. The colour of the skeleton varies from yellowish-white to golden-yellow, according to the degree of development of spongin.

As seen in section under the microscope, the skeleton-reticulation is of a very irregular pattern, and the fibres are of very varying stoutness; the latter are composed of roughly parallel spicules cemented by spongin, which usually forms a distinct sheath, but sometimes is barely more than sufficient in quantity to hold the spicules together. The primary fibres attain a diameter ranging in different specimens from about 80 to 130 μ, while the slenderest of the connecting fibres are but two or three spicules broad; single connecting spicules also occur. In the meshes of the reticulation, megascleres are scattered in some abundance, together with a few raphides; in the canal-traversed soft tissues occupying the wider interstices of the skeleton, on

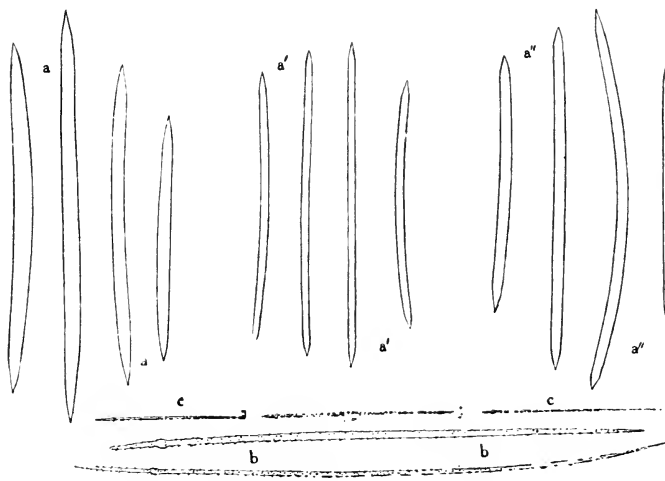

Fig. 20.—*Hemitedania anonyma.* *a*, Oxea, from each of three different specimens. *b*, Onychetæ.

the other hand, it is the raphides which are the more numerous. In addition to the fibres which compose the reticulation, separate strands of loosely associated parallel spicules, free from spongin, occur, sometimes consisting of oxea alone, more frequently of oxea and raphides in variable proportion, and apparently sometimes of raphides alone. The raphides also occur in dragmata, but these are sometimes extremely scarce. The dermal skeleton consists of vertical tufts of megascleres projecting slightly beyond the surface, and usually so disposed in linear series as to produce a more or less distinctly reticulate pattern; these tufts, for the most part, are the outer ends of radiating spicule-strands into which the outwardly running (secondary) fibres of the main skeleton break up on nearing the surface.

Spicules.—(*a.*) The oxea are mostly straight or nearly so, and abruptly sharp-pointed (tornotiform); among them, rare individuals occur, which are more or less rounded off at one extremity (stylote). Their maximum size in different specimens is fairly constant as regards length, but variable as regards stoutness: in Dendy's slide of *Rhaphisia anonyma*, they measure from 155 to 265 μ in length by at most 6 μ in diameter; in the type-specimen of *Reniera pandæa*, 165 to 245 by 8 μ; in the type-specimen of "*Halichondria rubra*," 160 to 230 by about 7 μ; and in another specimen, of unusually cartilaginous consistency, 150 to 275 by 12 μ.

(*b.*) The raphides are straight, slightly fusiform, asymmetrical with regard to opposite extremities; they taper gradually to a very fine point at one extremity, are abruptly truncated and produced into a minute extra-axial mucro at the other, and, at a distance of between one-sixth and one-tenth their length from the latter end, exhibit a small bulbous dilation. The spinules are very minute, are most pronounced at the basal end of the spicule, and, gradually diminishing in size, finally become indiscernible somewhere about the middle of the spicule. The spicules are of two sizes, the larger being the more numerous. The smaller occur plentifully in Dendy's slide of *R. anonyma*, but, in all the other specimens examined, including the one from Port Phillip, they are rather rare and in some cases apparently absent. In the two Port Phillip examples, the longer raphides measure from 135 to 175 μ, while in the Port Jackson examples, with one exception (viz., the specimen with oxea 12 μ in diameter), they are shorter, having a maximum length varying between 138 and 150 μ; their maximum stoutness varies in different specimens, proportionately with that of the megascleres, from less than 1 μ to about 2 μ. The smaller raphides are extremely slender, and seldom more than 40 or 50 μ long.

Locs.—Port Jackson and neighbourhood; Port Phillip.

HISTODERMA ACTINIOIDES sp.nov. (Pl. xxii., fig.3; and text-fig.21).
1888. *Stylotella polymastia* (err.), Lendenfeld(**27**), Pl. iv., fig.1.
——. *Sideroderma navicelligerum* R. et D. (err), Lendenfeld(**27**), p.210.

The sponge is of massive rounded form, and apparently grows attached by a narrow base. From the surface, over its entire extent, arise numerous longer or shorter digitiform, tapering, lax tubular processes (with thin membranous wall), which somewhat resemble the tentacles of a sea-anemone. Between the processes, the surface is smooth, and either even or much wrinkled. Oscula appear to be absent. The colour in alcohol is pale yellowish-grey within, and more whitish on the surface. The consistency is firm, compact, moderately tough and compressible, yet brittle rather than elastic. The dermal layer does not form a noticeable rind, but is thin and closely adherent to the underlying tissue.

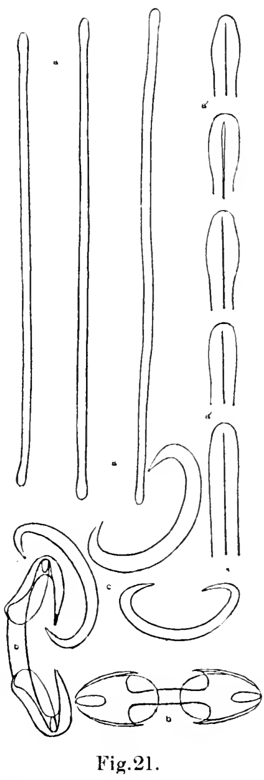

Fig.21.
Histoderma actinioides. *a*, Tylota. *a'*, Extremities of tylota. *b*, Isochelæ arcuatæ. *c*, Sigmata.

The single example*(Catalogue, Pl. iv., fig.1), which is a half-specimen, would, when complete, measure about 100 by 80 by 55 mm., in its three principal diameters. The tubular processes vary in length up to about 20mm., and are 2 to 4 mm. wide at the base.

The main skeleton consists of non-reticulating fibres running in various directions without regular course, and, scattered between these, of plentiful single spicules, and spicules aggregated in bundles and strands. The fibres

* Another specimen of the species has since been found among a collection of sponges belonging to the Department of Biology, Sydney University, and is figured in the present paper.

are of very variable stoutness, occasionally attain to 100 μ in diameter, and are composed of roughly parallel spicules usually not very compactly arranged. Spongin appears to be entirely absent. The microscleres are scattered chelæ and sigmata, the former rare except in the outermost layer of the dermis, the latter fairly abundant and occurring only in the choanosome. The dermal layer, which is never much more than 100 μ in thickness, is provided with moderately abundant single spicules disposed horizontally in several layers and crossing one another in various directions. In the fistulæ, however, the dermal skeleton (which is there the only skeleton) undergoes a gradual alteration in its arrangement, and towards their extremities becomes a reticulation of stout fibres. The meshes of this reticulation are tympanised by a thin membrane, which is perforated with numerous rounded pores varying from 15 to upwards of 80 μ in diameter.

Spicules.—(*a.*) The megascleres, which vary in form from tylota to strongyla, the tylota being the more numerous, are nearly or quite straight and scarcely, if at all, stouter at the middle than towards the ends. The end-swellings of the tylota are elongate and oblongish in shape, and, as a rule, are more pronounced in the stouter spicules than in the slenderer. The very slenderest (developmental) spicules are invariably strongyla, and usually taper slightly from one end to the other. The maximum size of the megascleres is 430 by 10 μ, and their length seldom falls below 320 μ.

(*b.*) Isochelæ arcuatæ, 12·5 to 18 μ long, with the distal end of the alæ pointed and abruptly incurved, and apparently with a tooth-like prolongation of the tubercula.

(*c.*) Simple and contort sigmata, 33 to 42 μ long from bend to bend, and at most 3·5 μ stout.

Embryos.—A few embryos of oval shape, the largest measuring 900 by 600 μ, were observed, most of which were provided with spicules in the form of equal-ended tylota of size rarely exceeding 190 by 2 μ. The spicules were usually scattered throughout the entire body of the embryo, but, in a few cases, were chiefly collected in a loose bundle situated near one end. The largest embryo without spicules measured 700 by 500 μ, but others, of smaller size than this, were present, which contained quite abundant spicules.

Loc.—Port Jackson.

RASPAILIA AGMINATA, sp.n (Pl. xxiii., fig.4; and text-fig.22).

1888. *Halichondria rubra* var. *digitata* (err.) Lendenfeld(**27**), Pl. ii., fig.1.

Description.—Sponge a compact tussock-like sessile cluster of erect tapered branches, which combine below into gradually fewer and stouter stems ultimately proceeding from a narrow area of attachment. An adequate idea of the outward form is conveyed by the figure of the single specimen (Pl. xxiii., fig.4), which measures 95 mm. in height. The surface is smooth, or in places minutely pustulate; and is sparingly hispid with spicules which project about 1 mm. beyond it. The colour in spirits is greyish-white, and the consistency fairly tough, compressible, and resilient.

The main skeleton, which is not condensed in the axial region, consists: (i.) of an irregular wide-meshed reticulation of pale slender spongin-fibres echinated, as a rule unilaterally, by moderately closely-spaced acanthostyles, the principal fibres of which are cored by pauciserial tylostyli, while the (usually plexus-forming) connecting fibres are with rare exceptions aspiculous; and (ii.) of, for the most part, longitudinally-directed styli and tylostyli lying between the fibres. In sections mounted in balsam, the spongin is scarcely or not at all discernible, and the by no means dense skeleton appears as if composed solely of spicules. An outermost layer of the sponge, which is sometimes as much as 0·5 mm. in width, though usually much narrower, is comparatively or quite free from spicules, excepting that it is crossed by the long styli, which hispidate the surface and give support superficially to tufts of small (auxiliary) spicules surrounding the points of exit of these styli. Auxiliary spicules also occur, in very small number, and usually not singly, but in pairs, scattered through the interior.

Spicules.—(*a.*) The principal megascleres are partially differentiated into groups, styli and tylostyli, the latter of which are almost invariably sharp-pointed, while the former are often more or less rounded off at the apex and occasionally pass into more or less abbreviated strongyla; both kinds are (usually not much) curved, especially in their basal moiety. The tylostyli, which are seldom, if ever, less than 950 μ long, are of very varying stoutness, and have the bulb less pronounced in proportion as they are stouter; between tylostyli and styli of the same length, there are all intermediate gradations. The styli are always proportionately stouter than the tylostyli and range in length from about 450 to 2800 μ; their maximum diameter is 28 μ.

(*b.*) The acanthostyles are straight, conical spicules, measuring at most 12·5 μ in stoutness, and varying from 80 to upwards of 190μ, though rarely exceeding 150 μ in length. The spines are recurved, generally between 2 and 4 μ in height, and nearly always are more or less reduced in number over portion of the basal half of the spicule.

(*c.*) The auxiliary spicules are styli and asymmetrically-ended oxea, straight or slightly curved, the latter comparatively few in number and, on the average, shorter and slenderer than the styli. They measure from 245 to about 400μ in length, and seldom as much as 6 μ in stoutness.

Loc.— Port Jackson.

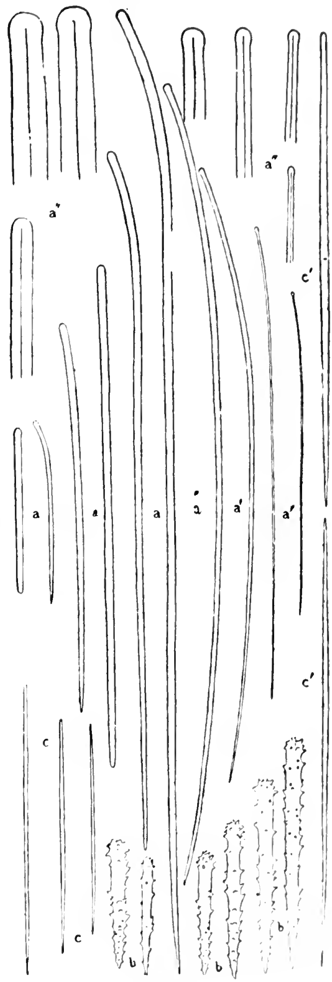

Fig. 22.

Raspailia agminata. *a*, *a′*, Principal spicules, styli and tylostyli with occasional substrongyla. *a″*, Basal ends of principal spicules. *b*, Acanthostyli. *c*, Auxiliary oxea and styli. *c′*, The same drawn to a larger scale.

Remarks.—The occurrence, as in this species, of auxiliary spicules in pairs – in incipient dragmata, as it were—is perhaps not uncommon in the genus *Raspailia*; although, as far as I am aware, no mention of it has hitherto been made. I have observed it not only in the three species of this genus described in the present paper, but also in *R. atropurpurea* (Carter) Whitelegge(**54**), and in the allied genus *Clathriodendron*(**18**).

AXIAMON, gen.nov.

Axinellidæ(?), typically of ramose or flabellate habit, and with conulose or lamelliferous surface, in which the characteristic megasclere is an oxea with spinose extremities, and the skeleton is a lattice-like reticulation of fibres formed of these spicules (and admissibly also of derivatives of them) cemented and ensheathed by spongin. Microscleres are absent.

The nearest approach I know of to the type of skeleton-reticulation typical of this genus, I have observed in an undescribed sponge from New Zealand; but, in the latter—which thus belongs to an unnamed genus—the fibres are cored by smooth styli, and echinated by rare distally spined rhabdostyli. I have also observed a somewhat similar type of skeleton in an undescribed species of *Trikentrion* from North-west Australia. As it seems highly probable that the New Zealand sponge is generically related to *Trikentrion* (but distinguished in having *stylote* instead of oxeote megascleres and cladose acanthostyli with only *one basal actine* instead of several), I am inclined to think that *Axiamon* also is related to *Trikentrion*, and thus of "Ectyonine" origin. Since, however, the genus is lacking in any character that would warrant its inclusion in the *Desmacidonidæ* as at present defined, the only course open seems to be to place it in the *Axinellidæ*.

In the form of its spicules, the type-species, *A. folium*, sp.nov., shows analogies, probably indicative of relationship, with *Axechina raspailioides* Hentschel(**21**); and it also presents points of agreement with *Thrinacophora funiformis* Ridley & Dendy.

A species, which, I believe, will be found to belong to *Axiamon*, has been described by Carter(**6**), from Australia(?), under the name

Ptilocaulis rigidus. But there is perhaps equal justification for the view expressed by Thiele(**39**), that this species should be included in the genus *Phycopsis*; and it is quite likely that *Phycopsis* and *Axiamon* are closely allied.

Axiamon folium, sp.nov. (Pl. xviii., figs.2, 3; Pl. xxiv., figs 7, 8; and text-fig.23).

1902. *Reniochalina stalagmites*(err.) + *Reniochalina lamella*(err.), Whitelegge(**56**), p.283.

Two specimens only are at hand—those which Whitelegge very briefly and not quite accurately described as the types respectively of *Reniochalina stalagmites* and *Reniochalina lamella*; and as these differ to some extent in certain external features, and may thus be varietally distinct, it is advisable to mention that I choose, as the typical specimen, that which Whitelegge took to be *R. stalagmites.*

Description.—Sponge flabellate, stipitate; the lamina entire, or palmato-digitate, or deeply dissected into branch-like parts. Surface ornamented with longitudinal close-set septiform ridges, usually either deeply notched at short intervals or segmented into separate languettes; between the ridges, the lamina is exceedingly thin except in the region of the stalk. Consistency in the dry state, dense, hard, tough, flexible within limits; colour greyish-brown.

The digitate typical specimen (Pl. xviii., fig.2), which is incomplete below, measures 250 mm. in height, and is provided with highly segmented ridges averaging 3 mm. in height, and set at a distance apart of from 2 to 3 mm. The second specimen (Pl. xviii., fig.3), 145 mm. in height, has continuous though deeply crenate ridges, averaging 1·5 mm. in height and 1 to 2 mm. in distance apart.

The main skeleton is a compact lattice-like reticulation with, for the most part, rhomboidal meshes, composed of spongin-ensheathed spicules arranged (somewhat confusedly) in pauci-serial fibres; the sides of the meshes are of about a spicule's length. Better defined primary fibres are sometimes observable running longitudinally and gradually trending outwards; but, as a rule, no distinction between main and connecting fibres can be drawn. Spongin is developed only in relatively slight amount in the younger parts of the sponge, but later comes to form well-defined fibres (up to 60 μ in diameter) enclosing the spicules and rounding off the angles of the meshes. Many spicules, however, remain uncovered by spongin; and, on the other hand, a small

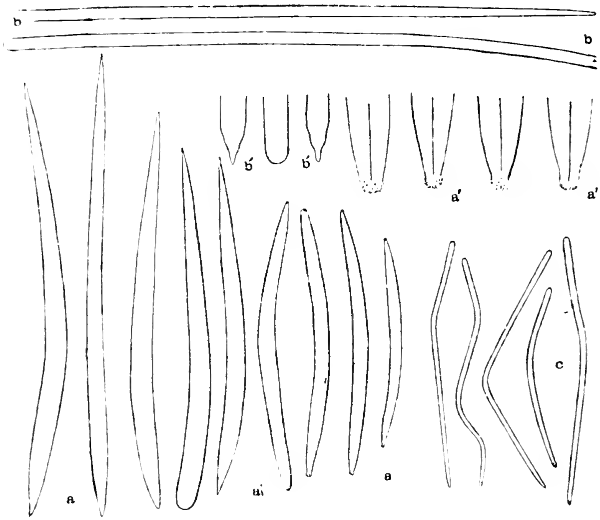

Fig. 23.—*Axiamon folium.* *a*, Principal oxea, anisoxea, and styli. *a'*, Extremities of principal spicules. *b*, Interstitial stylus. *b'*, Basal extremities of interstitial styli. *c*, Dermal styli.

proportion of short fibres are to be found composed entirely of spongin. The spiculation consists almost entirely of the characteristic oxea and of unequal-ended derivatives of these (anisoxea); but here and there, in some parts of the sponge at least, a long slender stylus may be met with; and, in the most superficial layer of the sponge, a very few small dermal spicules occur, lying scattered. The surface is rendered hispid by anisoxea projecting singly or in twos or threes, for three-fourths or more of their length, usually in an obliquely upward direction.

Spicules.—(*a.*) The oxea and anisoxea, which range from 180 to 420 μ in length, and up to 21 μ in stoutness, are moderately (and, as a rule, slightly angulately) curved, the oxea symmetrically so, the anisoxea only in their basal moiety. The shortest and slenderest spicules are invariably oxea, the longest and stoutest, anisoxea; those of intermediate dimensions include both oxea and anisoxea, and all possible gradations between them. Many of the slenderest oxea are (gradually) sharp-pointed at both ends, and most of the anisoxea are (somewhat abruptly) either sharp-pointed or more or less bluntly rounded off at the basal end; but, with these exceptions, the extremities of the spicules are almost invariably surmounted by a cap of minute spinules. Occasional spicules are stylote.

(*b.*) Exceedingly rare, long, slender styli, tapering very gradually to a fine point at the apex, sometimes abruptly somewhat pointed at the base, and measuring from about 550 to 1200 μ in length by 7 to 12 μ in stoutness.

(*c.*) Small dermal styli, straight or variously bent or flexuous, either gradually or more or less abruptly sharp-pointed, and, in the latter case, usually provided near the apex with a few minute spines; measuring 190 to 280 μ in length by 3 to 5 μ in stoutness.

Loc.—Western Australia.

Remarks.—In the British Museum, in addition to a specimen of this species (labelled "*Reniochalina stalagmites*"), there occur two further examples of the genus *Axiamon*, labelled respectively "*Reniochalina spiculosa* Port Jackson," and "*Reniochalina arborea*, New Zealand." These have oxeote and anisoxeote megascleres of almost or quite identically the same size and form as those of the type-species, but they appear to be entirely lacking in the other kinds of spicules. The former, of which I have seen only a small fragment, is apparently not widely different in surface-features from the typical specimen of *A. folium*; but the latter—which is represented also in the Australian Museum, by an almost complete specimen—has a peculiar densely conulose surface, and is obviously a quite distinct species.

For Reference List of Literature, see *antea*, pp.310-313.

EXPLANATION OF PLATES XV.-XXIV.

Plate xv.

Fig. 1.—*Sollasella digitata* Lendenfeld; (× 2/3).

Fig. 2.—*Sollasella digitata* Lendenfeld, from the type; (× 2/3).

Fig. 3.—*Donatia fissurata* Lendenfeld; (slightly reduced).

Fig. 4.—*Donatia phillipensis* Lendenfeld; surface-section showing the dermal reticulation, the primary meshes of which are subdivided (by lines of tylasters) into smaller meshes, each enclosing a pore; (× 18).

Fig. 5.—*Spirastrella*(?) *australis* Lendenfeld; a flabellate example; (× ½).

Fig. 6.—*Polymastia zitteli*, from the type of *Sideroderma zittelii* Lendenfeld; (nearly nat. size). The specimen is in a fragmentary condition.

Plate xvi.

Fig. 1.—*Cliona* (*Papillissa*) *hixoni*, from the type of *Raphyrus hixonii* Lendenfeld; portion of the exterior, showing the character of the surface-areolation; (× ¾).

Fig. 2.—*Cliona* (*Papillissa*) *hixoni*; showing the skeleton (after maceration by means of caustic potash) of a thick slice of a small specimen; (nat. size).

Figs. 3-4.—*Cliona* (*Papillissa*) sp., allied to *Cliona hixonii*; portions of the concave and convex surfaces respectively of a specimen having the form of a thick, curved plate, showing the character and arrangement of the surface-papillæ; (× ¾).

Plate xvii.

Figs. 1, 2.—*Cliona* (*Papillissa*) *lutea*, from the types of *Papillissa lutea* Lendenfeld; (× ½).

Fig. 3.—*Spirastrella*(?) *australis* Lendenfeld; showing the skeleton (as prepared by maceration by means of caustic potash) of the specimen illustrated in Pl. xv., fig. 5; (× ½).

Fig. 4.—*Amorphinopsis megarrhaphea* Lendenfeld; dermal skeleton; (× 8).

Fig. 5.—*Amorphinopsis megarrhaphea* Lendenfeld; pattern of the skeleton as shown in portion of a moderately thin section (× 10 approximately).

Fig. 6.—*Tedania digitata* var. *rubicunda*, from the type of *T. rubicunda* Lendenfeld; (× ½).

Plate xviii.

Fig. 1.—*Caulospongia elegans*, from the type of *Plectodendron elegans* Lendenfeld; (× 2/7).

Fig. 2.—*Axiamon folium*, sp.nov.; (× 4/5).

Fig. 3.—*Axiamon folium* (var.?); (× 4/5).

Fig. 4.—*Hemitedania anonyma* Carter; from a specimen of somewhat cartilaginous consistency, and with coarse-fibred skeleton; (× ½).

Plate xix.

Fig.1.—*Hemitedania anonyma* Carter, from a specimen labelled as the type of *Halichondria rubra* Lendenfeld; (× $\frac{3}{4}$).

Fig.2.—*Hemitedania anonyma*; from a macerated, coarse-fibred specimen; (× $\frac{1}{2}$).

Figs.3, 4, 5.—*Hemitedania anonyma*; illustrating various forms assumed by examples of this species; (× $\frac{1}{2}$ approximately).

Plate xx.

Fig.1.—*Chalina finitima* Whitelegge (non Schmidt); an incomplete specimen.

Fig.2.—*Phlœodictyon ramsayi*, from one of the co-types of *Rhizochalina ramsayi* Lendenfeld; illustrating a specimen of irregular shape provided with *many* root-like processes.

Fig.3.—*Phlœodictyon ramsayi* var. *pyriformis* (var.nov.) ; portion of the upper surface showing the sieve-like area formed by the closely apposed oscula; (× $\frac{2}{3}$)

Figs.4-5.—*Phlœodictyon ramsayi* ; tangential sections close beneath the surface, showing the pattern of the reticulation formed by fibres of the bast-layer in the wall of the fistula and in between the fistulæ respectively; (× 10).

Plate xxi.

Figs.1, 2, 3, 4.—*Stylotella agminata* Ridley, from type-specimens of *Stylotella digitata* Lendenfeld, and of *Tedania laxa* Lendenfeld; (× $\frac{1}{2}$ approximately).

Fig.5.—*Stylotella agminata* Ridley; further illustrating the variable habit of the species.

Plate xxii.

Fig.1.—*Axinella aurantiaca* Lendenfeld; longitudinal median section taken at the extremity of a thin branch; (× 15).

Fig.2.—*Stylotella agminata* Ridley; longitudinal section taken at the extremity of a branch; (× 12).

Fig.3.—*Histoderma actinioides*, sp.nov.; (× $\frac{2}{5}$ approximately).

Fig.4.—*Phlœodictyon ramsayi* Lendenfeld, var. *pyriformis* (var.nov.); inner surface of longitudinally bisected specimen, showing disposition of oscular canals; (× $\frac{2}{5}$).

Fig.6.—*Spirastrella*(?) *ramulosa* Lendenfeld; showing the skeleton which remains after maceration by means of caustic potash; (× $\frac{3}{5}$).

Fig.6.—*Raspailia tenella* Lendenfeld; longitudinal median section taken at the extremity of a branch; (× 12).

Fig.7.—*Raspailia gracilis* Lendenfeld; longitudinal section of a branch; (× 9).

Plate xxiii.

Fig. 1. *Raspailia gracilis*, from the type of *Axinella hispida* var. *gracilis* Lendenfeld; (× $\frac{3}{4}$).

Figs. 2-3. —*Raspaila tenella*, from the types of *Axinella hispida* var. *tenella* Lendenfeld; (× $\frac{3}{4}$ approximately).

Fig. 4. —*Raspailia agminata*, sp. nov.; from the specimen wrongly figured in the Catalogue (Pl. ii., fig. 1) in illustration of *Halichondria rubra*, var. *digitata* Lendenfeld; (× $\frac{3}{4}$).

Fig. 5. —*Chalinodendron dendrilla* Lendenfeld; (× $\frac{4}{5}$).

Plate xxiv.

Fig. 1. —*Mycale* (*Paresperella*) *penicillium* Lendenfeld ; dermal skeleton ; (× 18).

Fig. 2. —*Tedania digitata* var. *rubicunda* Lendenfeld ; dermal skeleton ; (× 18).

Figs. 3, 4, 5. —*Hemitedania anonyma* Carter; dermal skeleton; (× 18).

Fig. 6. —*Mycale serpens* Lendenfeld; dermal skeleton.

Figs. 7, 8. —*Axiamon folium*, sp. nov.; pattern of the skeleton as shown in moderately thin sections. Fig. 7, (× 10).

PETROLOGICAL NOTES ON VARIOUS NEW SOUTH WALES ROCKS.

By W. N. Benson, B.A., B.Sc., F.G.S., Linnean Macleay Fellow of the Society in Geology.

i. *Rocks of Nullum Mountain, near Murwillumbah.*

Some years ago, the writer spent a day at Murwillumbah, and examined Nullum Mountain, which lies five miles to the south-west of the town. Nothing yet has appeared concerning the geology of this area, so that a few notes may be given here to call attention to the spot. The mountain forms a short ridge, standing prominently in front of the range. Its relief is due to the presence of an inclined sheet of granophyre, which dips towards the north. The main mass of the mountain is composed of gnarled slaty rocks of the Brisbane Schists, of Lower Palæozoic or even earlier age. The inclined sheet outcrops on the southern side of the ridge, and is exposed on the northern slopes of the mountain for some distance down its face. At the base, various dykes have been noted. The sill consists chiefly of granophyre composed of small crystals of orthoclase and acid plagioclase, partly allotriomorphic, partly idiomorphic, surrounded by a granophyric intergrowth of quartz and orthoclase. A little biotite occurs and magnetite, but the bulk of the ferromagnesian constituents are altered into regular patches and spherulites of chlorite, and grains of epidote. A few apatite crystals are also present.

The rock of the upper surface of the sheet exposed on the north slope shows frequently no granophyric structure, but has a trachytic habit. It consists of a pilotaxitic felt of felspar-laths, both orthoclase and acid plagioclase, and frequently an untwinned felspar of the same refractive index as Canada balsam, possibly anorthoclase, together with a fair amount of interstitial quartz. The pyroxene is a normal grey augite, forming small prisms more or less altered to chlorite and epidote, magnetite and ilmenite in small grains and plates. Xenocrysts are present, that seem to have been derived from a dolerite: they may occur aggregated or singly, and are rather corroded. The basic plagioclase is being replaced by irregular patches of albite; the pyroxene is a grey augite, with a basal striation and varying optic axial angle, sometimes large, but in two instances almost 0°. This indicates that it is an enstatite-augite. Large plates of ilmenite occur also. The vesicles of the rock are filled with quartz and chlorite.

The majority of the dykes on the north face of the mountain are trachyandesites, related to the last rock. They are fine-grained green rocks, showing phenocrysts of plagioclase and orthoclase in a matrix of laths of the same minerals. The coloured constituents have been largely decomposed, but are sometimes seen to be minute prisms of grey augite, with rarely large chlorite-pseudomorphs after the same mineral; the extinction-angle of these pyroxenes is quite high; alkaline pyroxenes or amphiboles are not recognisable. Magnetite occurs in large and in very minute grains. Considerable variation is seen in the grainsize of the ground-mass, and in the proportion between the potash and lime-soda felspar, the decrease in the former indicating a passage towards the andesites.

A quite different type of dyke occurs in a road-cutting near the foot of the mountain, adjacent to one of the more basic green dykes. It consists entirely of colourless minerals, being a very fine-grained mixture of andesine, quartz and a minor amount of orthoclase, with a few small phenocrysts of quartz and andesine. The rock is much obscured by sericite.

One cannot be certain yet of the affinities of these rocks. From a macroscopical examination of the writer's collection, Dr. Jensen* considered that they might be riebeckite-trachytes, and he himself found dykes of alkaline trachyte in the neighbourhood of Murwillumbah; the microscopical study, however, has not confirmed the presence of riebeckite.

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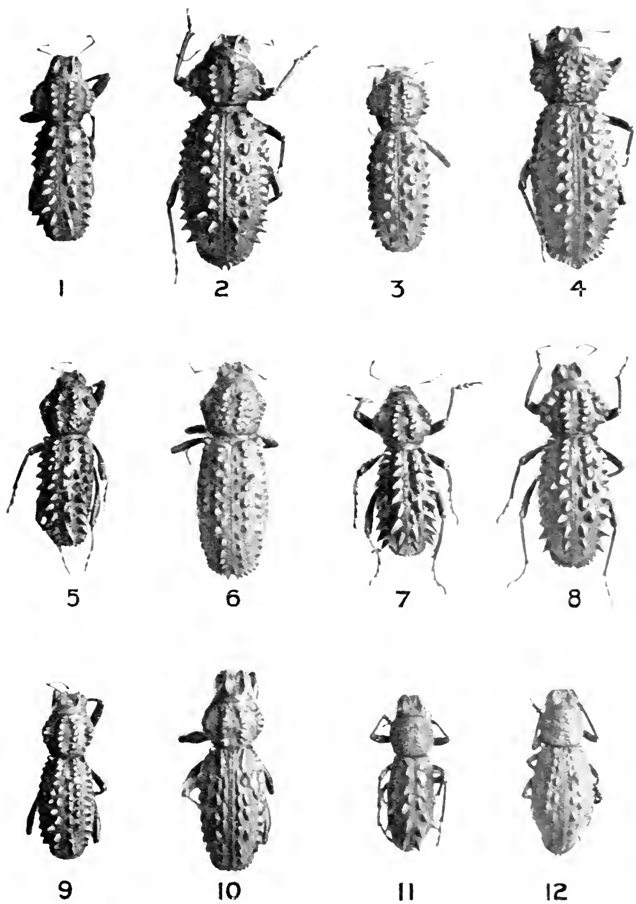
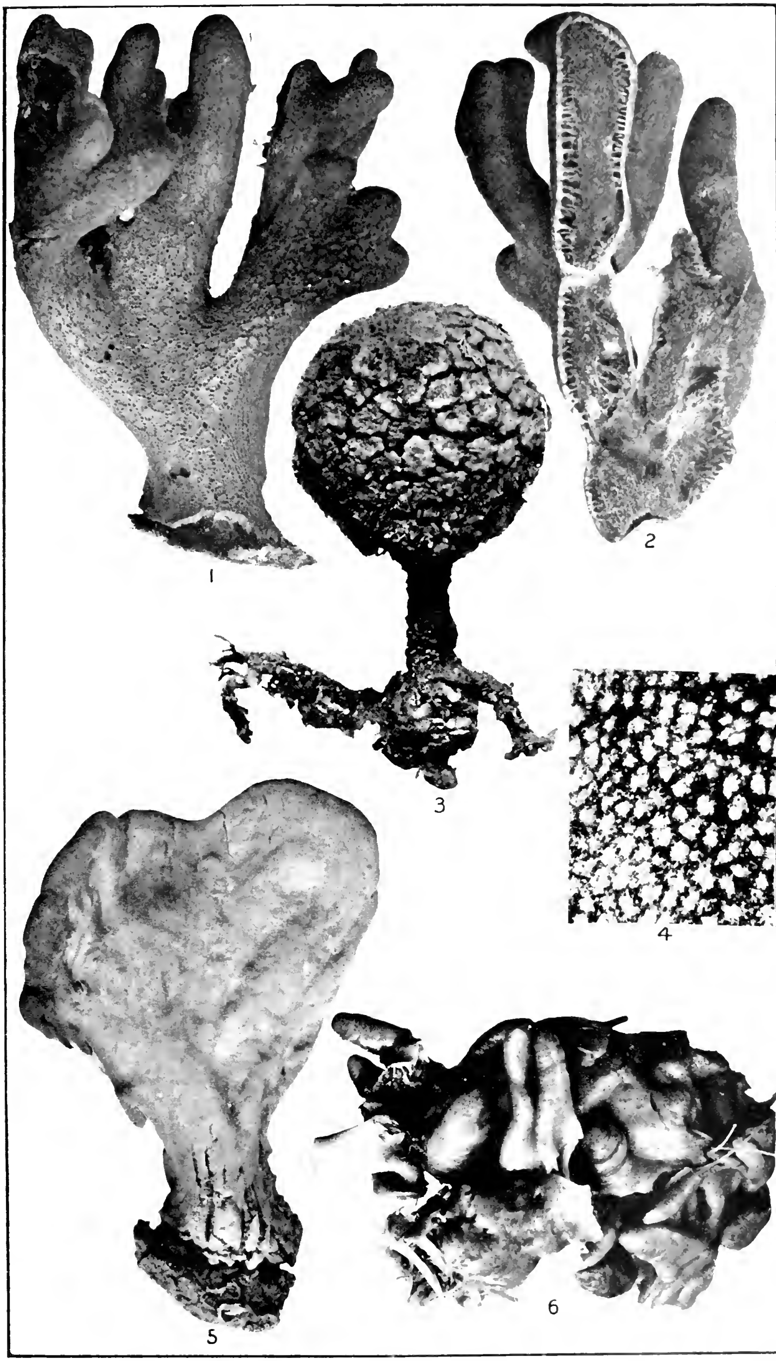
* Report Aust. Assoc. Advt. of Science, 1911, p.193.

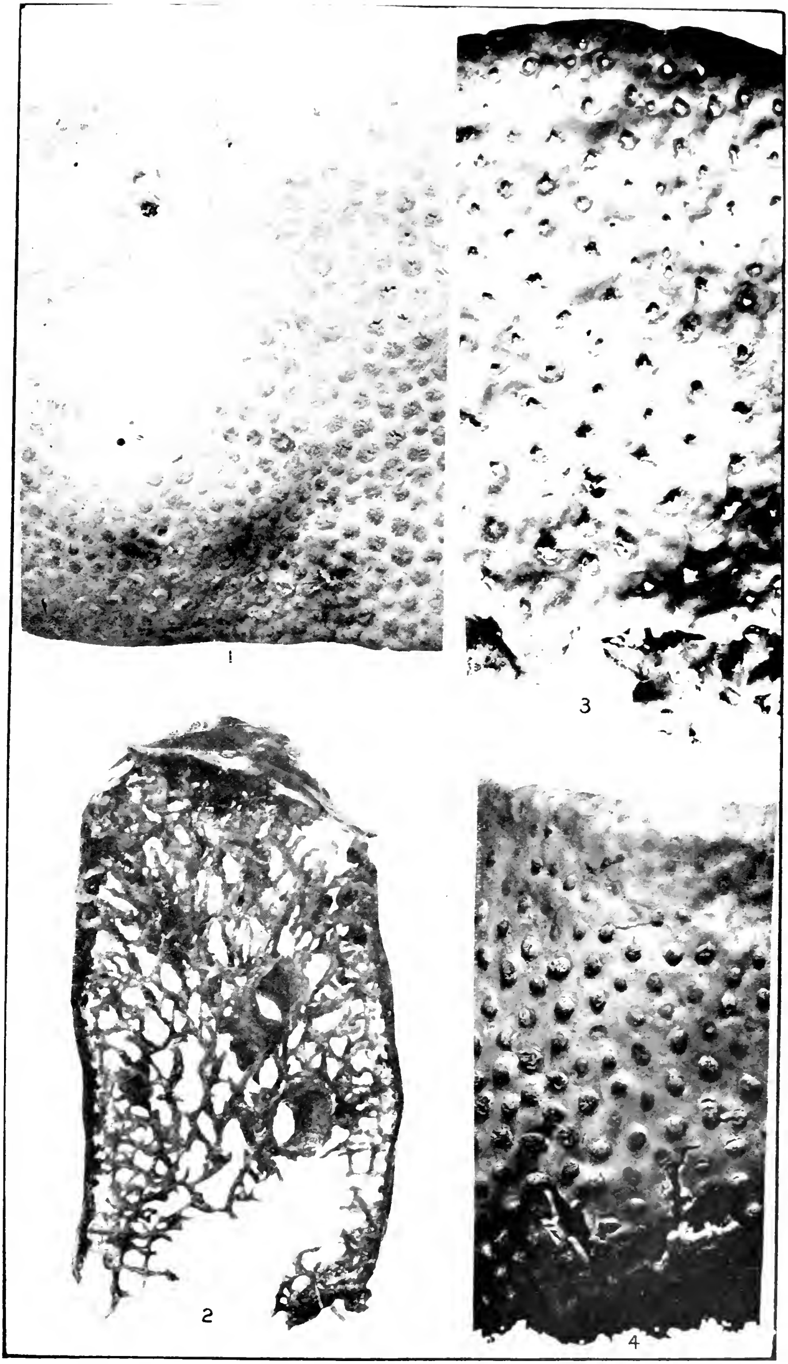
[Printed off, 16th September, 1914.]



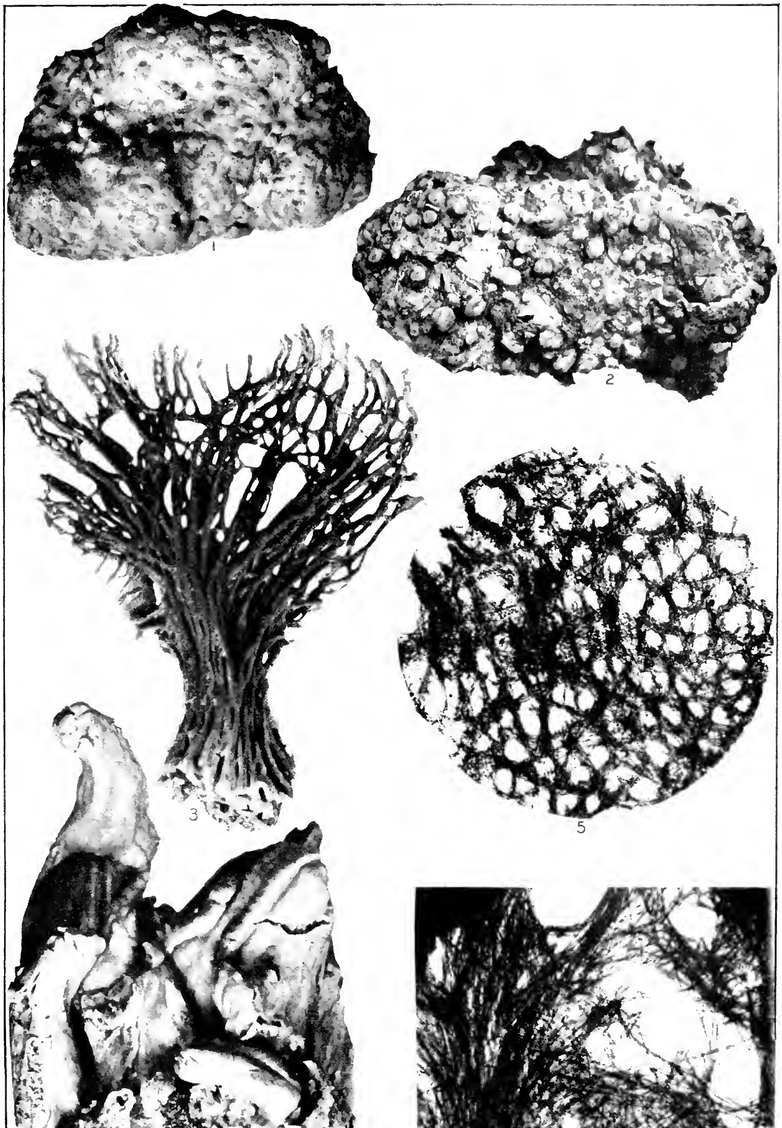
Macramycterus spp.



Sollasella, Donatia, Spirastrella, Polymastia.

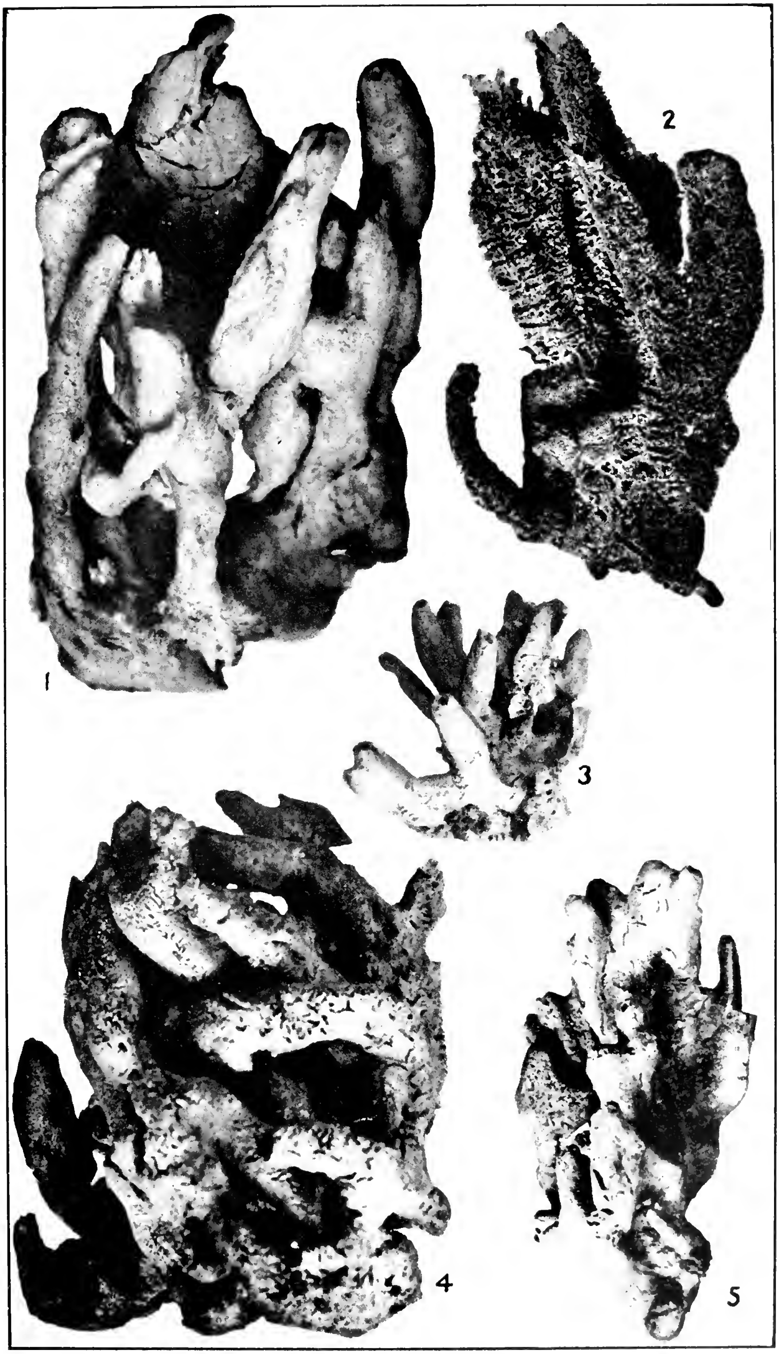


Cliona (Papillissa).

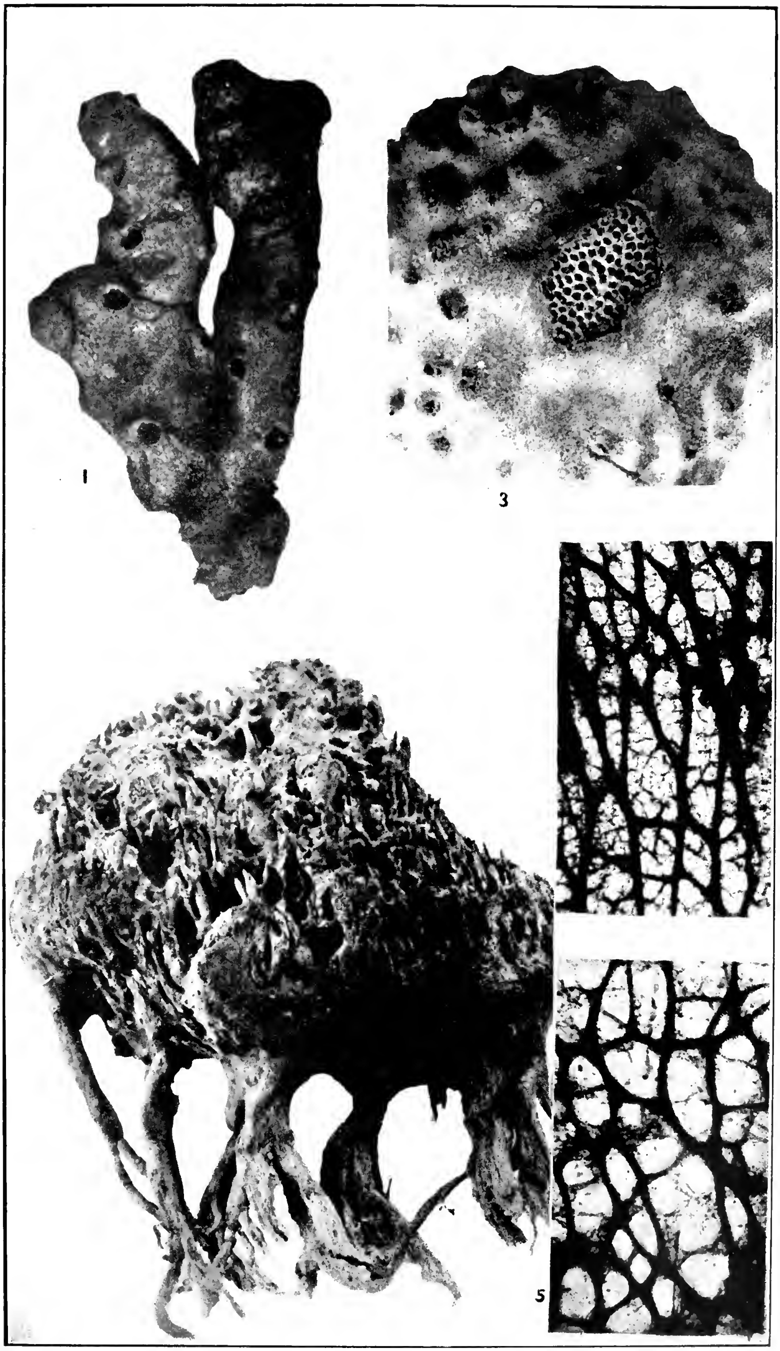


Cliona (Papillissa), Spirastrella, Amorphinopsis, Tedania.

Caulospongia, Axiamon, Hemitedania.

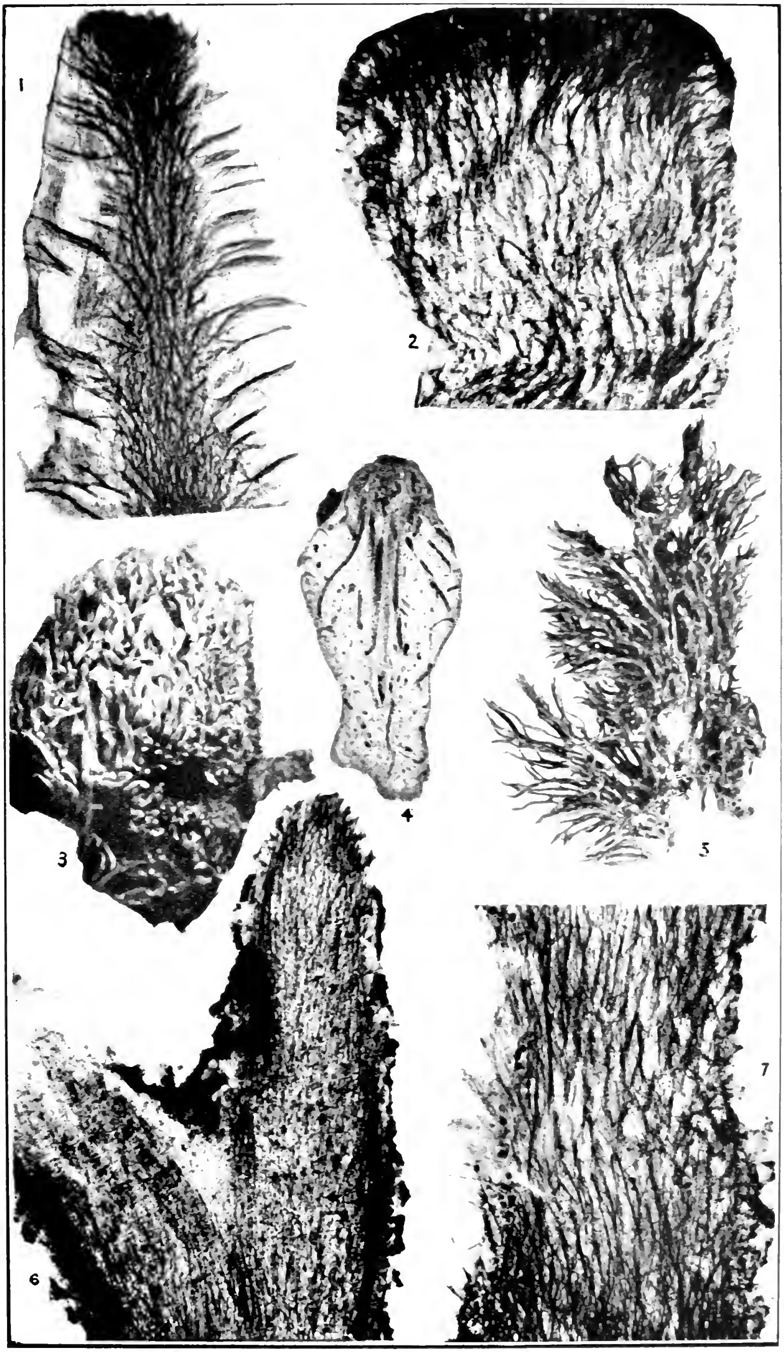


Hemitedania anonyma Carter.

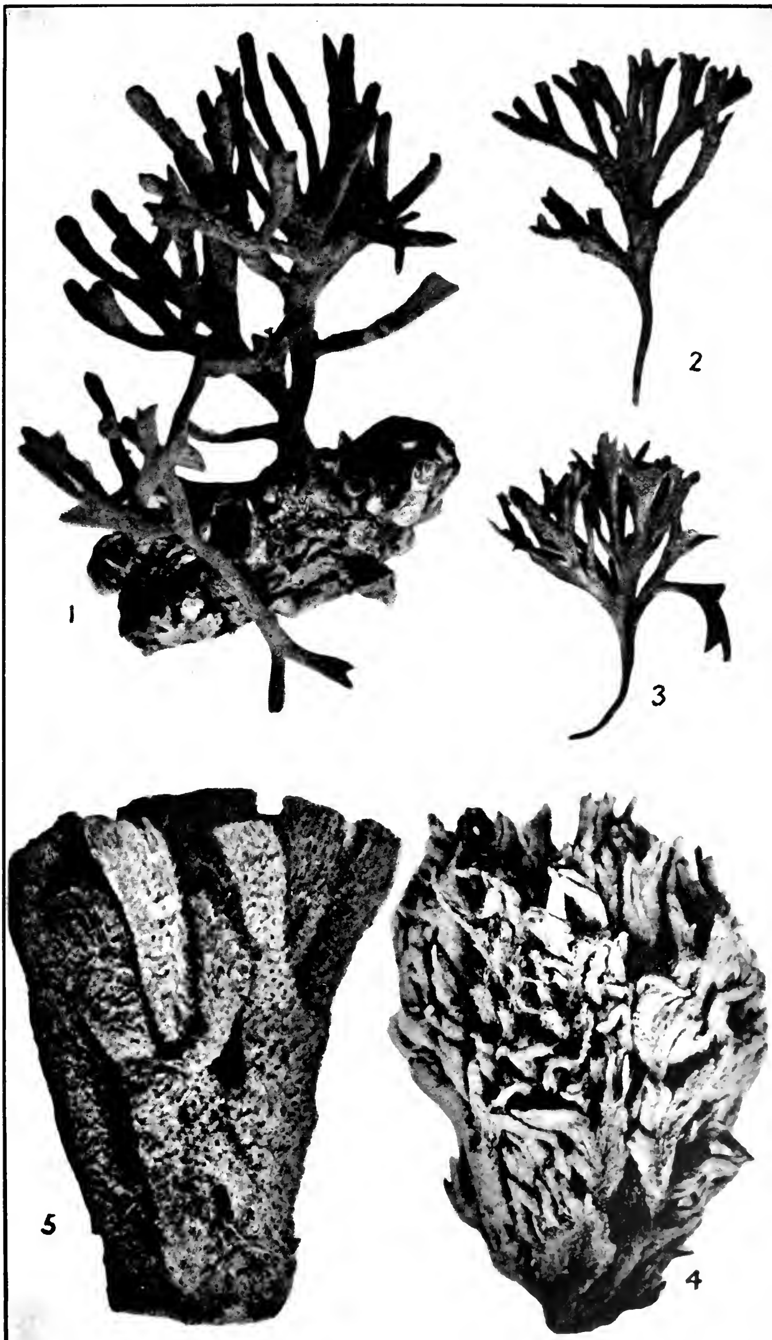


Chalina, Phlœodictyon.

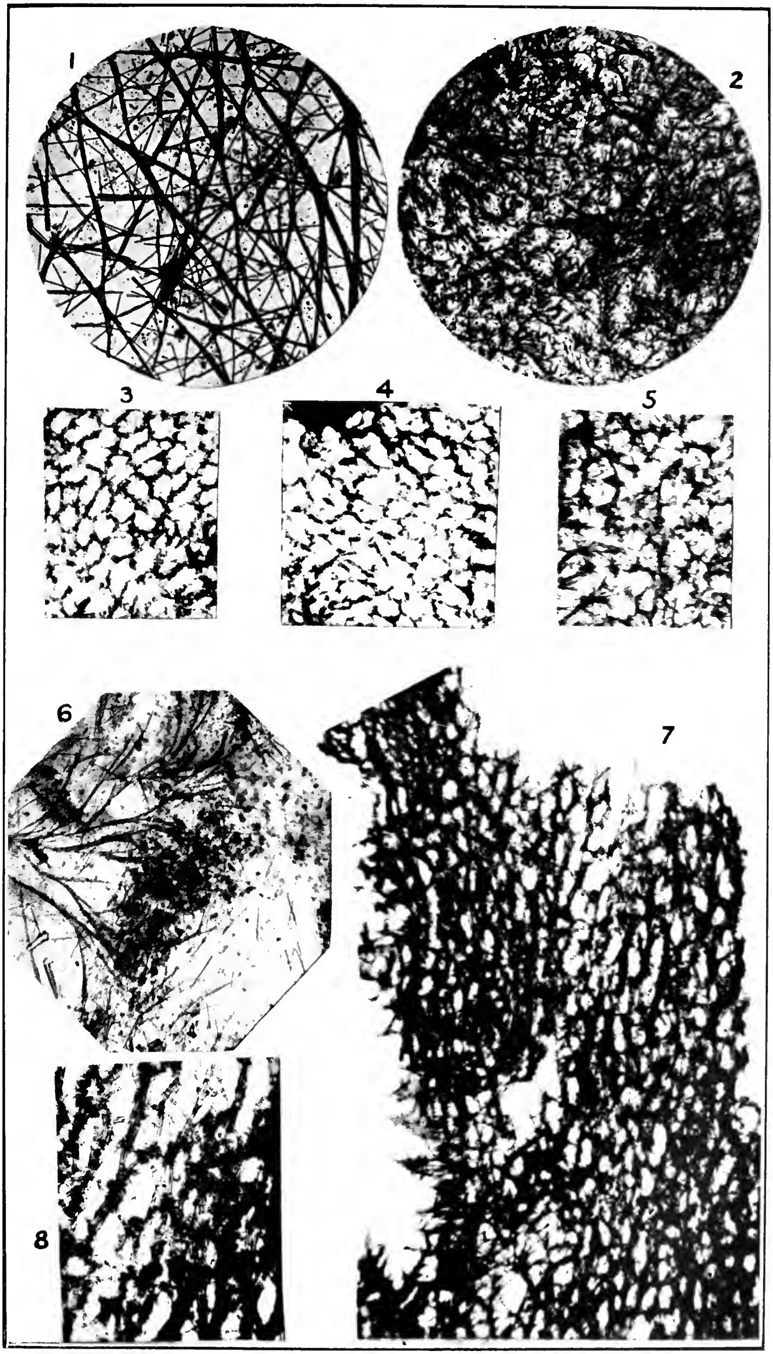
Stylotella agminata.



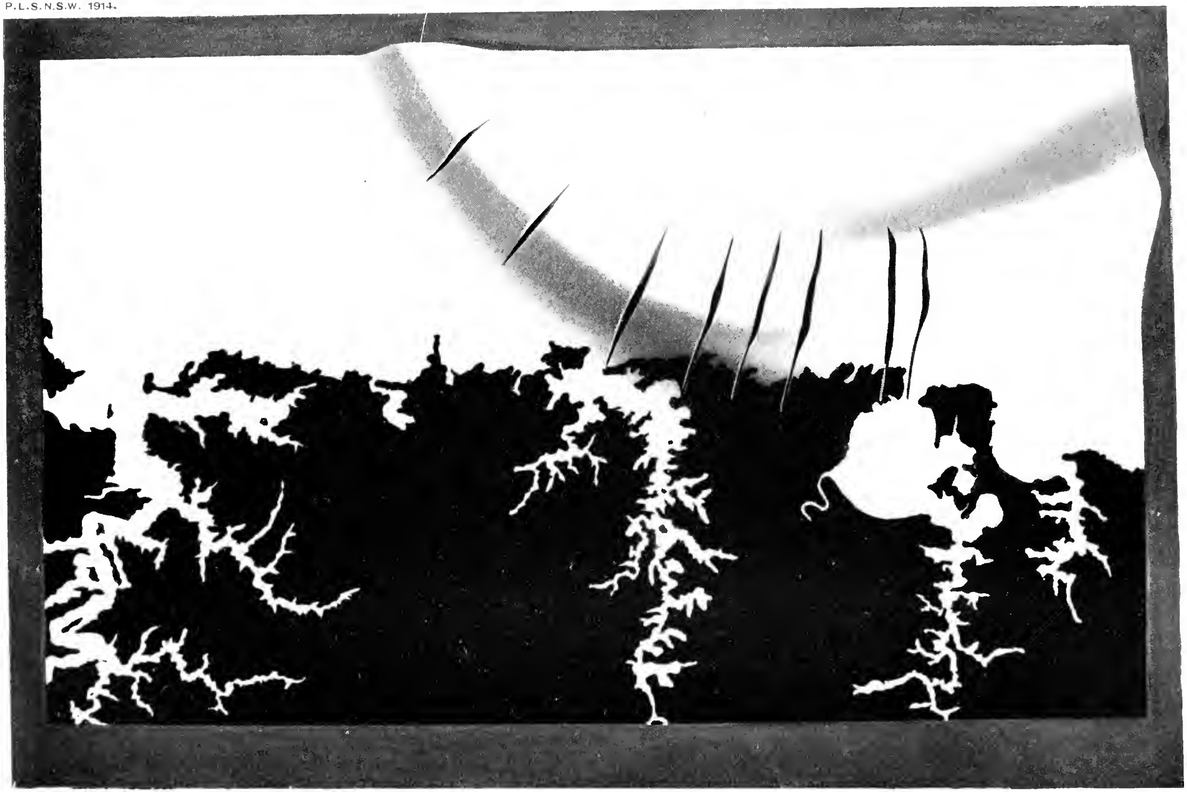
Axinella, Stylotella, Histoderma, Ph[illegible]*, Sp*[illegible]*, Ras*[illegible]



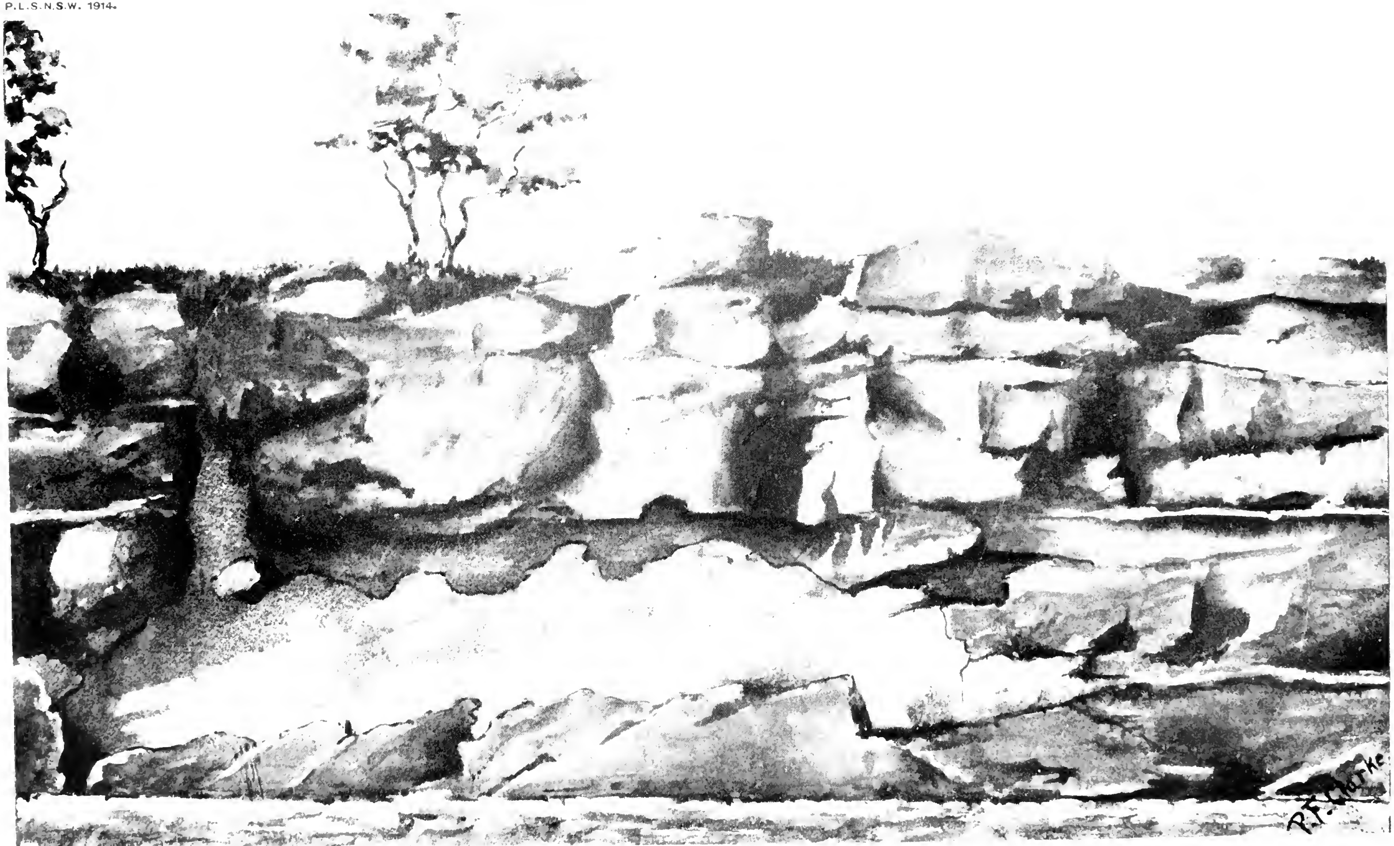
Raspailia, Chalinodendron.



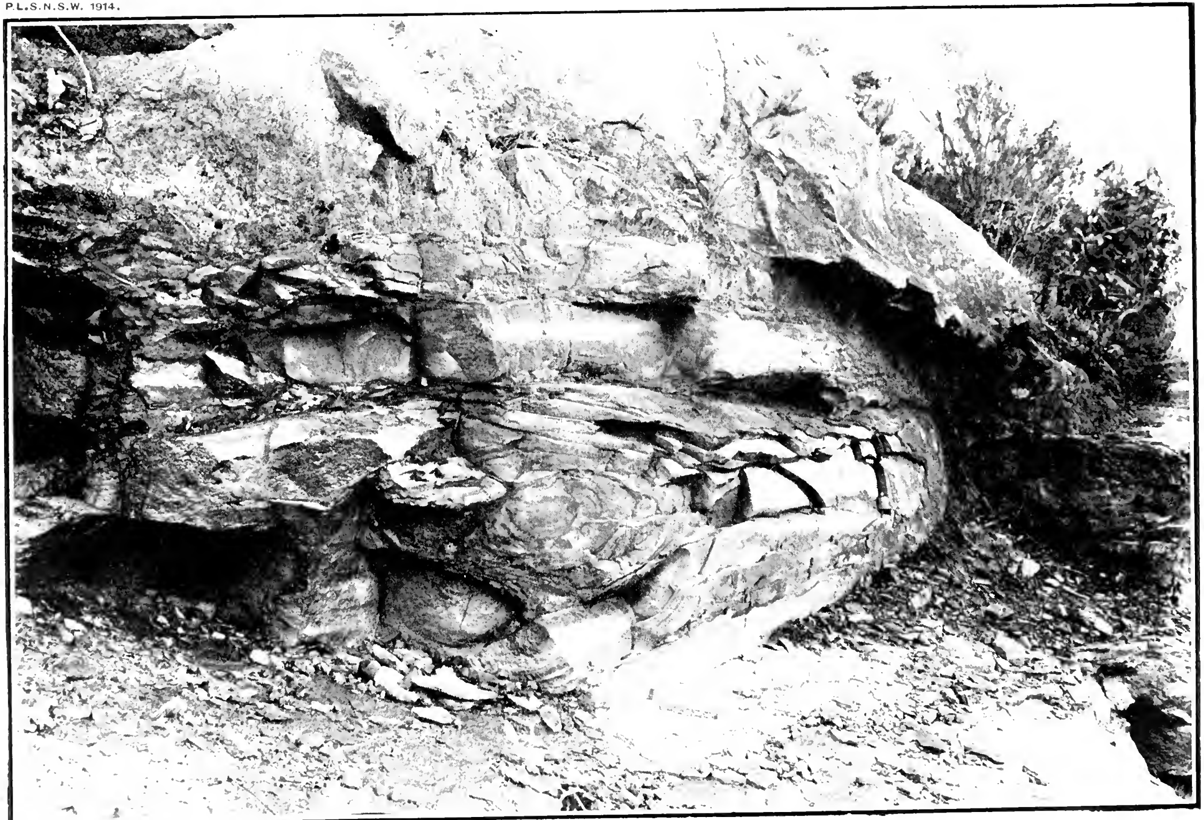
Mycale, Tedania, Hemitedania, Axiamon.



Scheme of the Bondi Anticline.

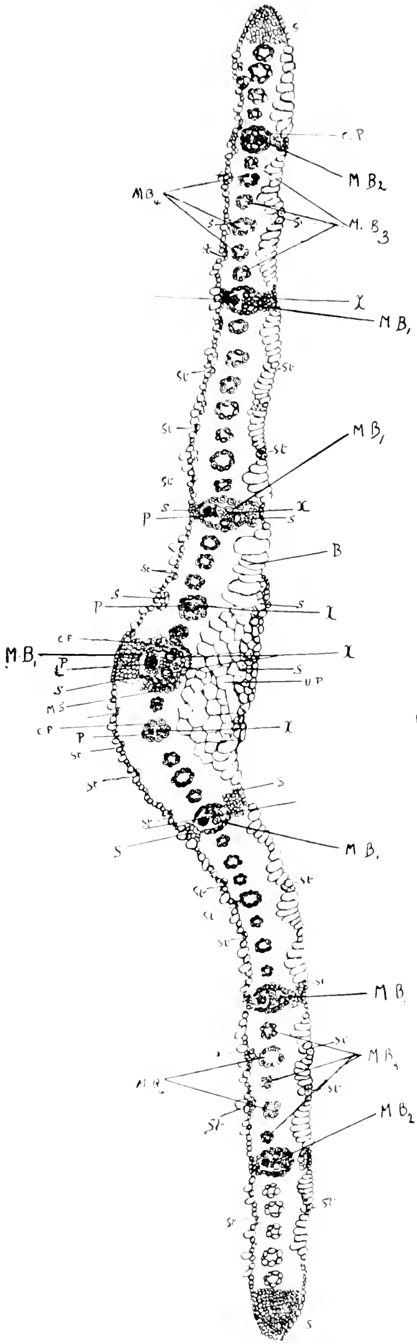


Example of a crumpled sheet of Shale.

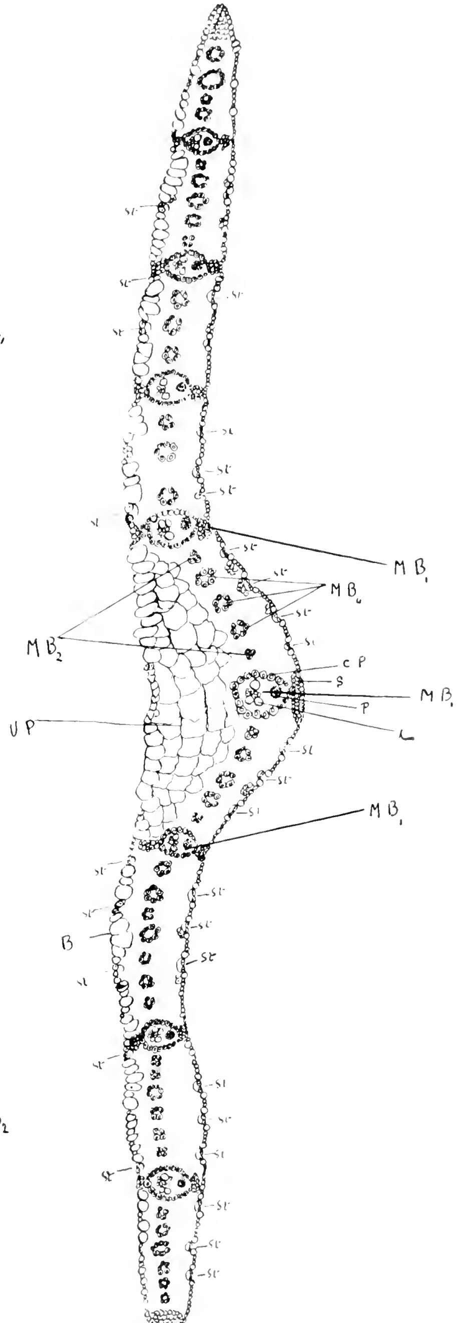


A series of coils of Sandstone.

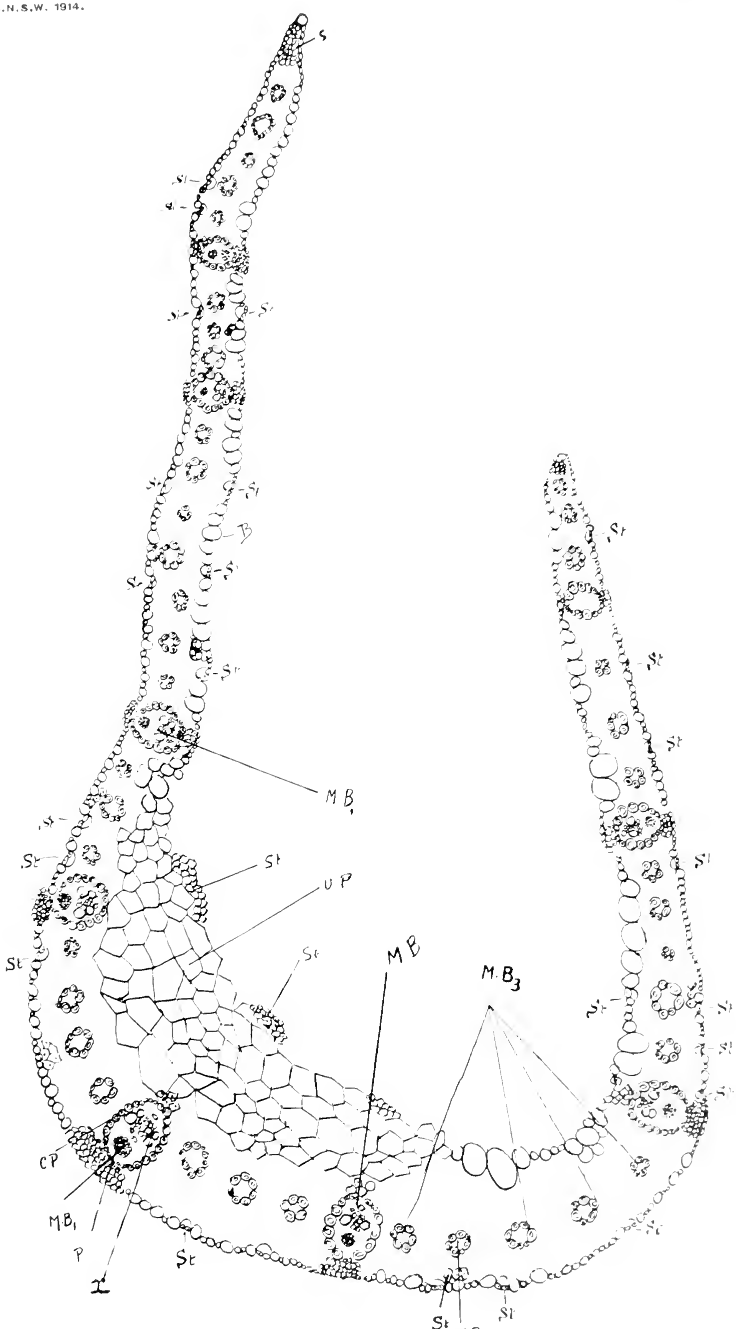
Plantago Hedleyi, n. sp.



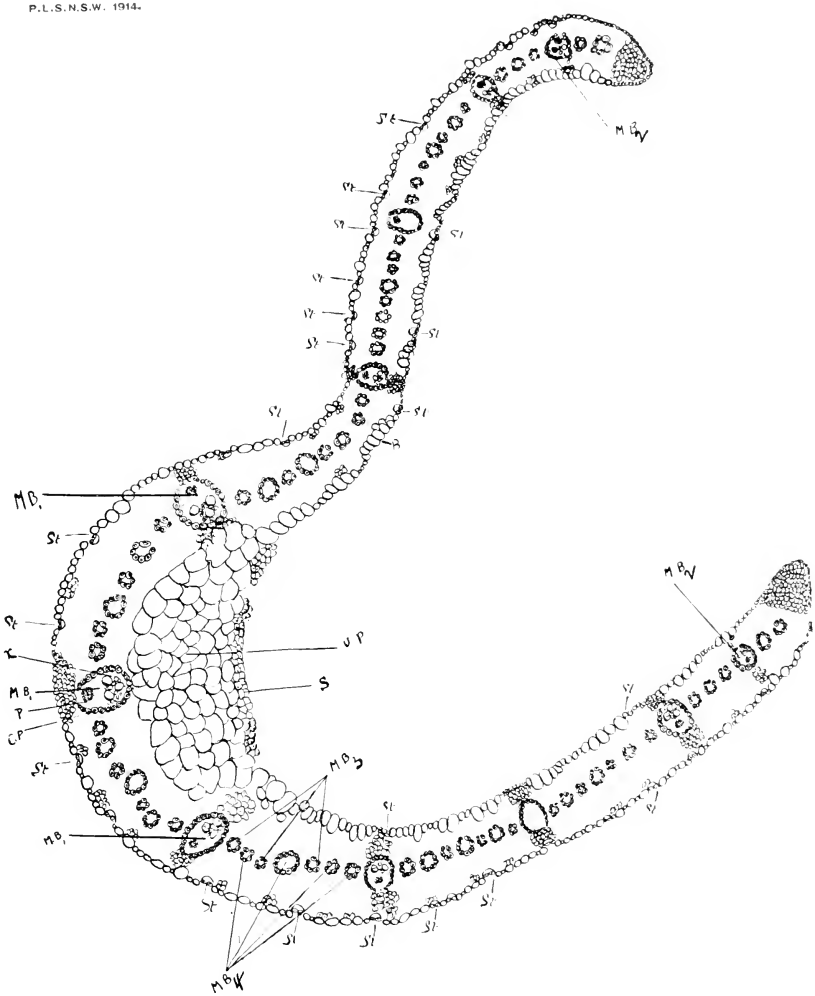
Andropogon sericeus.



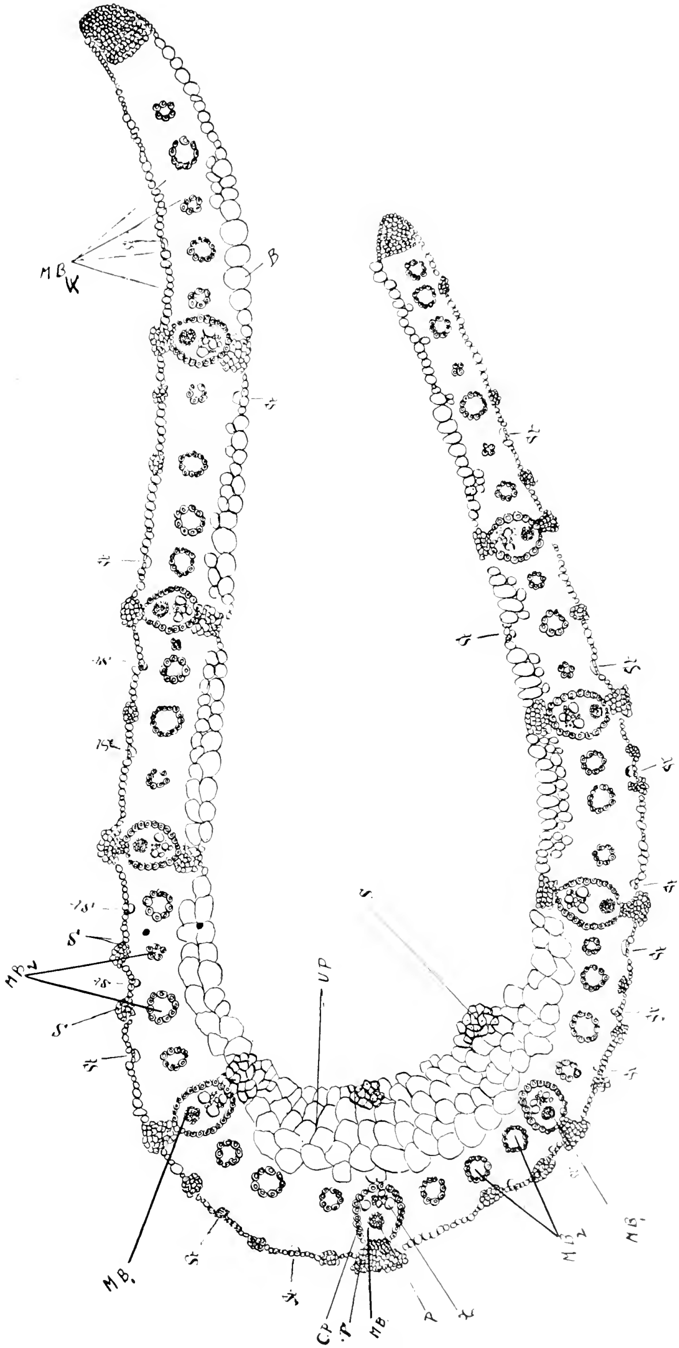
A. affinis.



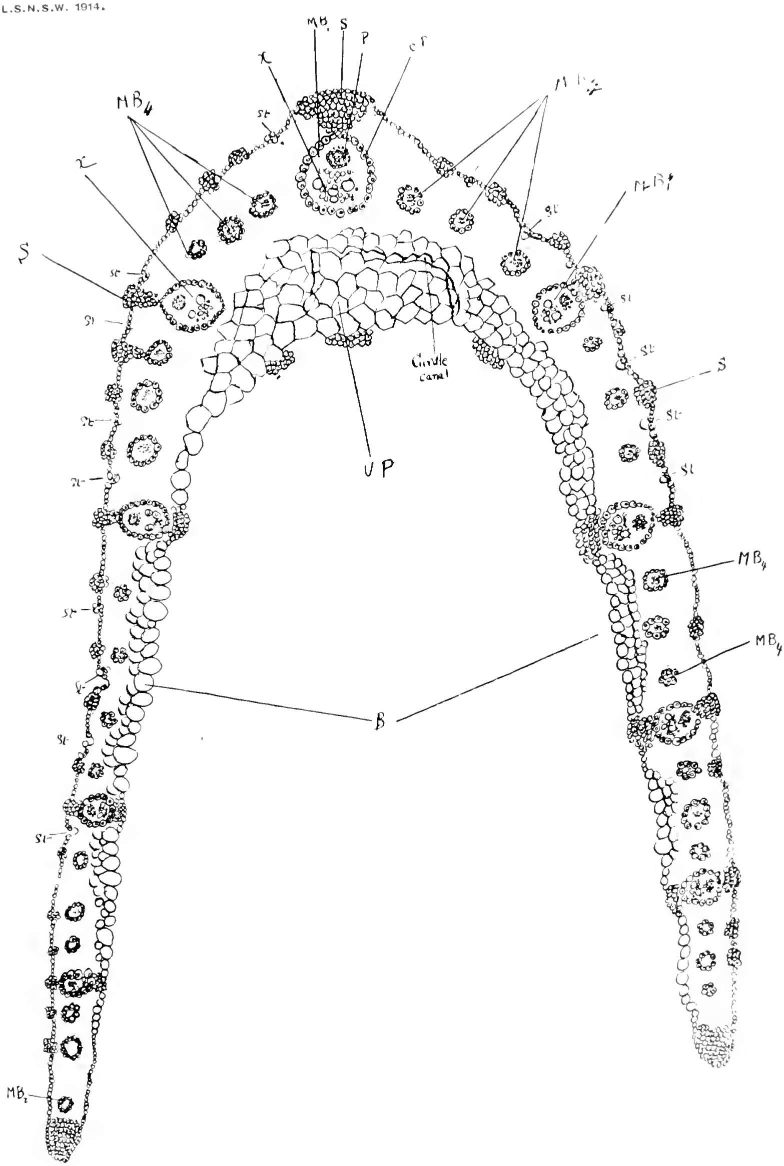
Andropogon intermedius R.Br.



Andropogon ischæmum Linn.



Andropogon refractus R.Br.



Andropogon bombycinus R.Br.

It may be suggested that the suite is related to the granophyres and andesites of the West Moreton District, described by Messrs. Wearne and Woolnough†. The latter has found a very interesting igneous complex to occur associated with the andesitic mass of Mount Warning, adjacent to Nullum Mountain.‡ A rich field of discovery awaits the petrological investigator in this district.

ii. *Inclusions in a dyke at Gerringong.*

The dyke under consideration occurs on the beach at Gerringong, and is recorded as No. 16 in Mr. Harper's list*. It splits up into overlapping lenticular branches. In places, the rock is full of steam-cavities, which are arranged in bands parallel to the boundaries of the intrusion. Here and there are inclusions in the volcanic rock, at one spot so abundant as to make up nearly half the bulk of the rock. About thirty slices of these have been studied, with the results here presented. The dyke-rock itself is a basalt, consisting of idiomorphic prisms of purple augite and laths of labradorite, with a fine even grain-size. As accessory constituents are present magnetite, small brown pleochroic crystals of hornblende, and very minute needles of apatite. No glass is to be seen. Chlorite and epidote are present in varying amount.

The rocks of the inclusions are derived from a gneissic complex, that must lie at great depth below the present surface (Upper Marine Permo-Carboniferous rocks). They consist of alkali-felspar gneisses and quartz-schists, with a few gabbroid rocks. Interesting features are brought about by the partial melting and absorption of the inclusion in the basalt-magma, some of which recall the observations of Lacroix on the granite-xenoliths in the basaltes of the Auvergne.

The best preserved gabbro was obtained by Mr. Aurousseau, who kindly permitted me to study it. It is a coarse-grained rock consisting chiefly of labradorite. The augite is in large ophitic grains, and slightly chloritised. Magnetite is also present. Another

† "Notes on the Geology of West Moreton, Queensland." Proc. Roy. Soc. N. S. Wales, 1911, pp. 137-159.

‡ Verbal communication.

* Rec. Geol. Surv. N. S. Wales, 1905, Vol. viii., Pt. 2, p. 105; also Plate xix.

specimen is of medium grain-size, and is composed of labradorite, subophitic augite, abundant magnetite and a little quartz. The augite has a peculiar spongy habit, containing felspar in irregular patches and numerous schiller-magnetites. Here and there, in irregular bays cutting across the large crystals, are patches of fine-grained lathy felspar, small augite, ilmenite, and magnetite-grains, with a general basaltic appearance. In such areas, there is sometimes a regular arrangement of the magnetite, as if pseudomorphous after a former crystal. These structures, together with the spongy nature of the augites, suggest a partial recrystallisation of the rock under the heat of the surrounding basalt-magma. The large amount of decomposition-products in this rock greatly hinders its elucidation.

The inclusions of the metamorphic series are of several kinds. One is an alkali-felspar gneiss, consisting of microperthite, orthoclase, quartz, and a very little plagioclase. It has a blastogranitic structure, and the quartz shows, very strongly, marked strain-effects. Another type contains, with orthoclase, a considerable amount of andesine. A third type has a very gneissic structure, and consists of abundant quartz, andesine, a little orthoclase, diopside and sphene; its composition is, therefore, that of a type of granodiorite. There are, in addition, numerous fragments of felspathic quartz-rocks. Several of these are very coarse-grained and poor in felspar, resembling crushed vein-rock. The others are altered quartzites, and are more or less felspathic. Both are greatly crushed, with occasionally long mylonitic streaks, which lie along the direction of crystalloblastic schistosity or obliquely to it. The crystalloblastic structure is very pronounced; the felspar of the vein-rocks is in large plates; that of the schists proper is disseminated in small grains throughout the rock.

The contact-effects may be divided into absorption, melting and recrystallisation, and these occur frequently in association. The first is well seen on the actual contact of an inclusion with the basalt. The difference betwen the boundaries of the quartz-grains and the felspars is most striking. As is usually the case, there is a strong reaction-rim developed round the corroded surface of the quartz, and this rim consists of minute colourless prisms of diopside. Around the felspar, no such rim exists; this mineral appears to have been absorbed into the basalt-magma much more quickly than the quartz-grains, which project out from the general boundary of the inclusion into the basalt or are even isolated in it. The single instance of a pyroxene-bearing gneiss shows how much less readily is the pyroxene absorbed than the felspar. It has been shown that this order of solubility holds also in the case of the basic felspar and augite of the gabbroid inclusions of Dundas.*

The rocks with glass are few in number. In the granodiorite, it occurs in irregular dull-brown patches, more or less cryptocrystalline with sometimes slag-like skeleton-crystallites, sometimes penetrated by laths of secondary felspar growing in from the felspar that forms the boundary to the droplet of glass. Frequently, the glass is replaced by chlorite. In another slide, the melt from the gneiss has clearly mingled with the basalt-magma. The zone of mingling is about $\frac{1}{4}$ inch wide; farthest from the basalt, residual quartz-grains lie in a base originally glassy but now chiefly chlorite and epidote. Nearer the basalt, the glass is filled with felspar-laths in addition to the two decomposition-minerals, and small reaction-rims are seen about the quartz-grains. Nearer still, magnetite and purple augite-grains occur, and the epidote and chlorite are less abundant; gradually this passes into the normal basalt. One would expect that the felspar varies in composition in the different stages, but, unfortunately, a determinative set of readings could not be obtained. The same feature of absorption was seen where there was no glass present. In one slide, one may follow, for the space of about a centimetre, a vein, projecting from the basalt into the gneiss, becoming poorer in coloured constituents as it goes; in another, veins of finely crystallised rock, scarcely a millimetre in width, traversing alkali-felspar grains in the gneiss, have abundant finely divided magnetite in the centre, but are free from it at the sides. In such veins, the felspar-laths make a felt

* "The Volcanic Necks of Hornsby and Dundas." Proc. Roy. Soc. N. S. Wales, 1910, p.542.

like that of some trachytes, and augite occurs in broad spongy plates of considerable size.

Finally, there is one instance of the partial recrystallation of an orthoclase-grain in the gneiss to a variolitic mass of felspar-laths. This change occurs at isolated spots in our rock, but among the inclusions of granite in the basalts of the Auvergne, Prof. Lacroix* has found a rock in which the felspar is entirely changed in this manner.

Some features recall the observations of Heineck on the melting down and mingling of granite with basalt-lava in Bohemia, but the process in our rocks is not nearly so far advanced as in the Bohemian†.

iii. *Granitic Inclusions in the Volcanic Necks of Dundas and Norton's Basin.*

In my account of the inclusions in the volcanic neck at Dundas, there is no mention of granite. Shortly before the quarrying operations ceased there, Mr. Aurousseau obtained a granite-inclusion, which he has handed to me for description. It differs from the majority of the xenoliths in being merely accidental not cognate with the including basaltic rock. It resembles the Gerringong inclusions discussed above. It has suffered considerable pressure, the quartz is greatly strained, and there is some peripheral crushing of the felspar-grains. These consist of large orthoclases, and smaller less irregularly shaped oligoclases. A little decomposed biotite is present. The whole rock has a dirty appearance, and is clouded with dust, kaolin, sericite, magnetite, and a considerable amount of carbonate.

A granitic inclusion has been found in the volcanic neck at Norton's Basin, on the Nepean River, above Penrith. It also is greatly shattered and full of carbonate veins. The structure appears to be crystalloblastic, rather than a normally aplitic one; though this

* Les Enclaves des Roches volcaniques, p.64.

† Geologische-petrographische Verhältnisse der Umgegend von Rothan im böhmische Erzgebirge. Neu. Jahrb. für Min.Beil., Band xxiii., pp.475-527.

is not definitely marked. The component minerals are orthoclase and quartz, and do not show much strain-effect. This rock may belong to the same ancient series as the inclusions in the Gerringong dyke.

iv. *Bowlingite at Dundas and elsewhere.*

Considerable difficulty was experienced, in the study of the Dundas inclusions, in the determination of the decomposition-products of olivine. The most common material is a green felted mass of very fine fibres, and this was doubtfully referred to pilite, actinolite, anthophyllite and talc*.

In examining, in Paris, Prof. Lacroix' collection of slides illustrative of his work "La Mineralogie de la France et ses Colonies," it was found that the bowlingite of that collection was identical with the decomposition-product in the Dundas rocks, which, also, is the usual product of olivine in all the basalts in the Sydney district. The mineral is a hydrous silicate of iron,magnesia, and a varying amount of alumina. Prof. Lacroix thinks it is probably identical with the platy mineral, iddingsite; but the name bowlingite should have priority. It is distinguished by its strong pleochroism, and birefringence, combined with a straight extinction.

* Proc. Roy. Soc. N. S. Wales, 1910, p.509.

CONTRIBUTIONS TO A KNOWLEDGE OF AUSTRALIAN *CULICIDÆ*. No i.

By Frank H. Taylor, F.E.S.

(Plates xxxiv.-xxxvii.)

(From the Australian Institute of Tropical Medicine.)

The present paper contains descriptions of seven new species and one variety, besides additional records for several previously known species. The new species are distributed in the following genera: *Stegomyia* (one), *Aedimorphus* (one), *Culicada* (two), *Culex* (one), *Skusea* (one), and *Menolepis*? (one). The type-specimens have been deposited in the Institute collection.

Pyretophorus atratipes (Skuse).

Proc. Linn. Soc. N.S.Wales,(2), iii., p. 1755 (1888); Taylor, *l.c.*, xxxviii., p. 748 (1914).

Dr. J. B. Cleland has presented a specimen of this Anopheline to the Institute, which was taken by him on Milson Island, Hawkesbury, River, N.S.W.

Myzorhynchus barbirostris (v.d. Wulp).

Leyden Museum Notes, vi., p. 46(1884); Theobald, Mon. Culicid., v., p. 50 (1910).

Hab.- Dilly, Portuguese Timor(H. Cupper-Mudd).

Numerous specimens of the above species have been received from Mr. Cupper-Mudd, in addition to specimens of another Anopheline, which appears to be *Nyssorhynchus annulipes* (Walker). The latter, however, were too damaged by mould to be determined with certainty.

Nyssorhynchus annulipes (Walker).

Ins. Saund., p. 433(1850); Theobald, Mon. Culicid., i., p. 164 (1901); Taylor, Proc. Linn. Soc. N.S.Wales, xxxviii., p.749(1914).

Hab.—Overland Corner, S. Australia (Dr. Cleland); Yerranderie, Narromine, N.S.W.,(Dr. Ferguson); Solomon Islands (W. W. Froggatt).

The specimens from the Solomon Islands are somewhat rubbed, but little doubt exists as to their correct identification.

ARMIGERES OBTURBANS (Walker).

(Pl. xxxiv., figs. 1, 2.)

Proc. Linn. Soc. Lond., iv., p. 91(1860), *Culex;* Theobald, Mon. Culicid., i., p. 323(1901), *Armigeres;* Blanchard, C.R. Soc. Biol., iii., p. 1046(1901), *Desvoidya;* Theobald, Mon. Culicid., iii., p.138 (1903), *Desvoidea;* Brunetti, Rec. Ind. Mus., iv., p. 440 (1912) *Blanchardiomyia;* Edwards, Bull. Ent. Research, iv., p. 224(1913).

Hab.—Milne Bay, Kerema, Papua (Dr. Breinl).

MUCIDUS ALTERNANS (Westwood).

Ann. Soc. Ent. Fr., iv., p. 681(1835); Theobald, Mon. Culicid., i., p. 269 (1901); Taylor, Ann. Report Aust. Inst. Trop. Med., p. 58, pl. xiii., figs. 9-10 (1911), 1913.

Hab.—Yarrawin, N.S.W. (W. W. Froggatt).

STEGOMYIA SCUTELLARIS (Walker).

(Pl. xxxiv., figs. 3-4.)

Journ. Proc. Linn. Soc. Lond., iii., p. 77 (1859); Theobald, Mon. Culicid., v., p.155 (1910).

Hab.—Darwin, N. Territory (G. F. Hill; 10/11/13).

This is the first occurrence of the above species on the mainland of Australia. Mr. Hill states that it is a day-biting species.

STEGOMYIA FASCIATA (Fabr.).

Syst. Antl., 36 (1805); Theobald, Mon. Culicid., i. 289 (1901).

Hab.—Maclean, Grafton, Casino, Tabulam, N.S.W. (Dr. Ferguson).

A very distinct variety occurs in Townsville, which has the thoracic clothing of a light fawn-colour, and has the lyre-shaped ornamentation only on its lateral edges, the median longitudinal lines of white scales being entirely absent. In other respects, it is typical.

STEGOMYIA PSEUDOSCUTELLARIS Theobald.

Entomologist, xliii., No.565, p.156(1910).

Hab.—Samarai Island, Papua(Dr. Breinl).

This species was originally described from Suva, Fiji; and is said, by Bahr, to be a transmitter of Filaria.

STEGOMYIA HILLI, n.sp.

(Pl. xxxv., fig. 5.)

Head black, with a line of white, upright-forked scales at the base. Thorax clothed with dark scales. Abdomen black. Legs black.

♀. Head black, clothed with black, flat and upright-forked scales, with a narrow line of upright-forked ones at the base, and a row of small flat white ones bordering the eyes; antennæ dark brown, verticillate hairs black, second segment clothed with small, brown, flat scales, basal lobes brown; palpi slender, clothed with black scales.

Thorax dark brown, clothed with small, brown, spindle-shaped scales; scutellum light brown, clothed with brown, flat scales, border-bristles black; metanotum brown, prothoracic lobes fairly prominent and clothed with small, pale, flat scales, and a few dark bristles. Halteres with pale stems and dark knobs.

Abdomen clothed with purplish-black scales, first segment with a few pale bristles in addition, posterior border-bristles pale and very short, apex of abdomen with a dense tuft of black bristles, segments five to seven with comparatively large, creamy, apical, lateral spots; venter creamy-white, apex dark and clothed with dark bristles.

Legs purplish-black, femora pale beneath except the apex; ungues equal and simple.

Wings with the costa clothed with dark brown scales, veins clothed with flat, comparatively broad, brown scales only; first fork-cell longer and slightly narrower than the second, base of the former nearer the base of the wing than that of the latter; stem of the first fork-cell scarcely half the length of the cell, stem of the second fork-cell about two-thirds the length of its cell; anterior basal cross-vein longer than the anterior cross-vein, and not quite twice its own length distant from it.

Length, 5 mm.

Hab.—Melville Island, North Australia (G. F. Hill; 12/4/14).

Described from two specimens. The clothing of the thorax, wings, and abdominal ornamentation renders this a conspicuous species. I have much pleasure in dedicating this species to its discoverer. Co-type in Mr. Hill's collection.

CHÆTOCRUIOMYIA SYLVESTRIS Theobald.

Mon. Culicid., v., p. 196(1910).

Hab.—Innisfail, Queensland(E. Jarvis).

SCUTOMYIA NOTOSCRIPTA (Skuse).

(Pl. xxxv., figs. 6-7).

Proc. Linn. Soc. N.S.Wales,(2), iii., p. 1738(1888); Theobald, Mon. Culicid., i., p. 286(1901); v., p. 200(1910).

Hab.—Murwillumbah, N.S.W.(Dr. Ferguson); Toorak, Victoria (Dr. Cumpston); Eidsvold, Queensland (Dr. Bancroft), Townsville (Dr. Priestley).

We have also received specimens of a well defined variety of the above from Dr. Bancroft and Mr. G. F. Hill, in which the two, short, lateral, silvery lines, on either side of the median one on the thorax, are entirely absent; in other respects it is quite typical. Mr. Hill's specimen is evidently starved, as it measures only 2·5 mm.

Hab.—Eidsvold, Queensland; Darwin, Northern Territory.

ÆDIMORPHUS AUSTRALIS, n.sp.

Head with brown and white flat scales, with narrow-curved ones behind. Thorax with dark brown, narrow-curved scales. Abdomen unbanded, with white, lateral, basal spots. Hind-legs with white, basally banded tarsi.

♀. Head clothed with alternate patches of dark brown and white flat scales, with narrow-curved ones behind, and black and pale upright-forked ones, the pale ones at the base; proboscis black; antennæ dark brown, basal lobes and basal half of second segment pale; palpi clothed with black scales; eyes deep purplish-black.

Thorax black, clothed with dark brown, narrow-curved scales, and a few golden ones on the sides; prothoracic lobes black, clothed with white, narrow-curved scales; scutellum pale brown, clothed with white, flat scales; pleuræ clothed with white, flat scales; metanotum pale brown.

Abdomen pale, unbanded, clothed with black scales with a coppery tint, first segment with a few dark hairs also, with white basal lateral spots to all the segments, posterior border-bristles pale; venter pale beneath, penultimate and apical segments dark-scaled.

Legs black, with coppery reflections, with basal pale spots on the first and second tarsi of the fore- and mid-legs; hind-legs with the first three tarsals with white basal banding, the fourth unbanded, fifth all white; ungues equal and simple.

Wings with the costa, subcostal, and first longitudinal veins densely clothed with black scales, remaining veins and fringe clothed with dusky-brown scales; first fork-cell longer and but little narrower than the second, stem of the former about one-third the length of its cell, stem of the latter about one-half the length of the cell; base of the first fork-cell nearer the base of the wing than that of the second fork-cell; anterior basal cross-vein about its own length from the anterior cross-vein, halteres pale.

Length, 2·5 mm. (vix).

Hab.—Townsville, Queensland.

Described from a single perfect specimen taken while biting in the daytime. The above species is relatively close to *A. alboannulatus* Theobald, but can be distinguished from it by the leg-banding, ungues, and wing-venation.

Var. DARWINI, n.var.

(Pl. xxxv., fig. 8.)

♂. Head-clothing similar to type. Antennæ pale, plumes brown. Thorax as in the type. Legs as in the type; ungues of fore- and mid-legs very unequal, the larger much curved and with a comparatively large tooth, hind equal and simple. Wings with the costa, subcostal, and first longitudinal veins black-scaled, but not as densely as in the type; stem of the first fork-cell about three-fourths the length of the cell, stem of the second fork-cell nearly as long as the cell. *Length*, 3 mm.

Hab.—Darwin, Northern Territory(G. F. Hill; 21/12/13).

MACLEAYA TREMULA Theobald.

(Pl. xxxv., fig.9.)

Entomologist, xxxvi., p. 155(1903).

Hab.—Eidsvold, Queensland (Dr. Bancroft), Stannary Hills (Queensland Museum).

CULICADA FERGUSONI, n.sp.

Head clothed with golden scales. Thorax golden. Legs unbanded. Abdomen with white, incomplete, apical banding.

♂. Head black, clothed with golden, narrow-curved and upright-forked scales, and small, pale, flat, lateral ones, with golden bristles overhanging the eyes from the centre; eyes black; antennæ pale, nodes dark, plumes dusky; palpi black-scaled, longer than the proboscis, penultimate and apical segments pale at their bases, clothed with black hairs; proboscis black.

Thorax pale brown, clothed with golden scales; prothoracic lobes prominent; scutellum clothed with narrow-curved, golden scales; pleuræ yellowish-brown clothed with broad, white, flat scales; metanotum brown.

Abdomen black-scaled; segments with broad, white, apical, lateral spots, which give them the appearance of being banded, penultimate segment with a narrow, apical, white band, apical segment almost entirely clothed with white scales; venter clothed with pale scales.

Legs black, knee-spot pale in the fore- and mid-legs, light ochraceous in the hind, tibio-tarsal spot ochraceous, femora pale beneath; ungues of fore- and mid-legs unequal, the larger with a single tooth, hind equal and simple.

Wings with the costa black, veins clothed with dusky-brown scales; first fork-cell longer and narrower than the second, stem of the former about one-half the length of its cell, stem of the latter about two-thirds the length of the cell; anterior basal cross-vein longer than the anterior cross-vein, and about once and one-half its own length distant from it; fringe dusky. Halteres with the stems pale, and knobs light brown.

Length, 5 mm.

♀. Similar to ♂. Palpi black-scaled; antennæ dark brown, basal lobes and base of second segment pale. The lateral spots on the abdomen not so prominent as in the ♂; sixth and seventh segments with apical banding. Ungues equal and simple. *Length*, 5·5 mm.

Hab.—Milson Island, Hawkesbury River, N.S.W.

Described from one male and one female, bred by Dr. Ferguson. Type-male in Coll. Ferguson.

CULICADA VICTORIENSIS, n.sp.

(Pl. xxxvi., fig.10.)

Head clothed with golden, narrow-curved scales, and black, lateral ones. Thorax clothed with narrow-curved, pale golden scales. Abdomen black-scaled, unbanded, with white lateral spots. Tarsi with basal banding.

♀. Head black, clothed with golden, narrow-curved and upright-forked scales, and black, flat, lateral ones, with a fringe of small, narrow-curved, golden ones bordering the eyes, with golden bristles overhanging the latter from the centre; antennæ black, verticillate hairs black, basal lobes dark brown, with creamy flat scales on their inner surfaces, basal two-thirds of second segment pale; palpi black-scaled, slender, second segment mottled with white scales, apex white; proboscis black; eyes purplish-black, with silvery spots; clypeus black.

Thorax dark chestnut-brown, with a narrow, median, longitudinal, black line extending from the anterior end to opposite the wing-roots, clothed with narrow-curved, pale golden scales, the posterior end and scutellum paler; scutellum clothed with pale golden, narrow-curved scales, and golden border-bristles; pleuræ yellowish-brown, clothed with creamy flat scales; metanotum light brown.

Abdomen clothed with black scales, first segment clothed with yellowish scales and hairs, the second to fourth segments with median, basal, creamy-yellow spots, all the segments with white, lateral, basal spots; venter mottled with creamy and dark scales.

Wings clothed with black scales; first fork-cell longer and narrower than the second, their bases level; stem of the first fork-cell one-half the length of its cell, stem of the second two-thirds the length of the cell; supernumerary and anterior cross-veins level, the anterior basal cross-vein the same length as the anterior cross-vein, and about twice and one-half its own length from it; fringe black.

Legs black, femora ochraceous beneath, knee-spots ochraceous; fore- and mid-tibiæ mottled, first three tarsi of fore- and mid-legs with creamy basal banding, all the tarsi of the hind-legs banded; ungues all equal and uniserrate.

Length, 5·5 mm.

Hab.—Toorak, Victoria (23/4/14).

Described from a single specimen, presented to the Institute by Dr. Cumpston. It can be distinguished from *C. bupengaryensis* Theobald, by its banded legs, unbanded abdomen, the clothing of the thorax, and the serrated ungues.

Culicada australis (Erichson).

Archiv für Naturg., viii., p.470(1842); Theobald, Mon. Culicid., ii., p.91(1901).

Hab.—Hilltop, Narromine, N.S.W.(Drs. Cleland and Ferguson).

This species is placed in the genus *Culicada* on account of the wings having short fork-cells; the vein-scales being clothed with larger and denser scales than in *Culex*; and the palpi being composed of four segments, the apical one small and nipple-shaped.

Culicada vittiger (Skuse).

Proc Linn. Soc. N. S. Wales, (2), iii., p.1728(1888); Theobald, Mon. Culicid., i, p.387 (1901); Taylor, Proc. Linn. Soc. N. S. Wales, xxxviii., p.753, Pl. xxx., figs.1-2 (1914).

Hab.—Nowra, N. S. W. (Dr. Cleland), Yarrawin (W. W. Froggatt); Eidsvold, Queensland (Dr. Bancroft), Cardigan (F. H. Taylor).

Culicada flavifrons (Skuse).

Proc. Linn. Soc. N. S. Wales, (2), iii., p.1735 (1888); Taylor, *l.c.*, xxxviii., p.751 (1914).

A specimen of this species was kindly lent to me by Mr. Froggatt, Government Entomologist of New South Wales, which was taken by him on the Clarence River, Northern New South Wales.

The ungues of the fore- and mid-legs are equal and uniserrate, of the hind-legs equal and simple.

CULICADA TASMANIENSIS Strickland.

Entomologist, xliv., No.576, p.181 (1911); Taylor, Trans. Ent. Soc. Lond., 1913, p.687, Pl. xli., figs.3-4 (March 31, 1914).

Hab.—Kelso, Hobart, Lindisfarne, St. Helens, Tasmania (F. M. Littler).

Edwards [Ann. Mag. Nat. Hist., (8), ix., p.526 (1912)] places this species as a synonym of *C. crucians* Walker, remarking that Walker's type is in poor condition, but quite recognisable as being the same as Strickland's species.

CULICADA VANDEMA Strickland.

(Pl. xxxvi., fig.11.)

Entomologist, xliv., No.577, p.202(1911).

Hab.—Wedge Bay, Tasmania (F. M. Littler).

CULICELSA VIGILAX (Skuse).

Proc. Linn. Soc. N. S. Wales, (2), p.1731 (1888); Edwards, Ann. Mag. Nat. Hist., (8), ix., p.524 (1919); Taylor, Proc. Linn. Soc. N. S. Wales, xxxviii., p.756 (1914).

Hab.—Rydalmere, Maclean, N.S.W. (Dr. Ferguson); Vailala, Lese, Papua (Dr. Breinl).

Edwards gives *C. procax* Theob., (*nec* Skuse) as a synonym. I think this must be an error, as the species, Theobald redescribed, agrees with Skuse's type.

CULICELSA ALBOANNULATA (Macquart).

(Plate xxxvi., figs.12-13.)

Dipt. Exot. Suppl., iv., p.10(1850); Theobald, Mon. Culicid., i., p.389(1901).

Hab.—The Oaks, N.S.W. (Dr. Ferguson); Eidsvold, Queensland (Dr. Bancroft), Stannary Hills (Queensland Museum).

Culex biocellatus, n.sp.

(Plate xxxvi., figs.14-15.)

Head clothed with golden scales. Thorax brown, clothed with golden scales, Abdomen black-scaled, with ochraceous basal banding. Legs with the first three tarsi basally banded.

♀. Head brown, clothed with golden, narrow-curved and upright-forked scales, with small, flat, golden ones laterally; proboscis black, with the middle third mottled with golden scales; palpi black-scaled; eyes black and silvery; antennæ black, basal lobes and base of second segment yellow.

Thorax brown, clothed with golden, narrow-curved scales; prothoracic lobes clothed with flat, golden scales and bristles; scutellum yellow, clothed with golden, narrow-curved scales; pleuræ brown, clothed with creamy, flat scales and golden bristles; metanotum yellowish-brown.

Abdomen pale, black-scaled, first segment clothed with creamy scales and golden bristles, the second and fifth to seventh segments with broad, ochraceous, basal banding, remaining segments with narrow banding, all the segments with lateral, white, basal spots, posterior border-bristles golden; venter with the first two segments creamy-yellow, remaining segments with creamy-yellow, basal banding.

Legs black-scaled; fore-legs with the femora creamy-yellow beneath, tibiæ and first tarsals mottled with yellow scales beneath, first and second tarsi with basal pale spots, remaining tarsi unbanded; mid-legs with the basal two-thirds of the femora pale beneath, the base and apex with golden rings, the first three tarsi with white basal bands; hind-femora creamy, with a broad, almost apical, black band and an apical pale ring, the first three tarsi with broad, white, basal banding; ungues of fore- and mid-legs equal and uniserrate, hind equal and simple.

Wings clothed with black scales, with a yellow costal spot at the base, and another extending to the first longitudinal vein immediately above the first fork-cell; fringe black; first fork-cell longer and scarcely narrower than the second: the anterior basal cross-vein longer than the anterior cross-vein, and about once and one-half its own length distant from it. Halteres creamy-yellow.

Length, 4 mm.

Hab.—Milson Island, Hawkesbury River, N.S.W.

Described from specimens taken by Drs. Ferguson and Cleland. It is a very handsome and well defined species.

CULEX FATIGANS Wiedeman.

Aussereurop. zweiflüg. Insecten, p.10 (1828); Theobald, Mon. Culicid., i , p.151 (1901).

Hab.—Casino, Tabulam, Milson Island, N.S.W.(Dr. Ferguson); Toorak, Victoria(Dr. Cumpston).

CULEX OCCIDENTALIS Skuse.

(Pl. xxxvii., figs.16-17.)

Proc. Linn. Soc. N. S. Wales, (2), iii., p.1729(1888); Theobald, Mon. Culicid., i., p.419 (1901); Taylor, Proc. Linn. Soc. N. S. Wales, xxxviii., p.756 (1914).

Hab.—Sydney, Yerranderie, The Oaks, Milson Island, N.S.W. (Dr. Ferguson); Eidsvold, Queensland (Dr. Bancroft).

Dr. Bancroft has recently sent me a series of a variety of this species, in which the hind spical tarsus is pure white. It conforms with typical specimens in other details.

CULEX TIGRIPES Grandpré et Charmoy.

(Pl. xxxvii., fig.18.)

Les Monst. (Planters' Gaz. Press) 1900; Theobald, Mon. Culicid., ii., p.34 (1901).

Hab.—Rydalmere, N.S.W.(Dr. Ferguson).

CULEX SITIENS Wied.

Aussereurop. zweiflüg. Ins., i., p.543 (1828); *Culex annulirostris* Skuse, Proc. Linn. Soc. N. S. Wales, (2), iii., p.1737(1888); Theobald, Mon. Culicid., i., p.360 (1901); Edwards, Bull. Ent. Research, iv., p.232 (1913).

Hab. – Kerema, Lese, Papua (Dr. Breinl).

I have examined a long series of *C. annulirostris* Skuse, from various localities, and have found specimens which exactly agree with Theobald's description of *C. sitiens* Wied.

Cænocephalus concolor Taylor.

Trans. Ent. Soc. Lond. 1913, p.700, Pl. xlii., figs.16-17 (1914).

Hab.—Kelso, Tasmania.

Specimens of this species have been received from Mr. F. M. Littler. They are larger, 6·5 mm., but are quite typical.

Finlaya poicilia Theobald.

Mon. Culicid., iii., p.283 (1903); v., p.464 (1910).

Hab. - Kerema, Papua (Dr. Breinl).

Skusea Bancrofti, n.sp.

(Pl. xxxvii., fig.19.)

Head clothed with brown and white flat scales, and black upright-forked ones. Abdomen brown, unbanded, with small, lateral, white spots. Legs brown, unbanded.

♂. Head brown, clothed with mixed brown and white flat scales, with a few, dark, upright-forked ones at the base; antennæ pale, nodes black, basal lobes black; proboscis brown, the apical third swollen, palpi black, with a few black bristles at the apex; clypeus black; eyes black and silvery.

Thorax brown, clothed with pale, narrow, curved scales; scutellum light brown, clothed with pale, narrow, curved scales; pleuræ yellowish-brown, clothed with white, flat scales; metanotum brown.

Abdomen clothed with dark brown scales, segments with small, lateral, basal, white spots; venter clothed with pale scales.

Legs brown, femora pale beneath; ungues of fore- and mid-legs unequal, the larger with a single tooth, hind-ungues equal and simple.

Wings with the costa dusky brown, veins clothed with brown scales; first fork-cell longer and narrower than the second, base of the latter nearer the base of the wing than that of the former; supernumerary and anterior cross-veins almost in a straight line, anterior basal cross-vein shorter than the anterior cross-vein, and nearly thrice its own length distant from it.

Length, 2·5 mm.

♀. Similar to ♂. Antennæ dark brown, basal lobes paler; palpi black-scaled, bristles brown; fore- and mid-ungues equal, uniserrate, hind equal and simple.

Wings with the first fork-cell longer and narrower than the second, stem of the former about two-thirds the length of the cell: anterior basal cross-vein a little more than twice its own length from the anterior cross-vein.

Length, 3 mm.

Hab.—Eidsvold, Queensland (Dr. T. L. Bancroft).

Close to *S. diurna* Theob., but can be distinguished from it by the head-ornamentation, the wing-venation, and the fore- and mid-ungues. I have much pleasure in dedicating this species to its discoverer. Dr. Bancroft writes that it is a sylvan species, and bites man.

MENOLEPSIS(?) TASMANIENSIS, n.sp.

(Pl. xxxvii., fig.20.)

Head clothed with creamy-yellow and dark brown scales. Legs brown. Abdomen black-scaled, unbanded.

♀. Head dark brown, clothed with creamy-yellow, narrow-curved scales, with mixed black and creamy-yellow, upright-forked ones, and a patch of bronzy-brown, narrow-curved ones on either side in front, the lateral, flat scales small and creamy-white, with a small patch of dark ones in their midst; eyes purplish-black and silvery, border-bristles dark, with some golden-yellow ones overhanging the eyes from the centre; palpi apparently three-jointed, pale, clothed with dark scales, and a few scattered pale ones with numerous black bristles; proboscis black; antennæ brown, second segment pale, basal lobes dark brown, and clothed with small, dark, outstanding, narrow scales.

Thorax chestnut-brown, clothed with small, narrow-curved, creamy scales, with a lateral, pre-alar row of white, outstanding, flat ones, and numerous, yellowish bristles at the roots of the wings; scutellum chestnut-brown, clothed with creamy, narrow-curved scales, posterior border-bristles golden; prothoracic lobes chestnut-brown, clothed with creamy, narrow-curved scales; pleuræ brown, clothed with creamy-white, flat scales and yellow bristles; metanotum chestnut-brown, with a patch of white, curved, and flat scales on the posterior third.

Abdomen brown, first and second segments very hairy, remaining segments more or less hairy; first segment with mixed pale and dark brown scales, the second and third segments with a few white scales at their bases, seventh segment with white basal banding, segments two to seven with white, lateral, basal spots; venter white-scaled.

Legs brown, femora, tibiæ, and first tarsals mottled with white scales, knee-spot pale; ungues equal and uniserrate

Wings with the costa subcostal, and first longitudinal veins clothed with dark brown scales; first fork-cell longer and narrower than the second, base of the former nearer the base of the wing than that of the latter; stem of the first fork-cell one-third the length of its cell, stem of the second one-half the length of the cell; anterior basal cross-vein longer than the anterior cross-vein, and about one-fifth its own length distant from it. Halteres with pale stems and dusky knobs.

Length, 6·5 mm.

Hab.—Wedge Bay, Tasmania (F. M. Littler).

EXPLANATION OF PLATES XXXIV.-XXXVII.

[Figs. 1, 2, 6, 8, 11 to 18, and 20 (× 16); figs. 3, 4, 5, 7, 9, 10 and 19 (× 40).]

Plate xxxiv.

Fig. 1.—*Armigeres obturbans* (Walker) ♀; head.
Fig. 2.—*Armigeres obturbans* (Walker) ♀; wing.
Fig. 3.—*Stegomyia scutellaris* (Walker) ♂; head.
Fig. 4.—*Stegomyia scutellaris* (Walker) ♂; wing.

Plate xxxv.

Fig. 5.—*Stegomyia hilli*, n.sp., ♀; wing.
Fig. 6. —*Scutomyia notoscripta* (Skuse) ♂; head.
Fig. 7.—*Scutomyia notoscripta* (Skuse) ♂; wing.
Fig. 8.—*Ædimorphus australis* var. *darwini*, n.var., ♂; wing.
Fig. 9.—*Macleaya tremula* Theobald, ♀; wing.

Plate xxxvi.

Fig. 10.—*Culicada victoriensis*, n.sp., ♀ ; wing.
Fig. 11.—*Culicada vandema* Strickland, ♀ ; wing.
Fig. 12.—*Culicelsa alboannulata* (Macq.) ♂ ; head.
Fig. 13.—*Culicelsa alboannulata* (Macq.) ♀ ; wing.
Fig. 14.—*Culex biocellatus*, n.sp., ♀ ; head.
Fig. 15.—*Culex biocellatus*, n.sp., ♀ ; wing.

Plate xxxvii.

Fig. 16.—*Culex occidentalis* Skuse, ♂ ; head.
Fig. 17.—*Culex occidentalis* Skuse, ♀ ; wing.
Fig. 18.—*Culex tigripes* G. et C., ♀ ; wing.
Fig. 19.—*Skusea bancrofti*, n.sp., ♀ ; wing.
Fig. 20.—*Menolepis*(?) *tasmaniensis*, n.sp., ♀; wing.

ORDINARY MONTHLY MEETING.

SEPTEMBER 30th, 1914.

Mr. W. S. Dun, President, in the Chair.

A letter from Dr. C. MacLaurin was communicated, returning thanks for the expression of the Society's sympathy, evoked by the decease of Sir Normand MacLaurin, the senior surviving Original Member of the Society.

By the kindness of the Local Hon. Secretary, British Association for the Advancement of Science (Sydney Meeting, August, 1914), copies of the Sydney Address of the President (Prof. Bateson) were available for distribution to Members of the Society (on application to the Secretary).

The Donations and Exchanges received since the previous Monthly Meeting (26th August, 1914), amounting to 5 Vols., 41 Parts or Nos., 2 Reports, 1 Map, and 6 Pamphlets, received from 37 Societies, etc., and two private donors, were laid upon the table.

NOTES AND EXHIBITS.

The Rev. W. W. Watts exhibited a specimen of Robert Brown's *Platyzoma microphyllum*, showing a character generally overlooked in descriptions, probably because seldom present, namely, a cluster of small, filiform leaves, growing out of the rhizome, close to the clustered fertile fronds. These are, in all probability, the sterile fronds; they are quite entire, and only about one-fifth the length of the fertile fronds. Though omitted in most descriptions, these small fronds were not overlooked by Robert Brown, who wrote at the end of his description (Prodr., p.160): "Frondes ex eodem rhizomate compresso-filiformes, indivisæ."

Mr. Froggatt exhibited a fine series of specimens of male and female Mountain-grasshoppers, *Acridopeza reticulata* (*Locustidæ*). They were received from Mr. Arthur McConochie, Gnomery Station, Brewarrina, who reported that they were feeding on Sowthistle. He showed, also, branchlets of Peppermint-gums from Salisbury Park, near Uralla, girdled by the larvæ of some undetermined longicorn beetle, which remains in the fallen branches. There are thousands of acres of the open forest-country, where the surface of the ground is littered with dead branchlets.

Mr. A. A. Hamilton showed a series of plants from the National Herbarium comprising: *Zinnia elegans* Jacq., Sydney Botanic Gardens (J. H. Camfield; April, 1906), showing floral, and foliar prolification of the inflorescence. The ray florets are elevated on adventitious stems which arise from the still adherent floral bracts, the lamina of the ligula at this stage exhibits virescence, and is seen to enclose an abortive, miniature flower-head. In both ligulate and tubular flowers the achenes are early attenuated and infertile.—*Zinnia* Hort. var., Hunter's Hill (H. Deane, 1902), showing lateral, foliar prolification of the inflorescence. Reduced branches with opposite leaves and miniature foliaceous flowers arise from the axils of the involucral bracts of the primary flower-head, its tubular florets are raised on lengthy peduncles, and several ray-florets are represented by lateral leafy ligulæ, the remainder being suppressed.—*Citrus medica* Linn., Beecroft (W. M. Carne; August, 1914), showing dialysis of the carpels. The pericarp is seen to be laterally ruptured, and the disjointed placentas have protruded, disclosing the seeds.—*Carduus lanceolatus* Linn.(W. Muggridge; February, 1904), showing lateral, foliar prolification of the inflorescence. A series of pedunculate adventitious buds consisting of involucral bracts, and with no trace of reproductive organs, occurs within the ordinary involucre of the capitate inflorescence.—*Goodenia dimorpha* Maiden &

Betche, Leura (A. A. Hamilton; April, 1914), showing a rosette of basal leaves on one of its branches. The plant, which is a swamp-dweller, had been overturned, and was lying on its side. While in this position, it had produced a basal rosette on the prostrate branch, and rooted it, thus strengthening its resistance to further displacement in its unstable environment.—*Acacia suaveolens* Willd., Cook's River (A. A. Hamilton; August, 1914), an example showing a reversion to juvenile foliage. The plant was found growing in a favourable situation, appeared to be normally healthy, and exhibited no sign of ill-usage, which would be likely to interfere with its ordinary growth. Examples of this species from Leura (A. A. Hamilton; April, 1914), were exhibited, showing the sclerophyllous phyllodes of this xerophyte. It was noted that, on the higher elevations of the Blue Mountains, *A. suaveolens* is to be found only on the tops of bleak, stony, soil-denuded ridges. A series of leaves was also shown to illustrate variation (A. A. Hamilton; Blaxland; June, 1914) chiefly in the relative proportions of length to width; some measurements are, $4\frac{1}{2} \times \frac{7}{8}$; $3 \times \frac{3}{4}$; $1\frac{1}{2} \times \frac{3}{8}$; $6 \times \frac{3}{16}$; $4\frac{1}{2} \times \frac{1}{8}$; $1\frac{1}{2} \times \frac{1}{16}$ inch.—*Smilax glycyphylla* Sm., Waterfall (A. A. Hamilton; June, 1914), a series of leaves showing morphological divergences in size, texture, and shape. The apices of the leaves vary from obtuse to acute and acuminate, and their bases from cordate, rotundate, or elliptical to lanceolate. Measurements, $4\frac{1}{2} \times 1$; $2\frac{3}{4} \times 1\frac{3}{4}$; $3 \times \frac{3}{8}$; $2 \times \frac{1}{4}$; $1 \times \frac{1}{2}$ inch.

Mr. E. Cheel exhibited a fine series of specimens, representing the following species of *Dillwynia*: *D. parvifolia* R.Br., (*D. ericifolia* var. *parvifolia* Benth.); between Flemington and Lidcombe (late Rookwood, August, 1898. Fresh specimens again collected in September, 1914).—*D. peduncularis* Sieb., (*D. ericifolia* var. *peduncularis* Benth.), common in the neighbourhood of Randwick; Kahibah, near Newcastle; and Hill Top to Mount Jellore, on the Southern Railway line.—*D. phylicoides* A. Cunn., (*D. ericifolia* var *phylicoides* Benth.), Mount Victoria, Lawson, and several other localities in the Blue Mountains.—The above species are united with *D. ericifolia* Sm., as varieties by Bentham, but the different habit, distribution, and character of the foliage and flowers enables one to separate them easily from that species. Examples of a species, probably undescribed, collected at Bishopscourt, near Randwick, in August, 1898, and other localities as far as Hill Top, where it is very common, having distinctly spinescent branches, were also exhibited, together with typical specimens of *D. ericifolia* Sm., *D. floribunda* Sm., *D. brunioides* Meissn., *D. juniperina* Sieb., and *D. cinerascens* R.Br., for comparison with the above.—Mr. Cheel also showed fresh, flowering specimens of *Callistemon viminalis* (Sol.) Cheel,* from a private garden at Flemington, where there are nine fine shrubs about 15-18 feet high. all in full flower at the present time.—A flowering spike, about 5½ inches long, from a hybrid of *C. lanceolatus* × *C. acuminatus*, together with a spike from typical *C. lanceolatus* DC., for comparison. The characters of the leaves and habit are intermediate between the two.

Dr. C. Hall showed a remarkable series of hybrid Freesias.

Mr. E. C. Andrews sent, for exhibition, specimens of ordinary red fruits, and also yellow fruits of *Fusanus acuminatus* R.Br., the Quandong, with a basal elongation of the pericarp; from Bogan River, near Tottenham.

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* Australian Naturalist, ii.(1913), 185.

THE EVOLUTION OF THE EUCALYPTS IN RELATION TO THE COTYLEDONS AND SEEDLINGS.

By Cuthbert Hall, M.D., Ch.M.

(Plates xxxviii.-lxix.)

Introductory.—Although so much work has been done in elucidating the botanical, chemical, industrial, and other relations of the various species of Eucalyptus, the subject of the seedlings, and especially of the form of the cotyledon-leaves, and the part the latter have taken in the evolution of the genus, has received scant attention. Our two main contributions, so far, have been from Lubbock, in his "On Seedlings," in which the seedlings of ten species are described; and from Baron von Mueller, in his "Eucalyptographia," in which he gives drawings of the cotyledons of twenty species; but some of these are far from accurate, especially in the case of *E. amygdalina* and *E. globulus.* In this research, I have investigated the seedlings of nearly 150 species, and so have been able to compare one with another, and to trace the development of the higher from the more primitive forms, and gain an idea of the influences which brought this about.

I am under a deep debt of obligation to Mr. R. T. Baker, F.L.S., for supplying seeds that were botanically correct, and for identifying the species where seeds were collected by myself; to Mr. H. G. Smith, F.C.S., for help and advice, and to Mr. T. C. Roughley, of the Technological Museum, Sydney, for the excellent series of photographs of the mounted seedlings taken by him. The seeds of most of the Western Australian species were obtained from Mr. J. Staer, and so I have to rely on his naming of them. Those from him were *E. calophylla*, *E. cornuta*, *E. diversicolor*, *E. eudesmioides*, *E. gomphocephala*, *E. leptopoda*, *E. Lehmanni*, *E. loxophleba*, *E. marginata*, *E. occidentalis*, *E. perfoliata*, *E. platyphylla*, *E. polyanthema*, *E. redunca*, *E. salubris*, *E. striaticalyx*, and *E. Todtiana*. Professor Ewart, of Melbourne, kindly supplied *E. Muelleriana*; and Mr. R. H. Cambage, *E. Moorei*.

The seeds were planted in boxes, in ordinary potting soil consisting of a mixture of sand, leaf-mould, and loam; and were covered with a mulch of tan-bark. Germination usually took place at the end of a week, though often stray seedlings would appear a week or fortnight later, especially if cool cloudy weather succeeded hot sunny conditions. Sometimes seeds, though known to be fresh and, therefore, supposedly fertile, failed to germinate at all. In other cases, a few germinated, but chemical and physical conditions seemed to be adverse, and it was impossible to grow them to any size. Notable among these, were *E. Dawsoni*, *E. camphora*, *E. fastigata*, and *E. dextropinea*. In other instances, the seed had been kept so long, that most, if not all, the fertile seeds had perished. It must be remembered that most of the Eucalypts have specialised in their liking for a particular soil and certain climatic conditions for unknown ages, and unless they can get these to their liking, they do not thrive. September appears to be the best month in which to plant.

The keeping qualities of Eucalyptus seeds in a dry state.

This faculty is very marked in most of the species. The seeds used in this research were all grown in the soil, but Professor Ewart, of Melbourne, by soaking in water, then placing on filter paper in glass dishes in a germinating chamber, had 6·6 % of seeds of *E. rostrata* germinate after keeping 37 years, 1·2 % of *E. leptopoda* after 30 years, 11% of *E. diversicolor* after 24 years, and 9% of *E. cornuta* after 22 years. With the exception of *E. calophylla*, all these have small cotyledons, and *E. leptopoda* and *E. cornuta* have deeply bifid ones. A great many of the seeds I used were obtained from the specimen-cases of the Technological Museum, Sydney, where they had lain, after falling from the fruit on its drying, and dehiscence occurring. In many instances, only a few seeds were procurable, and most of these may not have been fertile in the first instance. If a large quantity of seed was obtained and carefully preserved, I believe Eucalyptus seeds could be made to keep for much longer periods than found here. Seed of *E. Baileyana*, after 23 years, failed to germinate; and others that also gave no result were *E. lactea* (19 years), *E. quadrangulata* (18), *E. sideroxylon* (17), *E. melliodora* (13), *E. Muelleri* (16), *E. terminalis* (12), *E. angophoroides* (11), *E. vitrea* (12), *E. dextropinea* (13 and 18), *E. Dawsoni* (13), *E. hæmastoma* (16), *E. fraxinoides* (13), *E. acaciæformis* (14), *E. Luehmanniana* (19), *E. fastigata* (13), *E. pyriformis* (21), *E. albens* (12), and *E. tessellaris* (12 years). On the other hand, *E. Risdoni* (9 years), *E. carnea* (11), *E. Stuartiana* (10), *E. ovalifolia* (12), *E. Woollsiana* (8), *E. pendula* (11), *E. hemilampra* (9), *E. punctata* (16), *E. umbra* (6), *E. viridis* (11), *E. paludosa* (13), *E trachyphloia* (18), *E. Rossii* (7), *E. pulverulenta* (10), *E. Baeuerleni* (10), *E Macarthuri* (8), *E. nigra* (13), *E. goniocalyx* (13), *E. conica* (11), *E. camphora* (12), *E. gracilis* (8), *E. Planchoniana* (11), *E. intertexta* (10), *E. Morrisii* (11), *E. aggregata* (13), *E. dealbata* (12), *E. marginata* (7), *E. affinis* (10), *E. hæmastoma* var. *micrantha* (16), and *E. obliqua* (18 years), all germinated after such prolonged periods of preservation. That seeds of *E. obliqua* and *E trachyphloia* should keep 18 years, and *E. hæmastoma* var. *micrantha* and *E. punctata* 16 years, is a remarkable testimony to the power of the seeds of this genus of withstanding dessication for prolonged periods.

Much has been written, especially by foreign observers, as to "the variability of Eucalyptus under cultivation." I have not found this to be so, even after growing seedlings of the same species from widely separated localities. They have invariably come true. We may get some fluctuations or slight departures from the normal, but when species have been botanically identified by an expert, who knows the Eucalypts, this supposed variability has not been found to occur. Many of the mistakes have been due to trusting to the vernacular names of collectors, who had a very imperfect botanical knowledge. Again as to hybridism, I have been keenly on the alert to discover instances of this, but, after examining thousands of seedlings from different species, I have not seen one single instance of it so far.

Although the seedlings of many species differ so markedly from one another, that they could be detected at once, I have hitherto found them uniform throughout, though there may be slight differences in size, vigour, etc. Still, knowing that hybridism has actually been proved in the genus *Acacia* (Proc. Linn. Soc. N. S. Wales, xxxv., Pt.2), of which, as of the Eucalypts, so many species occur in Australia, we may hope soon for actual demonstration of such occurring in the latter. Up to the present, though much has been said as to one species being a hybrid of two others, we have had no actual proof.

Fruits and Seeds.—In Eucalyptus, the fruit is a capsule opening at the top in three to six valves, which dehisce along their centre. In *E. phœnicea*, there are only two cells. Fruit generally many-seeded, the majority, or all but one, being sterile. In the *corymbosa*-group, of which *E. corymbosa* may be taken as the type, there is generally only one fertile seed to each cell, and this is vertically compressed, and flattened from before backwards, the hilum showing as a paler depression in the middle of the ventral surface, and the testa is frequently prolonged into a membranous appendage to aid distribution by the wind. In *E. corymbosa*, the posterior angle is keeled. In most of the other Eucalypts, the fertile seeds are more numerous, and are compressed and angled laterally, according to their position in the cell; the hilum is at the narrower inner extremity, and the larger outer extremity is rounded to the shape of the wall of the cell. The sterile seeds are light brown, narrow or linear, the fertile ones dark brown or black.

The *testa* is membranous, brown or black, and has not undergone much modification, except in the development of the aforesaid membranous appendage in the Corymbosas, and some allied northern species.

Endosperm is absent.

Embryo.—As endosperm is not present, the form of the embryo depends on the shape, size, and manner of folding of the cotyledons. The length of the petioles in the embryo depends on the distance from the junction of lamina and petiole to the superior pole of the radicle; and, in most species, is probably fairly short before germination. In *E. citriodora* and *E. maculata*, the cotyledons are almost sessile. In *E. marginata*, the hypocotyl is subterranean, and the failure of this to elongate, by growth in germination, is compensated for by the great elongation by growth of the petioles, so as to raise the laminæ well above the ground. A similar condition obtains in *Angophora cordifolia*, where the hypocotyl is short, and the petioles long. *E. calophylla* and *E. Todtiana* also have fairly long petioles.

Radicle.—A series of sections of the seeds for microscopic examination would be necessary to give the shape and length of the radicle, and with such small seeds as the majority of the species possess, this would be difficult of accomplishment. As far as I have been able to observe, in the larger seeds, the radicle is short, thick, and truncate, resting on the lower pole of the seed from which it emerges in the *corymbosa*-group; or against the hilum, from the neighbourhood of which it emerges, in the *globulus*- and allied groups.

Cotyledon-Leaves.—Lubbock states that, in the great majority of plants, the cotyledons are entire. In the Eucalypts, however, emargination in a greater or less degree is more common, and in some species, reaches an extreme degree. As this appears to be a response to Australian xerophytic conditions, it indicates that the species with simpler, entire cotyledons are those of the more primitive type; while those, with emarginate cotyledons, are of the more evolved and developed type, and this bears out the researches on the botanical and chemical characters of the genus. Botanically and chemically, the "Bloodwood"- or *corymbosa*-group has been considered the most primitive, and to most closely approach the allied genus *Angophora*, and the seedlings bear this out. In my companion paper to this, "The Seedlings of the Angophoras," (Proc. Roy. Soc. N. S. Wales, Vol. xlvii.), I have shown that all, except *A. cordifolia*, have reniform, entire cotyledons. Those of *E. corymbosa* and its congeners are of the same form, and quite indistinguishable. The primary leaves, however, serve to separate them, as in the Corymbosas they are petiolate, and alternate after the first or second pair, in many cases becoming peltate as well. Both, however, have stellate hairs on the early leaves. After growing the seedlings of such a large number of species, and comparing them, it was seen that a very interesting and instructive classification of them, according to size and shape of cotyledons, could be made; and that, in many instances, this tentative arrangement followed certain morphological and chemical lines in a manner hitherto unsuspected by workers on the subject of Eucalyptology. Certain species were found to adhere to the entire type of cotyledon, and in the case of the Eastern Australian Stringybarks, this adherence was very close. In other instances, there seemed a return to the primitive type of cotyledon, as in *E. dumosa* and *E. incrassata.* What species represent the prototype of the emarginate form, whether it appeared suddenly or gradually, in what part of the continent it first developed, cannot at present be told. Fuller knowledge of the seedlings of the remaining species of Eucalypts, and a consideration of their distribution, may give a key to solve the problem. However, just as we have the Corymbosas with large, entire cotyledons, so we have the group, like *E. marginata*, with large, emarginate ones; then we have the peppermint-group, with smaller cotyledons, slightly or hardly at all emarginate; then a large collection of species, all more or less emarginate, but with cotyledons gradually diminishing in size, till we get the almost minute ones of *E. rostrata* and *E. viridis*; and finally, the extremely bifid species of the *E. squamosa* type. We may thus place the Eucalypts in two great cotyledonary classes, entire and emarginate, and group them as follows.

i. *Entire Cotyledons.*

(*a*). Bloodwoods or Corymbosas, characterised by very large or medium-sized cotyledons, usually reniform in shape, and resembling those of the Angophoras, comprising *E. calophylla*, *E. perfoliata*, *E. eximia*, *E. corymbosa*, *E. trachyphloia*, *E. citriodora*, *E. maculata*, and *E. intermedia.* The primary leaves very soon become alternate, and generally peltate; they are petiolate, and covered with glandular hairs.

(*b*). Cotyledons of medium size to small, reniform, entire; primary leaves opposite, shortly petiolate, covered with glandular hairs; mainly Stringybarks, with reniform anthers.—*E. laevopinea*, *E. dextropinea*, *E. Wilkinsoniana*, *E. eugenioides*, *E. capitellata*, *E. macrorhyncha*, *E. nigra*, *E. obliqua*, *E. Muelleriana*, *E. Marsdeni* (sp.nov.), *E. fastigata*, and *E. regnans*. The last-named has a smooth bark, but otherwise the seedling resembles the others.

(*c*). Cotyledons small, reniform or orbicular; leaves smooth and petiolate. *E. dumosa*, *E. populifolia*, *E. quadrangulata*, *E. polybractea*, and *E. incrassata*. It is probable that these, in undergoing reduction in size, have reverted to the primitive type as regards shape.

ii. *Emarginate Cotyledons.*

(*a*). Cotyledons large, obcordate, cuneate at base, petioles long. *E. marginata*, *E. Todtiana*, *E. megacarpa*, and *E. santalifolia*. The last-named shades off into the following group.

(*b*). Cotyledons medium to small, emargination moderate, slight or even practically absent. Primary leaves smooth, as a rule, and sessile. In most cases, the under sides of the leaves and cotyledons are tinged deep purplish-red. Most of these species contain eucalyptol, and many of them phellandrene and piperitone. The anthers are generally reniform. This group comprises *E. Planchoniana*, *E. pilularis*, *E. acmenioides*, *E. umbra*, *E. carnea*, *E Risdoni*, *E. linearis*, *E. phlebophylla*, *E. hæmastoma*, *E. stricta*, *E. Rossii*, *E. striaticalyx*, *E. piperita*, *E. amygdalina*, *E. coccifera*, *E. vitrea*, *E. Luehmanniana*, *E. oreades*, *E. Sieberiana*, *E. Delegatensis*, *E. campanulata*, *E. Andrewsi*, *E. coriacea*, *E. dives*, *E. radiata*, *E. apiculata*, *E. virgata*, *E. obtusiflora*, *E. stellulata*, and *E. Moorei*.

(c^1) Cotyledons smaller, more or less transversely oblong, emargination moderate or very slight; primary leaves generally smooth, petiolate, or sessile, the latter often glaucous. In this group may be placed the Ironbarks and most of the Boxes, with anthers opening by pores; the remainder mostly have parallel anthers. In this group are *E. botryoides*, *E. saligna*, *E. robusta*, *E. Baeuerleni*, *E. propinqua*, *E. microcorys*, *E. paniculata*, *E. crebra*, *E. sideroxylon*, *E. melanophloia*, *E. siderophloia*, *E. albens*, *E. hemiphloia*, *E. resinifera*, *E. punctata*, *E. Muelleri*, *E. fasciculosa*, *E. longifolia*, *E. diversicolor*, *E. leucoxylon*, *E* sp.nov. (R. T. Baker), *E. patentinervis*, *E. viminalis*, *E. saligna* var. *pallidivalvis*, *E. Perriniana*, *E. Gunnii*, *E. Stuartiana*, *E. cinerea*, *E. Smithii*, *E paludosa*, *E. lactea*, *E. melliodora*, *E. sideroxylon* var. *pallens*, and *E. acervula*.

(c^2). Cotyledons very small, transversely oblong or triangular, emargination slight or practically absent. Primary leaves generally smooth and petiolate. Where the petiole is so small, it is sometimes almost impossible to know whether to put some of these in this group or in i.(*c*). Comprised in this group are *E. Macarthuri*, *E. rubida*, *E. pulverulenta*, *E. Morrisii*, *E. maculosa*, *E. odorata*, *E. Behriana*, *E. dealbata*, *E. ovalifolia*, *E.* sp.nov., (R. T. Baker), *E. Woollsiana*, *E. conica*, *E. intertexta*, *E. Fletcheri*, *E. nova-anglica*, *E. viridis*, *E. affinis*, *E. camphora*, *E. aggregata*, *E. rostrata*, *E. acaciæformis*, *E. Rodwayi*, *E. tereticornis* var. *linearis*, *E. tereticornis*, *E. Parramattensis*, *E. Bosistoana*, and *E. polybractea*.

(c^3). Cotyledons larger than in ii.(c^1), more deeply emarginate, lobes obovate-oblong, obtuse, divergent. In many, the primary leaves are sessile and glaucous. It will be seen that this group shades off from (c^1), just as (c^2) may be taken to shade off from (c^1) in the other direction. Comprised in it are *E. eudesmioides*, *E. gomphocephala*, *E. Lehmanni*, *E. cosmophylla*, *E. corynocalyx*, *E. hemilampra*, *E. elæophora*, *E. goniocalyx*, *E. urnigera*, *E. unialata*, *E. Maideni*, *E. globulus*, and *E.* sp.nov.,(R. T. Baker).

(*d*). Cotyledons deeply bifid, the emargination being carried to an extreme degree; hence they may be termed Y-shaped. The lobes or limbs of the Y are finally so reduced as to be merely linear. The primary leaves are generally opposite, and linear or linear-lanceolate. This comprises *E. cornuta*, *E. polyanthema*, *E. occidentalis*, *E. salubris*, *E. leptopoda*, *E. loxophleba*, *E. redunca*, *E. gracilis*, *E. pendula*, *E. calycogona*, *E. uncinata*, *E. cneorifolia*, *E. oleosa*, *E. salmonophloia*, and *E. squamosa*.

Description of Eucalyptus Seedlings.

i. Cotyledons entire.

(*a*.) Cotyledons large to medium, mostly reniform; primary leaves generally with stellate hairs, frequently peltate.

E. calophylla R.Br. (Plate xxxviii., fig.1).—My results agree with Lubbock's. Note should be made of the large reniform-orbicular cotyledons, the largest so far known among Eucalypts, and larger than any in the Angophoras; the petioles are really longer than are shown in Lubbock's diagram, and the leaves alternate from the beginning. The incipient emargination mentioned by Lubbock is usually due more to separation and splitting during germination. The stellate hairs on the petioles of cotyledons are unusual. The earlier leaves tend to become peltate for a few pairs, a character they afterwards lose. The leaves are very like those of *E. corymbosa.* It is noteworthy that this species and *E. ficifolia* are the only ones of the Corymbosa- or Bloodwood-group found in South-western Australia. (Pl. lxix., fig.4).

E. corymbosa Sm. (Plate xxxviii., fig. 4).—Hypocotyl erect, terete, glabrous, 1·2 cm. long. Cotyledons 1·1 × 0·8 cm., petiole 0·7 cm., entire, reniform, glabrous, purplish on under surface, sometimes with a small apical point. Stem erect, terete, herbaceous, ultimately woody, greenish but drying to red, covered with glandular hairs. Leaves alternate, petiolate, entire, ovate to oval; lateral veins rather oblique, open; petioles and laminæ covered with glandular hairs. In the very young stage, the leaves have a purplish tinge. First pair, 1·3 × 0·5, petiole 0·7; second pr., 2·5 × 0·9, petiole 1; third pr., 3·2 × 1·2, petiole 1 cm. First internode 2·5, second internode 1·2 cm. Leaves assume a peltate character, which they lose again. Later leaves are coriaceous, smooth and shining, large and broad, with lateral veins parallel, more closely set and almost at right angles to the midrib. (Pl. lxix., figs.3, A, D).

E. eximia Schau. (Plate xxxix., fig.1).—Cotyledons resemble those of *E. corymbosa*, but are slightly smaller. Internal concave border shallower, petiole shorter. Leaves entire, alternate, obtuse, ovate, petiolate. First pr. 1·4 × 1, petiole 1·1; second pr. 2·7 × 1·5, petiole 0·7 cm. Stem and leaves covered with glandular hairs. After the third pair, the leaves become peltate for a few pairs. They have a peculiar bluish-green appearance. Venation a little oblique and open. Leaves broader, but shorter than in *E. corymbosa.*

E. ficifolia F.v.M.—*See* Lubbock's "On Seedlings."

E. trachyphloia F.v.M. (Pl. xxxviii., fig.3).—Cotyledons reniform, entire, glabrous, 0·7 × 0·45, petiole 0·3 cm. Leaves oval then lanceolate, opposite, soon alternate and vertical, obtuse, entire, petiolate. Stem and leaves covered with glandular, stellate hairs. Stem erect, terete, green. The cotyledons are smaller than in *E. corymbosa*, corresponding with the smaller fruit. This is interesting, as the species occurs at Narrabri, where the climate is very hot, and much drier than on the coast. This reduction is to meet the hot, drier climate. The first leaves, too, are smaller, first pr. being 0·7 × 0·4, petiole 0·3; second pr. 0·9 × 0·6, petiole 0·3; third pr. 1 × 0·4, petiole 0·4; fourth pr. 1·5 × 0·9, petiole 0·6 cm. Peltate leaves not seen so far as grown.

E. intermedia R. T. Baker (Pl. xxxviii., fig.2).—Hypocotyl terete, glabrous, 0·6 cm. Cotyledons reniform, lighter green on under surface, very slightly emarginate, 1 × 0·6, petiole 0·4 cm. Leaves entire, opposite, soon alternate, lanceolate, obtuse, tapering to petiole, lighter colour on under surface. First pr. 1·2 × 0·6, petiole 0·2; second 1·5 × 0·8, petiole 0·4; third 3 × 1, petiole 0·4 cm. Stem and leaves covered with glandular hairs; peltate leaves not observed. Mr. Baker rightly separated this species from *E. eximia* and *E. corymbosa*. It differs in one very important matter in that, in many cotyledons, there is slight but distinct emargination. These are also smaller. The leaves, too, are distinct. The lateral veins are transverse, and the intramarginal vein close to the edge.

E. perfoliata R.Br. (Pl. xxxix., figs.2-3).—Seed, supplied by Mr. J. Staer, gave seedlings of two kinds. In one, the cotyledons were larger, 1·5 × 0·9, petiole 0·5 cm., reniform, entire, glabrous, dark green. Leaves oval, obtuse, opposite. In the other, cotyledons not so broad, 1·3 × 0·9, petiole 0·3cm., laminæ purplish on under surface. Leaves ovate, not so obtuse. In both cases, leaves shortly petiolate, and they and stem covered with glandular hairs.

E. citriodora Hook. (Pl. lxv., fig.1; Pl.lxix., fig.2).—Hypocotyl glabrous, terete, 0·9cm. long. Cotyledons orbicular-reniform, almost sessile, entire, sometimes with apical tooth, glabrous, 0·7 cm. in diameter. Leaves ovate, then lanceolate and peltate, obtuse, alternate, petiolate, drying a yellowish-brown, citron-scented. First pr. opposite, 1 × 0·3, petiole 0·2; second 1·2 × 0·5, petiole 0·4; third 1·8 × 0·7, petiole 0·4 cm. Stem and leaves rough, with short glandular hairs.

E. maculata Hook. (Pl. xliv., fig. 1).—Hypocotyl erect, terete, glabrous, 0·9 cm. long. Cotyledons as in *E. citriodora*, but smaller and more orbicular, subsessile, entire, 0·65 cm. in diameter. Leaves ovate, obtuse, alternate, petiolate, then peltate for a few pairs, becoming again petiolate, dark green. Venation oblique, with often two main lateral veins springing from near petiole. (This is seen, too, in *E. citriodora*). Leaves and stem have glandular hairs. These two species are of special interest. *E. citriodora* has sometimes been put as a variety of *E. maculata*, but should not. However, they raise a point I wish to emphasise, that when, in allied species, the fruits closely resemble each other or are practically identical, the cotyledons also resemble one another. This obtains specially in these two species, and their being subsessile, separates them from all other species of Eucalypts, yet they differ in primary leaves, oils, bark, timber, habitat, etc. The colour of *E. citriodora*, on drying, is also worthy of comment, and is probably due to its chemical composition. The peltate leaves emphasise their relation to the Bloodwoods. The primary leaves of *E. maculata* have some resemblance to those of *E. eximia*.

i.(*b*). Eucalypts with reniform, entire cotyledons; "stringy" bark; shortly petiolate primary leaves with glandular hairs. Though the cotyledons are entire and the leaves hairy, the group differs from the Bloodwoods in the primary leaves being opposite and shortly petiolate.

E. lævopinea R. T. Baker (Pl. xl., figs. 1-2).—Hypocotyl terete, glabrous, reddish, 0·7 cm. long. Cotyledons obtusely quadrilateral, reniform or cuneate at base, entire, glabrous, reddish underneath, 0·9 × 0·8, petiole 0·3 cm. Leaves broadly lanceolate, subacute then acute, opposite, shortly petiolate, margin waved or slightly serrate, venation pinnate. First pr. 2 × 0·9; second 3·5 × 1·5 cm. Stem and leaves with glandular hairs. Stem terete, reddish. First internode 0·7; second 0·8; third 2 cm.

The later leaves, tenth to fifteenth pairs, are broad, coriaceous, sessile, often cordate at base, acute, alternate.

E. dextropinea R. T. Baker (Pl. xl., fig.4).—Hypocotyl terete, glabrous, reddish, 0·6 cm. Cotyledons smaller than in *E. lævopinea*, reddish-purple on under side, sometimes slightly emarginate, 0·8 x 0·7, petiole 0·4 cm. Leaves broader than in *E. lævopinea*, purplish-red on under surface, dark green, subsessile, opposite, obtuse, margin waved or serrated, ovate-lanceolate, veins pinnate and looped. First pr. 2·1 x 1; second 3·6 x 1·5; third 4 x 1·8 cm. First internode 0·4, second 0·5, third 0·6 cm. Stem terete, greenish, and it and leaves covered with stellate hairs.

E. Wilkinsoniana R. T. Baker (Pl. xli., fig.2).—Hypocotyl erect, terete, glabrous, 1 cm. Cotyledons smaller than in *E. lævopinea*, reniform, entire, glabrous, 0·4 x 0·3, petiole 0·3 cm. Leaves ovate or oval, petiolate, margin serrate or sinuate, obtuse, opposite, venation pinnate. First pr. 1·5 x 0·6, petiole 0·4; second 3 x 1·2, petiole 0·5; third 3·3 x 1·5, petiole 0·4 cm. Stem and leaves covered with glandular hairs. First internode 0·9, second 1·8, third 1·6 cm. Leaves, especially from fourth to seventh pairs, have margins much more sinuate than in *E. nigra*.

E. macrorhyncha F.v.M. (Pl. lviii., fig.6).—Hypocotyl as in other members of the group. Cotyledons as in *E. Wilkinsoniana*, only very dark purple on under surface. Leaves ovate-lanceolate, obtuse, opposite, petiolate, margin sinuate. First pr. 2 x 0·9, petiole 0·6; second 3 x 1·8, petiole 0·5 cm. First internode 1·2, second 2·5, third 1·8 cm. Stem and leaves covered with glandular hairs.

E. capitellata Sm. (Pl. lviii., fig.7).—Cotyledons as in *E. Wilkinsoniana*, only rather cuneate at base, petiole longer. Leaves much like those of *E. macrorhyncha*, only narrower.

E. nigra R. T. Baker (Pl. lix., fig.1).—Cotyledons and leaves closely resemble those of *E. Wilkinsoniana*, but leaves not so obtuse and rounded at apex as in that species.

E. eugenioides Sieb. (Pl. xliii., fig.2).—Cotyledons reniform, smaller than in *E. Wilkinsoniana*, 0·3 x 0·25, petiole 0·3 cm. Leaves narrower than in the other Stringybarks, lanceolate, opposite, decussate, petiolate, subacute, margin sinuate. First pr.

1·1 × 0·5, petiole 0·5; second 2 × 0·6, petiole 0·5 cm. First internode 1·2, second 2·4, third 1·6 cm. Stem and leaves covered with stellate hairs. The seedling of *E. eugenioides* is very distinct from those of the others of the group.

E. Muelleriana A. W. Howitt (Pl. li., fig.5).—Hypocotyl terete, covered with stellate hairs, 0·6 cm. Cotyledons reniform, entire, larger than those of *E. lævopinea*, glabrous, 0·9 × 0·8, petiole 0·3 cm. Leaves opposite, entire, broadly lanceolate, decussate, obtuse, shortly petiolate. Margin not sinuate as in *E. lævopinea*. First pr. 1·3 × 0·8, petiole 0·3; second 2 × 1, petiole 0·25; third 2·6 × 1·2, petiole 0·2 cm. First internode 0·3, second 0·4, third 0·6, fourth 0·7 cm. Internodes much shorter than in *E. lævopinea*. Stem and under surface of midrib covered with fine, glandular, reddish hairs. Upper surface of leaves smooth and shining. This confirms the observation of A. W. Howitt as to the smooth, shining character of the juvenile foliage. Study of the seedlings confirms the specific nature of *E. Muelleriana* as distinct from *E. pilularis*. They have nothing in common, except a superficial resemblance of the fruits. The cotyledons and primary leaves are distinct, and they should never be placed together.

E. obliqua L'Hér., Hobart, Tas. (Pl. lxiii., fig.3).—Cotyledons orbicular-reniform, entire, reddish on under surface, 0·4 × 0·35, petiole 0·3 cm. Leaves opposite, shortly petiolate, decussate, lanceolate, obtuse, lateral venation oblique, margin slightly sinuate. First pr. 1·8 × 0·7, petiole 0·3; second 2·8 × 1, petiole 0·2; third 3 × 1, petiole 0·2 cm. First internode 0·6, second 2·5, third 3·5 cm. Stem reddish. Stem and leaves covered with stellate hairs, but these shorter than in *E. lævopinea*.

E. obliqua, Mt. Gambier, S.A. (Pl. lxiv., fig.1).—In this form, the cotyledon-leaves are larger than in the Tasmanian, and the primary leaves broader and more ovate.

E. Marsdeni, sp.nov.; Toongabbie, N.S.W. (Pl. lxvii., fig.4).—Hypocotyl terete, glabrous, reddish, 0·4 cm. long. Cotyledons the smallest seen in the Stringybarks, 0·25 × 0·2, petiole 0·2 cm., orbicular-reniform, entire, purplish on under surface, glabrous. Leaves opposite, decussate, obtuse, shortly petiolate, lanceolate, venation pinnate, rather oblique, edges sinuate. First pr. 0·8 × 0·3, petiole 0·25; second 1·5 × 0·6, petiole 0·3; third 3·6 × 0·8, petiole 0·3 cm. First internode 0·3, second 0·4, third 0·9, fourth 2 cm. Stem reddish, and both it and leaves covered with fine stellate hairs. This seedling has some resemblance to those of *E. Moorei* (Maiden), and *E. eugenioides.*

E. regnans F.v.M. (Pl. lxvi., fig.1).—Cotyledons reniform, entire, 0·6 × 0·45, petiole 0·3 cm. Leaves opposite, ovate-lanceolate, with sinuate and slightly serrate margins, petiolate, venation somewhat oblique, intramarginal vein close to edge, upper surface smooth and shining; lower surface with a few stellate hairs; oil-dots few in number. First pr. 2·5 × 1, petiole 0·3; second 3·3 × 1·5, petiole 0·3 cm. First internode 0·5, second 0·8 cm. Stem and leaves covered with short, glandular hairs. Although this species has a smooth bark, the seedling is so much of the type of the Stringybarks, that I have placed it with them. The reniform anthers, it possesses, also support this grouping.

E. fastigata Deane & Maiden (Pl. lviii., fig. 5).—Cotyledons small, reniform or triangular, petiolate. Leaves opposite, but soon alternate, entire, shortly petiolate, then petioles longer, lanceolate, acute, oil-dots fairly numerous. Venation oblique; intramarginal vein away from edge and looped with lateral veins. Leaves and stem covered with fine hairs, but soon becoming smooth. This seedling is quite distinct from that of *E. regnans*, having smaller cotyledons, much narrower lanceolate leaves of fine texture, and fairly plentiful oil-glands, so agreeing with the results of the distillation of the oils.

i.(*c*). Cotyledons small, entire, reniform or orbicular. Leaves mostly glabrous and petiolate.

E. Dawsoni R. T. Baker (Pl. lviii., fig.4).—Cotyledons reniform, glabrous, 0·4 × 0·3, petiole 0·3 cm. Leaves entire, opposite, decussate, glabrous, petiolate, lanceolate, acute. I was able to raise only one seedling of this species, but, by comparison, a great difference will be seen between it and those of *E. ovalifolia* and *E. polyanthema.*

E. dumosa A. Cunn.(Pl. liii., fig.2; Pl. lxix., fig.5).—Cotyledons reniform-orbicular, glabrous, 0·25 × 0·2, petiole 0·3 cm. Leaves opposite, petiolate, lanceolate, glabrous, obtuse. First pr. linear-lanceolate; second 1 × 0·4, petiole 0·6; third 1·8 × 0·6, petiole 0·6 cm First internode 0·6, second 1·2, third 1·3 cm. The cotyledons are worthy of note, as they differ so greatly from those of the rest of the Mallees, especially those of the *E. gracilis* type.

E. populifolia Hook. (Pl. xlvii., fig.2).—Cotyledons very small, obtusely quadrilateral or orbicular, entire, glabrous, petiolate, 0·15 × 0·1, petiole 0·15 cm. Leaves opposite, entire, petiolate, glabrous, lanceolate, subacute. First pr. 0·9 × 0·3, petiole 0·4; second 1·2 × 0·5, petiole 0·5; third 1·6 × 0·6, petiole 0·3 cm. First internode 0·4, second 0·3, third 0·4 cm

E. quadrangulata Deane & Maiden (Pl. xliv., fig.7).—Cotyledons orbicular-reniform, reddish on under surface, 0·25 × 0·2, petiole 0·15 cm. Leaves narrow-lanceolate, glabrous, opposite, subacute, sessile, reddish on under surface.

E. incrassata Labill. (Pl. lxvi., fig.3).—Cotyledons reniform, entire, glabrous, purplish-red beneath, 0·6 × 0·5, petiole 0·5 cm. Leaves opposite, decussate, entire, glabrous, obtuse, petiolate.

E. Moorei Maiden & Cambage (Pl. lxvi., fig.2).—Cotyledons small, orbicular-reniform, glabrous, purplish on under surface, 0·2 × 0·15, petiole 0·15 cm. Leaves opposite, decussate, sessile, lanceolate, obtuse, glabrous, entire, dark green. First pr. 1 × 0·5, second 2·5 × 0·7, third 3 × 0·8 cm. First internode 0·2, second 0·4, third 1, fourth 1·8 cm. Stem purplish-red, covered with short, stellate hairs, terete. This species has been said to be closely related to *E. stellulata*, but the seedlings are very different, both as to cotyledons and primary leaves; these latter, in *E. stellulata*, being ovate or almost orbicular.

ii. Eucalypts with emarginate cotyledons.

(*a*). Cotyledons large, slightly emarginate, cuneate at base, petioles long.

E. marginata Sm.—Described in Lubbock's "On Seedlings." Mr. Maiden's figure, Plate xl., "Critical Revision of Eucalyptus," and description are really of *E. calophylla*. This error was corrected later. The cotyledons are much more asymmetrical than shown by Lubbock (Pl. lxix., fig.6).

E. Todtiana F.v.M.(Pl. xli., fig. 1).—Hypocotyl terete, glabrous, reddish, 1·3 cm. long. Cotyledons somewhat like those of *E. marginata* but more symmetrical, obtusely quadrilateral, slightly emarginate, cuneate at base, 1·8 × 1·2, petiole 0·9 cm. Petiole terete, glabrous, reddish, grooved on upper side at distal extremity. Leaves opposite, decussate, broadly lanceolate, tapering at base, coriaceous, obtuse, sessile, dark green, glabrous, lateral veins oblique, parallel. Stem terete, reddish, with a few glandular hairs. First pr. of leaves 3·6 × 1·6; second 4 × 1·6 cm. First internode 0·6, second 0·6, third 0·5 cm.

E. megacarpa F.v.M. (Pl. lii., fig. 3)—Hypocotyl short, terete, reddish, glabrous, 0·6 cm. long. Cotyledons resemble those of *E. Todtiana*, but broader, and petiole shorter and narrower. They are obtusely oblong, trinerved, 1·5 × 1, petiole 0·7 cm., base of lamina cuneate. Leaves entire, opposite, decussate, obtuse, sessile, glabrous, broadly lanceolate, venation pinnate, open, intramarginal vein ill defined. First pr. 4 × 1·5, second 4·5 × 1·8 cm. First internode 0·7, second 2·5, third 2 cm. Stem terete, reddish, glabrous.

E. santalifolia F.v.M.(Pl. l., fig. 5)—Hypocotyl terete, glabrous, 0·7 cm. long. Cotyledons smaller than in *E. megacarpa* but of same form, obtusely quadrilateral, cuneate at base, slightly emarginate, 1 × 0·7, petiole 0·5 cm. Leaves opposite, decussate, glabrous, sessile, ovate, obtuse, cordate at base, lateral veins parallel, somewhat oblique. First pr. 2·4 × 1·1, second 3 × 1·4, third 3·1 × 1·6 cm. First internode 0·4, second 0·2, third 0·6, fourth 1·2 cm. Stem reddish, terete, glabrous.

The above four species form a good group, as far as the seedlings are concerned, *E. marginata* being most removed from the others in its asymmetrical cotyledons, long petioles, and subterranean hypocotyl. They all have broad, sessile leaves, which are large from the very first pair.

ii.(*b*). Eucalypts with cotyledons large then smaller, usually obtusely quadrilateral, slightly emarginate, leaves usually sessile. Undersurface of cotyledons and leaves generally tinged deep purplish colour. This group comprises the "Peppermints" and their near allies containing phellandrene, eucalyptol, and pinene.

It is confined to South-eastern Australia and Tasmania. In nearly all cases, the anthers are kidney-shaped.

E. Planchoniana F.v.M.(Pl. lix., fig.3; Pl. lxix., figs.7 and D).—Hypocotyl erect, terete, glabrous, reddish, 1 cm. long. Cotyledons emarginate, under side reddish, glabrous, obcordate, cuneate at base, 1·1 × 0·9, petiole 0·5 cm. Leaves opposite, decussate, lanceolate, subacute, glabrous, tapering at both ends, sessile, edges waved First pr. 3·6 × 1, second 4 × 1 cm. First internode 1·3, second 1·2 cm. Stem reddish, terete, glabrous. The cotyledons in this species are the largest in the group, but the seedling has much resemblance to that of *E. pilularis* in other respects. Its oil, also, is of the same class. This species has parallel anthers, however.

E. pilularis Sm.(Pl. lix., fig.2).—Cotyledons reniform, glabrous, deep purple beneath, 0·6 × 0·3, petiole 0·3 cm. Leaves opposite, lanceolate, subacute, sessile, tapering at both ends, becoming cordate with rounded auricles at base, glabrous, margin waved, purplish-tinged on under sides. First pr. 2·4 × 0·7, second 3·6 × 1·4, third 6 × 1·6 cm. First internode 0·9, second 1·2, third 2·4, fourth 2 cm. Stem terete, glabrous, purplish. This seedling bears no resemblance whatever to that of *E. Muelleriana.*

E. acmenioides Schau.(Pl. lvii., fig.1; Pl. lxix., fig.8).—Cotyledons obtusely quadrilateral, slightly emarginate, slight tinge of reddish-purple beneath, 0·6 × 0·5, petiole 0·3 cm. Leaves lanceolate, opposite, sessile, obtuse then subacute, tapering at base, then cordate and stem-clasping, glabrous, entire. First pr. 1·8 × 0·6, second 2·2 × 0·7, third 3 × 0·8 cm. First internode 1·6, second 1·8, third 1·8 cm. Stem terete, glabrous.

E. umbra R. T. Baker (Pl. xli., figs.3-4).—Cotyledons resemble those of *E acmenioides*, but are a little smaller. The first pair of leaves generally shortly petiolate, the next and following being sessile and cordate at base and ovate-lanceolate, broader than in *E. acmenioides*, the venation also being pinnate, parallel, and less oblique.

E. carnea R. T. Baker (Pl. lvii., fig.2).—This seedling closely resembles *E. umbra*, but the cotyledons are smaller, and the emargination very slight. The first pair of leaves has petioles

0·3 cm. long, the second pair subsessile, and the following leaves closely resembling those of *E. umbra.*

E. Risdoni Hook. f.(Pl.lx., fig.1).—Cotyledons obtusely quadrilateral, slightly emarginate, cuneate at base, 0·4 × 0·35, petiole 0·3 cm. Leaves opposite, decussate, sessile, obtuse, ovate, then triangular with cordate base, glabrous, entire. First pr. 1·8 × 0·9, second 2·5 × 1·8, third 2 × 1·2 cm. Leaves and cotyledons purplish beneath. First internode 1, second 1·2, third 1·3 cm. Stem terete, glabrous, purplish. This seedling is strikingly dissimilar to that of *E. amygdalina*, with which it was synonymised by Mueller. The primary broad ovate then triangular leaves are entirely different from those of *E. amygdalina.*

E. linearis A. Cunn.(Pl. lx., fig.5).—Cotyledons triangular, slightly emarginate, cuneate at base, 0·45 × 0·45, petiole 0·4 cm. long, deep purple on under side. Leaves opposite, decussate, subsessile, lanceolate, obtuse. First pr. 1·5 × 0·45, second 2·5 × 0·6, third 2·6 × 0·5 cm. First internode 0·5, second 1, third 1·2 cm. Stem and under sides of leaves are purplish. The cotyledons of this species are quite distinct from those of *E. amygdalina* (Tasmanian form), being larger and triangular, and the emargination more distinct. The primary leaves of both are much alike.

E. phlebophylla F.v.M. (Pl. lxiv., fig.3).—Cotyledons obtusely quadrilateral, slightly emarginate, 0·6 × 0·5, petiole 0·4 cm. Leaves opposite, lanceolate, subacute, shortly petiolate for three pairs, then sessile, lateral veins oblique, glabrous. First pr. 1·1 × 0·4, sessile; second pr. 1·3 × 0·5, petiole 0·3; third 1·8 × 0·8, petiole 0·25; fourth 2·5 × 1·1 cm., sessile. First internode, 0·5, second 0·4, third 0·4, fourth 0·6 cm. Stem terete, glabrous, reddish.

This species has been synonymised with *E. coriacea*, but the seedlings are very distinct, the former having larger cotyledons, and the primary leaves lanceolate instead of oval. The internodes are also shorter, the leaves being thus more crowded. I must, therefore, disagree with the placing of them under the one species by Mueller and Maiden.

E. hæmastoma Sm.(Pl. lvii., fig.3).—Cotyledons obtusely quadrilateral, slightly emarginate, glabrous, deep purple beneath, 0·5 × 0·3, petiole 0·5 cm. long. Leaves lanceolate, tapering at base, opposite, decussate, obtuse, petiolate then sessile, glabrous, purplish on under sides. First pr. 2·5 × 0·7, petiole 0·5; second 5 × 2, subsessile; third 5 × 2 cm., sessile. Lateral veins parallel, oblique. First internode 0·6, second 1, third 3 cm. Stem terete, glabrous.

E. stricta Sieb. (Pl. liv., fig.5). –Cotyledons almost orbicular, emargination slight or none, 0·5 × 0·4, petiole 0·4 cm., deep purple beneath. Leaves opposite, lanceolate, obtuse, entire, glabrous, shortly petiolate then subsessile, purplish beneath, venation oblique, pinnate. First pr. 2·2 × 0·9, petiole 0·3; second 3·3 × 1·1, petiole 2 cm. First internode 0·6, second 1, third 0·8 cm.

E. Rossii R. T. Baker and H. G. Smith (Pl. xlviii., fig.6).—Cotyledons closely resembling those of *E. stricta*, and are slightly emarginate, and broader than in that species. Leaves lanceolate and petiolate, then oval or ovate and subsessile, obtuse, opposite, entire, glabrous, venation somewhat oblique, tinged red on under sides. First pr. 1·5 × 0·6, petiole 0·3; second 2·4 × 1·2 cm., subsessile. First internode 0·6, second 1·1, third 1·1 cm.

Messrs. Baker and Smith class *E. Rossii* with the eucalyptol-pinene group, and *E. stricta* with the eucalyptol-pinene-aromadendral group, the members of which, as a rule, have parallel anthers, while these have reniform anthers. The seedlings explain the seeming anomaly, as these species are now shown to have great affinity to the "Peppermint" group, and, apart from their chemical composition, should be placed therein.

E. striaticalyx (Pl. lv., fig.3).—Hypocotyl terete, glabrous, reddish, 1·5 cm. long. Cotyledons obtusely quadrilateral, glabrous, purplish on under sides, 0·6 × 0·5, petiole 0·5 cm. Leaves entire, glabrous, opposite, obtuse, petiolate, ovate-lanceolate or ovate. First pr. 1·2 × 0·5, petiole 0·6; second 2 × 1, petiole 0·6 cm. First internode 0·6, second 0·9, third 1·7 cm. Stem terete, glabrous. Though the cotyledons are of the same form, the leaves are different from those of the others of the group.

E. piperita Sm. (Pl. lx., fig.3; Pl. lxix., fig.9).—Cotyledons obtusely oblong, slightly emarginate, purplish on under sides, 0·6 × 0·5, petiole 0·2 cm. Leaves opposite, ovate-lanceolate, obtuse, petiolate then sessile, glabrous, entire. First pr. 1·3 × 0·6, petiole

0·3; second 2·5 × 1, subsessile; third 3·3 × 1 cm., sessile. Leaves have slight reddish tinge underneath. First internode 1, second 0·6, third 1·3, fourth 2·5 cm.

E. amygdalina Labill.—Before seeing the remarks of Messrs. Baker & Smith, in their "Eucalypts of Tasmania," on this species, I had been puzzled by the marked difference between the seedlings of the Tasmanian *E. amygdalina* and those of the mainland. This was explained in the light of the knowledge of the oils and morphology of the two.

E. amygdalina (Hobart, Tas.) (Pl. lxi., fig.4; Pl. lxii, fig.2).—Cotyledons small, obtusely quadrilateral. emargination slight or absent, 0·3 × 0·25, petiole 0·3 cm. Leaves opposite, as far as seen, narrow-lanceolate, tapering at both ends, subacute, sessile or subsessile, edges sometimes waved, a few stellate hairs on midrib. First pr. 0·8 × 0·25, second 1·1 × 0·3, third 1·3 × 0·3, fourth 1·8 × 0·3 cm. First internode 0·3, second 0·6, third 0·8, fourth 1 cm. Stem purplish, terete, covered with glandular hairs.

E. amygdalina (Yarra Junction, Vic.) (Pl. lxii., fig.1; Pl. lxix., fig.11).—In this, the cotyledons are larger, the emargination more pronounced, and the leaves opposite but much broader, ovate-lanceolate, obtuse, cordate at base, glabrous. The stem is also glabrous. In *E. amygdalina* from Laurel Hill, N.S.W., the primary leaves are of the same character, but not so broad.

E. coccifera Hook. f. (Pl. lx., fig.2).—The seedlings of this species are very characteristic, and the dried specimen makes a beautiful object when mounted. Cotyledons obtusely quadrilateral, cuneate at base, slightly emarginate, 0·5 × 0·4, petiole 0·3 cm. Leaves entire, opposite, glabrous, oval, obtuse, sessile, petioles at first scabrous. First pr. 1 × 0·7, second 1·4 × 1, third 2·1 × 1·2 cm. Stem terete, scabrous; stem and under sides of cotyledons and leaves deep purplish-red.

E. Luehmanniana F.v.M. (Pl. lxii., fig. 3; Pl. lxix., fig. 10).—Cotyledons obtusely quadrilateral, slightly emarginate, cuneate at base, 0·6 × 0·5, petiole 0·5 cm. Leaves opposite, entire, glabrous, broadly lanceolate, tapering at base, obtuse, venation fairly oblique, intramarginal vein away from edge, and showing the characteristic looping arrangement, such as is met with in this group. First pr. 1·8 × 0·8, petiole 0·4; second 2·5 × 1·1, petiole 0·3; third 3·6 × 2, petiole 0·4 cm. Stem terete, glabrous. Stem and undersides of leaves and cotyledons deep purple.

E. oreades R. T. Baker (Pl. xlii., fig.4).—The cotyledons are almost identical with those of *E. Luehmanniana.* The leaves are similar, but are larger, broader, and more ovate than in that species. In both, the leaves are shortly petiolate.

E. Sieberiana F.v.M. (Pl. lxii., fig.5).—The cotyledons are also very like those of *E. Luehmanniana.* The leaves are ovate-lanceolate, obtuse, opposite, large, first pair shortly petiolate then sessile, tapering to base. Venation as in *E. Luehmanniana.*

The above three species resemble one another closely, and are hard to distinguish. *E. Luehmanniana* has smaller petiolate leaves. In *E. oreades*, the leaves are very large and petiolate; in *E. Sieberiana*, the leaves, from the second pair, are sessile.

E. Delegatensis R. T. Baker (Pl. lxiii., fig.2).—Cotyledons resemble those of *E. Luehmanniana*, but are smaller, not so cuneate at base, emargination practically absent. Leaves of same type as in *E. oreades* and petiolate.

E. campanulata R. T. Baker (Pl. lx., fig.6).—Cotyledons obtusely quadrilateral, slightly emarginate, 0·45 × 0·4, petiole 0·25 cm. Leaves opposite, ovate, obtuse, petiolate, glabrous. Stem and under sides of leaves and cotyledons deep purplish-red.

E. Andrewsi Maiden (Pl. lxiv., fig.2).—Cotyledons resemble those of *E. campanulata.* Leaves opposite, entire, glabrous, petiolate, broadly lanceolate, obtuse, not so deeply coloured beneath as in *E. campanulata.* Messrs. Baker & Smith (Journ. Proc. Roy. Soc. N. S. Wales, Vol. xlv.) consider this a northern form of *E. dives* inasmuch as the fruits, oils, timber, and bark are identical. "It seems now that the only difference, so far, is that no sessile cordate sucker-leaves have been found in connection with *E. Andrewsi.* Mr. Cambage informs us that the seedlings of these two trees are different." My results confirm Mr. Cambage's view. The cotyledons of *E. Andrewsi* are much larger than those of *E. dives*, and the leaves are broadly lanceolate and petiolate, while those of the latter are sessile, ovate and cordate.

E. tæniola Baker & Smith (Pl. lxviii., fig. 2).—Cotyledons obtusely quadrilateral, slightly emarginate, 0·45 × 0·4, petiole 0·3 cm. Leaves opposite, entire, lanceolate, obtuse, then narrowly lanceolate and acute, subsessile, then sessile, lateral veins oblique and looped with the intramarginal vein, which is away from the edge. Stem and under surface of leaves and cotyledons purplish-red. This seedling is very like that of *E. amygdalina*, but quite different from that of *E. virgata*, with its broad, primary leaves.

E. coriacea A. Cunn. (Pl. lxiii., fig. 1).—Cotyledons smaller than in most of its congeners, obtusely quadrilateral, not stained on under sides, emargination almost absent, 0·4 × 0·3, petiole 0·3 cm. Leaves opposite, entire, glabrous, ovate or oval, obtuse, shortly petiolate, lateral veins oblique, looped. First pr. 1·2 × 0·7, petiole 0·3; second 2·5 × 1·4, petiole 0·3; third 2·8 × 1·5, petiole 0·2 cm. First internode 0·9, second 1·5, third 1·6 cm. Leaves paler than usual in this class, stem glabrous, green. I would again draw attention to the distinct differences in the seedlings of this and *E. phlebophylla*.

E. dives Schau. (Pl. lxiii., fig. 4).—Cotyledons small but obtusely quadrilateral, not coloured on under sides, emargination very slight, lamina 0·3 × 0·25, petiole 0·25 cm. Leaves opposite, entire, ovate, obtuse, sessile, glabrous, venation well marked, lateral veins oblique and looped, intramarginal veins away from edge. First pr. 1·1 × 0·5, subsessile; second 2 × 0·9; third 2·5 × 1·2 cm. Stem terete, glabrous, reddish. First internode 0·7, second 1·1, third 2, fourth 2 cm.

E. radiata Sieb. (Pl. lxiv., fig. 4).—Cotyledons obtusely oblong, slightly emarginate, 0·4 × 0·2, petiole 0·2 cm. Leaves opposite, lanceolate then ovate, subsessile then sessile, obtuse, glabrous, venation oblique, intramarginal vein looped and away from edge. Under surfaces of leaves and cotyledons not stained. First pr. 1 × 0·3, petiole 0·2; second 1·6 × 0·5, third 1·8 × 0·7 cm. Stem terete, glabrous, greenish. From what I have seen of the seedlings, I quite agree with those who separate *E. radiata* from *E. amygdalina*. In the former, we have more oblong, narrower cotyledons, and the first leaves are more ovate and shorter, also subsessile for the first few pairs.

E. apiculata Baker & Smith (Pl. lxv., fig.2).—Cotyledons obtusely quadrilateral, slightly emarginate, purplish-red underneath, lamina 0·5 × 0·4, petiole 0·4 cm. Leaves opposite, entire, glabrous, lanceolate, subacute, tapering at base, shortly petiolate. First pr. 1·8 × 0·5, second 2·5 × 0·7 cm. First internode 0·7, second 0·6 cm.

This species has been confused with *E. stricta*, but although the cotyledons are almost identical, the primary leaves differ, those of *E. apiculata* being narrower and more pointed, also tapering at base. This, then, confirms the analysis of the oils. Attention must also be drawn to the difference in the anthers, *E. apiculata* in this respect varying from the rule in this group.

E. virgata Sieb., (St. Mary's, Tas.) [Pl. lxv., fig.3].—Hypocotyl short, 0·5 cm. Cotyledons obtusely quadrilateral, emargination almost absent, lamina 0·45 × 0·4, petiole 0·4 cm. Leaves opposite, sessile, ovate-lanceolate, obtuse, entire, glabrous, lateral veins oblique and forming a looped arrangement with the intramarginal vein, which is removed from the edge. First 1·1 × 0·5 cm., shortly petiolate; second 2·1 × 0·9, third 3·6 × 1·2 cm. First internode 0·4, second 0·3, third 0·9, fourth 1·5 cm. The first internodes are very short, and, consequently, the leaves are crowded together. Cotyledons and first leaves are stained a deep blackish-purple.

Much controversy has occurred over this species, and as to whether it is identical with *E. Sieberiana* or not. The seedlings, however, are very distinct, the cotyledons of *E. virgata* being smaller and different in shape, and the leaves smaller, narrower, and more obtuse.

E. obtusiflora DC. (Pl. lxv., fig.5).—Cotyledons resemble those of *E. Sieberiana*, but are slightly smaller. Leaves opposite, entire, glabrous, lanceolate, obtuse, tapering into a short petiole. First pr. 2·8 × 0·8, second 3·8 × 1·1 cm. Lateral veins oblique, looped. First internode 1·2, second 1·2 cm. Cotyledons and leaves only slightly stained purplish-red on under sides.

E. stellulata Sieb. (Pl. lxiv., fig.7).—Cotyledons obtusely quadrilateral, very slightly emarginate, 0·2 × 0·15, petiole 0·15 cm. Leaves opposite, entire, glabrous, ovate, obtuse, shortly petiolate, then sessile, glaucous, lateral veins oblique, looped with intramarginal vein.

ii.(c^1). Eucalypts with cotyledons obtusely oblong, slightly emarginate; sometimes slightly lobed.

This and the next two groups are the most difficult to differentiate. It is at most a tentative classification, but was done in default of any other. The forms and relations of the Eucalypts with small cotyledons are many, and they merge so into one another, that it is quite possible, in the light of further knowledge, these groups will have to be altogether recast. They comprise the "Ironbarks" and "Boxes" with anthers opening in pores, also most of the "Parallelantheræ" whose anthers are parallel. Most of the eucalyptol-pinene species come in these groups, also many of those containing aromadendral. A few of the eucalyptol-pinene-phellandrene species are also included, but the piperitone-phellandrene and piperitone-phellandrene-eucalyptol oils are not represented. I have kept the "Ironbarks" together, for purposes of comparison.

E. botryoides Sm.(Pl. xlii., fig. 2).—Cotyledons obtusely oblong, emarginate, 0·55 × 0·2, petiole 0·4 cm. Leaves opposite for first three pairs, then alternate, entire, glabrous, lanceolate, obtuse, petiolate, venation somewhat oblique, drying pale green. First pr. 1·1 × 0·5, petiole 0·3; second 2·5 × 0·7, petiole 0·5; third 3·5 × 1, petiole 0·5 cm. Stem terete, glabrous. First internode 0·6, second 0·6, third 1·5 cm.

E. saligna Sm. (Pl. xlii., fig. 3).—Cotyledons smaller and lobes at a more acute angle than in *E. botryoides*, hence the emargination is deeper, lamina 0·45 × 0·18, petiole 0·3 cm. Leaves opposite, tending soon to alternate, glabrous, petiolate, lanceolate, obtuse, venation obscure, leaves dark green. First pr. 0·6 × 0·2, petiole 0·3; second 1·5 × 0·3, petiole 0·5; third 1·8 × 0·6, petiole 0·5 cm. Stem terete, glabrous. First internode 0·6, second 1·2, third 1, fourth 1·2 cm.

E. robusta Sm. (Pl. xlii., fig 4).—Cotyledons of same form but smaller than in *E. saligna*, lamina 0·3 × 0·15, petiole 0·2 cm. Leaves opposite, entire, glabrous, dark green, obtuse, lanceolate, petiolate, venation obscure, somewhat oblique. First pr. 1 × 0·15, petiole 0·3; second 1·2 × 0·4, petiole 0·5; third 2·5 × 0·9, petiole 0·6; fourth 3·3 × 1·2, petiole 0·6 cm. Stem terete, glabrous. First internode 0·7, second 0·8, third 1·2, fourth 1·5 cm.

The above three species chemically belong to the pinene group, in which *E. corymbosa* and the other "Bloodwoods" are placed. But, botanically, they have always been considered a great deal removed from the Bloodwoods. The seedlings bear this out. As the fruits should indicate beforehand, the cotyledons are small and emarginate, and the leaves are petiolate and glabrous. Stem glabrous.

E. diversicolor F.v M. (Pl. xlii., fig.6).—Cotyledons obtusely oblong, emargination almost or quite absent, lamina 0·45 × 0·3, petiole 0·3 cm. Leaves lanceolate then ovate, petiolate for first two pairs then sessile, pale, obtuse, opposite, entire, glabrous. First pr. 0·8 × 0·25, petiole 0·2; second 1·2 × 0·5, petiole 0·15; third 2·5 × 0·8; fourth 2·2 × 1·5 cm. First internode 0·9, second 1·1, third 1·1, fourth 1 cm. Stem glabrous, terete.

E. Baeuerleni F.v.M. (Pl. xliii., fig.6).—Cotyledons obtusely quadrilateral, slightly emarginate, asymmetrical, lamina 0·6 × 0·3, petiole 0·3 cm. Leaves petiolate, then sessile from the third pair, opposite, subacute, glabrous. First pr. 0·8 × 0·15, petiole 0·2 cm; second 1·2 × 0·3, petiole 0·15; third 1·4 × 0·5 cm. First internode 0·6, second 0·7, third 0·6 cm. Stem terete, glabrous.

E. propinqua Deane & Maiden (Pl. xliii., fig.4).—Cotyledons slightly emarginate, 0·4 × 0·2, petiole 0·3 cm. Leaves opposite, entire, glabrous, lanceolate, subacute, petiolate. First pr. 0·9 × 0·25, petiole 0·2; second 1·2 × 0·3, petiole 0·4; third 1·4 × 0·3, petiole 0·5 cm. First internode 1, second 0·6, third 0·6, fourth 0·6 cm. Stem terete, glabrous.

E. microcorys F.v.M. (Pl. xliii., fig.3; Pl. lxix., fig.12).—Cotyledons 0·5 × 0·3, petiole 0·25 cm., slightly emarginate. Leaves opposite, entire, glabrous, lanceolate, acute. First pr. 0·8 × 0·3, petiole 0·3; second 1 × 0·5, petiole 0·6; third 1·4 × 0·6, petiole 0·7 cm. First internode 1, second 0·8, third 1·1 cm. Stem terete, glabrous.

In some respects, this might be put among the "Peppermints," but, on the whole, I prefer it here. One should note, however, that the anthers are reniform.

E. paniculata Sm. (Pl. xliv., fig.2).—Cotyledons small, obtusely oblong, slightly emarginate, 0·3 × 0·15, petiole 0·2 cm. Leaves opposite, entire, glabrous, lanceolate, then ovate, obtuse, petiolate, venation parallel, oblique. First pair of leaves 1 × 0·25, petiole 0·3; second 1·8 × 0·8, petiole 0·5; third 2·8 × 1·4, petiole 0·5 cm. First internode 0·7, second 0·6, third 1·2, fourth 2·2 cm. Stem terete, glabrous.

E. crebra F.v M. (Pl. lxi., fig.1). Cotyledons like those of *E. paniculata* and emarginate. Leaves opposite but soon alternate, lanceolate, petiolate, subacute then obtuse, glabrous. First pr. 1 × 0·15, petiole 0·4; second 1·8 × 0·6, petiole 0·6; third 3·2 × 0·9, petiole 0·6 cm. First internode 0·7, second 1·4, third 2·5 cm. Stem terete, glabrous.

E. siderophloia Benth. (Pl. lxi., fig.3) —Cotyledons larger than in the other "Ironbarks," 0·6 × 0·3, petiole 0·2 cm., emarginate. Leaves opposite, entire, glabrous, lanceolate then ovate, obtuse, petiolate, venation oblique. First pr. 1 × 0·3, petiole 0·3; second 1·7 × 1, petiole 0·4; third 3·6 × 1·7, petiole 0·4 cm. First internode 1, second 1, third 1·4, fourth 1·8 cm. Stem terete, glabrous.

E. melanophloia F.v.M. (Pl. lxi., fig.2).—Cotyledons 0·5 × 0·3, petiole 0·25, slightly emarginate, asymmetrical. Leaves lanceolate, obtuse, opposite, entire, glabrous, shortly petiolate. First pr. 1 × 0·3, petiole 0·15; second 1·5 × 0·45, petiole 0·25; third 1·8 × 0·55, petiole 0·3 cm. First internode 1, second 1, third 1·4, fourth 1·8 cm. Stem terete, glabrous.

E. sideroxylon A. Cunn. (Pl. xlviii., fig.5).—Cotyledons 0·4 × 0·25, petiole 0·25 cm., slightly emarginate. Leaves lanceolate, then ovate-lanceolate, obtuse, glabrous, entire, petiolate. First pr. 0·8 × 0·3, petiole 0·2; second 1·3 × 0·6, petiole 0·5; third 1·9 × 1, petiole 0·5 cm. First internode 0·8, second 0·6, third 1·2 cm. Stem terete, glabrous. The seedlings of the "Ironbarks" bear a general family resemblance to one another. The cotyledons are all fairly small and oblong, and slightly emarginate. The leaves are petiolate, those of *E. melanophloia* having the shortest petioles; those of *E. crebra* and *E. sideroxylon* are lanceolate, while those of *E. siderophloia* and *E. paniculata* are ovate.

E. hemiphloia F.v.M. (Pl. lvi., fig.5).—Cotyledons obreniform, petiolate, slightly emarginate, 0·5 × 0·3, petiole 0·4 cm. Leaves lanceolate then ovate, subacute, entire, opposite, glabrous. First pr. 1·2 × 0·3, petiole 0·4; second 1·9 × 0·6, petiole 0·3; third 3 × 0·9, petiole 0·5 cm. First internode 1·2, second 1·2, third 1·8, fourth 2 cm. Stem terete, glabrous.

E. albens Miq.(Pl. lvi., fig.4).—Cotyledons slightly smaller than in *E. hemiphloia*, slightly emarginate. Leaves entire, opposite, glabrous, lanceolate then ovate, petiolate, obtuse. First pair 1 × 0·3, petiole 0·3; second 1·8 × 0·9, petiole 0·5; third 2 × 1·1, petiole 0·5 cm. First internode 0·7, second 0·9, third 1 cm. Stem terete, glabrous. These two "Boxes" may be distinguished by the larger cotyledons of *E. hemiphloia*, and its leaves are narrower than those of *E. albens*.

E. fasciculosa F.v.M. (Pl. li., fig. 3).—Cotyledons obtusely oblong, slightly emarginate, 0·5 × 0·3, petiole 0·3 cm. Leaves opposite, entire, then margins slightly serrate, lanceolate, subacute, glabrous, petiolate then subpetiolate, lateral veins oblique, parallel. First pr. 0·9 × 0·25, petiole 0·3; second 1·2 × 0·5, petiole 0·3; third 1·8 × 0·7; fourth 2·7 × 1 cm. First internode 0·6, second 0·9, third 0·9, fourth 1·1 cm.

E. Muelleri T. B. Moore (Pl. li., fig.5).—Cotyledons resemble those of *E. fasciculosa*. Leaves entire, opposite, glabrous, lanceolate, obtuse, shortly petiolate. Leaves and cotyledons deep purplish-red on under sides.

E. resinifera Sm. (Pl. xlv., fig.3; Pl. lxix., fig.13).—Cotyledons obreniform, emarginate, 0·45 × 0·25, petiole 0·25 cm. Leaves opposite, entire, obtuse, lanceolate, glabrous, petiolate, light green. First pr. 1·1 × 0·25, petiole 0·5; second 2 × 0·5, petiole 0·5; third 3·6 × 0·7, petiole 0·5 cm. First internode 0·7, second 0·6, third 1, fourth 1·2 cm. Stem terete, glabrous.

E. punctata DC. (Pl. xlvi., fig.4).—Cotyledons resemble those of *E. resinifera*. Leaves entire, opposite, lanceolate, obtuse, petiolate, glabrous. First pr. 0·9 × 0·25, petiole 0·25; second 1·6 × 0·6, petiole 0·5; third 3 × 0·9, petiole 0·6 cm. First internode 0·7, second 0·6, third 1·2, fourth 0·8 cm. Stem terete, glabrous.

E. longifolia Link & Otto(Pl. xlvii., fig.4).—Cotyledons and leaves closely resemble those of *E. resinifera*, but, in the former, the leaves are more obtuse and the petioles longer.

E. saligna var. *pallidivalvis* R. T. Baker(Pl. lv., fig.8).—Cotyledons obreniform, emarginate, 0·5 × 0·25, petiole 0·3 cm. Leaves opposite, entire, lanceolate, obtuse, glabrous. First pr. 0·8 × 0·3, petiole 0·2; second 0·9 × 0·35, petiole 0·25; third 1·2 × 0·5, petiole 0·25 cm. First internode 0·6, second 0·6, third 0·3 cm. Stem terete, glabrous.

This seedling is quite distinct from that of *E. saligna*, the leaves being broader and shorter, and the internodes shorter. The cotyledons are alike, and this would account for the fruits being so much of the same form.

E. leucoxylon F.v.M.(Pl. lxvii., fig.5).—This seedling has been described by Lubbock, but seedlings grown from *E. leucoxylon*, Dimboola, Victoria, sent me by Mr. Baker, do not tally with Lubbock's description. In these, the cotyledons are transversely oblong, obtuse, petiolate, margin truncate or slightly emarginate, lamina 0·5 × 0·35, petiole 0·3 cm. Leaves entire, opposite, glabrous, slightly glaucous, ovate-lanceolate then ovate, cordate at base, obtuse, first two pairs subsessile, then sessile. First pr. 0·7 × 0·4, second 1·5 × 0·9, third 1·9 × 1·1 cm. First internode 1, second 1·3, third 2·5, fourth 3·5 cm. Stem terete, glabrous.

E. patentinervis R. T. Baker(Pl. lxiv., fig.6).—Cotyledons transversely oblong, obtuse, slightly emarginate, sometimes asymmetrical, 0·5 × 0·25, petiole 0·3 cm. Leaves entire, opposite, soon alternate, glabrous, lanceolate, subacute, petiolate. First pr. 1 × 0·3, petiole 0·3; second 1·3 × 0·45, petiole 0·3 cm. First internode 1·2, second 1·5, third 1·1 cm. Stem terete, glabrous.

E. sp. nov., R. T. Baker(Pl. l., fig.4).—Cotyledons resemble those of *E. leucoxylon*, but are purple underneath. Leaves opposite, soon alternate, lanceolate, obtuse, petiolate, edges serrate, veins oblique and parallel. First pr. 1·2 × 0·5, petiole 0·6; second 2·3 × 0·8, petiole 0·6; third 2·8 × 1·1, petiole 0·5 cm. First internode 1·2, second 1·3 cm. Stem slightly scabrous.

E. viminalis Labill. (Pl. lviii., fig.1).—Cotyledons transversely oblong, obtuse, truncate rarely, slightly emarginate, cordate at base, 0·5 × 0·25, petiole 0·25 cm. Leaves opposite, entire, glabrous, lanceolate then ovate-lanceolate, obtuse, sessile. First pr. 1 × 0·3, petiole 0·15 ; second 1·4 × 0·6 ; third 2·5 × 0·8 ; fourth 3 × 1·1 cm. First internode 1, second 1·2, third 1·5, fourth 1·5 cm. Stem terete, glabrous.

E. Smithii R. T. Baker (Pl. xlvii., fig.5).—Cotyledons transversely oblong, obtuse, emarginate, 0·6 × 0·25, petiole 0·4 cm. Leaves opposite, entire, glabrous, lanceolate then ovate-lanceolate, obtuse, sessile, cordate at base. First pr. 1·6 × 0·3, tapering at base; second 2·2 × 1·5, third 2·5 × 1·7 cm. First internode 0·7, second 1·2, third 2·4, fourth 3 cm. Stem terete, glabrous.

E. cinerea F.v.M. (Pl. xlvii., fig. 3).—Cotyledons transversely oblong, obtuse, slightly emarginate, 0·4 × 0·2, petiole 0·2 cm. Leaves opposite, entire, glabrous, glaucous, lanceolate and shortly petiolate for two pairs, then ovate, cordate, obtuse, venation oblique. First pair 0·7 × 0·2, second 1·5 × 0·6, third 1·8 × 1·1, fourth 1·9 × 1·3 cm. First internode 1, second 1·3, third 1·8, fourth 1·8 cm. Stem terete, glabrous.

E. Gunnii Hook.f.(Pl. lx., fig.4).—Cotyledons transversely oblong, obtuse, very slightly emarginate, 0·4 × 0·2, petiole 0·2 cm. Leaves opposite, entire, glabrous, glaucous, ovate or orbicular, obtuse, sessile, cordate. First pr. 0·4 × 0·2, second 0·6 × 0·3, third 0·8 × 0·5, fourth 1·2 × 0·8 cm. Stem terete, glabrous.

E. Perriniana F.v.M.(Pl. lii., fig.2).—Cotyledons as in *E. Gunnii*, but more cordate at base, very slightly emarginate. Leaves opposite, sessile, ovate, obtuse, cordate at base, stem-clasping then after 4-5 pairs perfoliate, glaucous. First pr. 1 × 0·4, second 1·7 × 1·1, third 1·5 × 1 cm. Stem terete, glabrous.

E. paludosa R. T. Baker (Pl. xliv., fig. 4).—Cotyledons transversely oblong, obtuse, slightly emarginate, 0·35 × 0·2, petiole 0·2 cm. Leaves opposite, entire, glabrous, lanceolate, petiolate then sessile.

E. lactea R. T. Baker(Pl. xliv., fig.5).—Cotyledons as in *E paludosa*. Leaves opposite, glabrous, entire, subsessile then sessile.

E. Stuartiana F.v.M.(Pl. xlix., fig.1; Pl. lxix., fig.14).—Cotyledons transversely oblong, obtuse, 0·45 × 0·15, petiole 0·2 cm. Leaves opposite, entire, glabrous, glaucous, ovate, cordate, obtuse. First pr. 0·9 × 0·3, petiole 0·15; second 1·5 × 0·9, third 1·5 × 1·1 cm. Stem terete, glabrous as far as grown. First internode 0·9, second 1, third 1, fourth 1 cm.

E. melliodora A. Cunn.(Pl. lvi., fig.1).—Cotyledons transversely oblong, obtuse, petiolate, slightly emarginate. Leaves alternate after first pair, glabrous, entire, lanceolate, obtuse then subacute, petiolate.

E. acervula Sieb.(Pl. lxvi., fig.4).—Cotyledons transversely quadrilateral, obtuse, slightly emarginate, 0·4 × 0·2, petiole 0·2 cm., base somewhat cordate. Leaves opposite, entire, glabrous, lanceolate, obtuse, shortly petiolate for first few pairs, not glaucous. First pr. 1·1 × 0·5, petiole 0·2; second 1·8 × 0·6, petiole 0·2 cm. Stem terete, glabrous. First internode 0·7, second 0·8 cm.

This specimen resembles, in the seedling, that of *E. paludosa*, but the cotyledons are smaller, and the leaves narrower. From that of *E. Gunnii*, it is quite distinct, its primary leaves not being at all like the sessile, ovate, glaucous ones of that species.

ii.(*d*). Eucalypts with very small cotyledons, transversely oblong or triangular, with slight or no emargination.

This group shades off from the previous one, and, in many cases, it is hard to put a species in one or the other. Practically all contain eucalyptol in a greater or less amount, many contain pinene, and others aromadendral and phellandrene. Piperitone is absent. In this class, the cotyledons have been reduced to their smallest dimensions, in contrast to the relatively enormous cotyledons of *E. calophylla*. The reason for this will be discussed later.

E. nova-anglica Deane & Maiden(Pl. xlii., fig.5).—Cotyledons very small, transversely oblong, petiolate. Leaves entire, opposite, glabrous, glaucous, lanceolate and shortly petiolate, then ovate, sessile, cordate, obtuse. First pr. 0·5 × 0·15, petiole 0·2; second 1·2 × 0·4, petiole 0·2; third 1·7 × 0·8 cm, sessile. First internode 0·7, second 1·2, third 1·1 cm. Stem terete, glabrous.

This species is interesting in that, although the oil contains only pinene, in that respect being only of the primitive type, and so allied to the *Corymbosa*-group, yet the cotyledons, leaves, and fruit are of the higher type.

E. Fletcheri R. T. Baker(Pl. lix., fig.4 .—Cotyledons small, transversely oblong, emargination slight or none. Leaves opposite, entire, glabrous, petiolate, lanceolate, obtuse. Mr. Baker has pointed out that this is distinct from *E. polyanthema*. The seedling confirms this, as the latter has bifid cotyledons.

E. Bosistoana F.v.M.(Pl. lxvii., fig.2).—Cotyledons small, obtusely oblong, slightly emarginate, often asymmetrical. Leaves opposite, soon alternate, entire, glabrous, lanceolate, petiolate, obtuse. First pr. 0·6 × 0·2, petiole 0·3; second 1·6 × 0·8, petiole 0·7; third 3 × 1·2, petiole 0·9 cm. First internode 0·3, second 0·5, third 0·7 cm. Stem terete, glabrous.

E. intertexta R. T. Baker(Pl. xliv., fig.3).—Cotyledons as in *E. Fletcheri*. Leaves opposite, entire, glabrous, narrow-lanceolate, acute, petiolate. Stem terete, glabrous.

E. conica Deane & Maiden(Pl. xliv., fig.6).—Cotyledons very small, triangular, emargination practically absent, petiolate. Leaves opposite, entire, glabrous, lanceolate, petiolate, obtuse. Stem glabrous, terete.

E. dealbata A. Cunn.(Pl. xlvi., fig.1).—Cotyledons small, obtusely oblong, slightly emarginate, petiolate. Leaves opposite, entire, glabrous, lanceolate, obtuse, petiolate. First pr. 0·9 × 0·25, petiole 0·2; second 1·8 × 0·7, petiole 0·3; third 2·5 × 0·7, petiole 0·25 cm. First internode 0·5, second 0·5, third 0·7 cm. Stem terete, glabrous.

E. tereticornis var. *linearis* R. T. Baker(Pl. xlvi., fig.2).—Cotyledons very small, transversely oblong, emarginate. Leaves opposite, entire, glabrous, narrow-lanceolate, subacute, shortly petiolate.

E. maculosa R. T. Baker (Pl. xlvi., fig. 3).—Cotyledons small, transversely oblong, obtuse, emargination almost absent, lamina 0·3 × 0·15, petiole 0·15 cm. Leaves opposite, entire, glabrous, narrow-lanceolate, tapering into a short petiole, subacute. Stem terete, glabrous.

E. Macarthuri Deane & Maiden(Pl. lxiv., fig.5).—Cotyledons transversely oblong, obtuse, emargination almost absent, 0·35 × 0·15, petiole 0·15 cm. Leaves opposite, entire, glabrous, lanceolate then ovate-lanceolate, then ovate and cordate, obtuse.

E. rostrata Schlecht.(Pl. lviii., fig.2).—Cotyledons small, transversely oblong, emargination almost absent. Leaves entire, opposite, soon alternate, lanceolate, obtuse, petiolate, glabrous.

E. ovalifolia R. T. Baker(Pl. lviii., fig.3).—Cotyledons very small, transversely oblong, shortly petiolate. Leaves opposite, entire, glabrous, petiolate, lanceolate then ovate, obtuse.

E. odorata Behr (Pl. lv., fig.5).—Cotyledons transversely oblong, obtuse, emargination almost absent. Leaves opposite, entire, glabrous, lanceolate, petiolate, acute. First pr. 0·7 × 0·25, petiole 0·2; second 1 × 0·4, petiole 0·3; third 1·5 × 0·6, petiole 0·4 cm. First internode 0·7, second 1·2, third 1·3 cm. Stem terete, glabrous.

E. Behriana F.v.M.(Pl. xlv., fig.4).—Cotyledons small, transversely oblong or triangular, petiolate, emargination slight or absent. Leaves opposite, entire, glabrous, lanceolate then ovate-lanceolate, obtuse, petiolate, lateral veins oblique.

E. sp.nov., R. T. Baker(Pl. liv., fig.4).—Cotyledons very small, of same form as *E. Behriana*. Leaves entire, opposite, lanceolate, obtuse, petiolate, glabrous. First pr. 0·25 × 0·5, petiole 0·15; second 0·35 × 0·1, petiole 0·2; third 0·6 × 0·2, petiole 0·25; fourth 0·5 × 0·3, petiole 0·3 cm. First internode 0·4, second 0·3, third 0·4, fourth 0·4. Stem terete, glabrous.

E. polybractea R. T. Baker(Pl. liii., fig.3).—Cotyledons resemble those of *E. Behriana*. Leaves opposite, entire, glabrous, narrow-lanceolate, subacute, petiolate. First pr. 0·4 × 0·05, petiole 0·2; second 0·9 × 0·15, petiole 0·3; third 1·2 × 0·3, petiole 0·3; fourth 2 × 0·3, petiole 0·3 cm. First internode 0·6, second 0·7, third 0·8, fourth 1 cm. Stem terete, glabrous. The cotyledons easily distinguish this species from most of the other "Mallees," as *E. dumosa*, *E. cneorifolia*, *E. oleosa*, etc.

E. viridis R. T. Baker(Pl. lvi., fig.2).—Cotyledons very small, of same shape as *E. Behriana*, but much smaller. Leaves entire, opposite, glabrous, linear-lanceolate, petiolate, subacute. First pr. almost linear; second 0·8 × 0·1, petiole 0·3; third 1·8 × 0·25, petiole 0·3; fourth 2·7 × 0·3, petiole 0·3 cm. First internode 0·4, second 0·4, third 0·7, fourth 0·6 cm. Stem terete, glabrous.

E. Woollsiana R. T. Baker(Pl. lvi., fig.3).—Cotyledons as in *E. viridis*. Leaves opposite, entire, glabrous, linear-lanceolate then lanceolate, broader than in *E. viridis*, petiolate, obtuse. First pr. 0·5 × 0·1, petiole 0·3; second 1·2 × 0·2, petiole 0·3; third 2 × 0·5, petiole 0·4; fourth 2·1 × 0·7, petiole 0·3 cm. First internode 0·5, second 0·8, third 1·7, fourth 1·6 cm. Stem terete, glabrous. Cotyledons are very much smaller than in *E. hemiphloia* and *E. albens*. First two pairs of leaves are also smaller.

E. pulverulenta Sm.(Pl.lxvi., fig.7).—Cotyledons transversely oblong, obtuse, emargination very slight or absent, 0·25 × 0·15, petiole 0·2 cm. Leaves opposite, entire, glabrous, short, ovate-lanceolate then ovate or oval, obtuse, subsessile, then sessile. First pr. 0·5 × 0·25, second 0·6 × 0·3, third 0·9 × 0·4, fourth 1 × 0·7 cm. First internode 0·4, second 0·6, third 1, fourth 1 cm.

E. Morrisii R. T. Baker(Pl. xlviii., fig.4).—Cotyledons transversely oblong, obtuse, asymmetrical, very slightly emarginate, lamina 0·3 × 0·15, petiole 0·3 cm. Leaves opposite, entire, glabrous, narrow-lanceolate, tapering into a short petiole, obtuse then subacute. First pr. 0·7 × 0·2, petiole 0·2;

second 1·3 × 0·3, petiole 0·2; third 1·9 × 0·35, petiole 0·2 cm. First internode 0·6, second 0·9, third 1 cm. Stem terete, glabrous.

E. Rodwayi Baker & Smith(Pl. l., fig.3).—Cotyledons smaller than in *E. Macarthuri*, and of different form, being transversely oblong, obtuse, 0·22 × 0·15, petiole 0·17 cm. Leaves entire, opposite, glabrous, pale green, lanceolate then oval-lanceolate, obtuse, subsessile. First pr. 0·7 × 0·2, petiole 0·2 cm.; second 1 × 0·45, subsessile; third 1·4 × 0·6 cm. First internode 1, second 0·6, third 0·8, fourth 1 cm. Stem terete, glabrous.

E. affinis Deane & Maiden(Pl. xliii., fig.5; Pl. lxix., fig.15). —Cotyledons as in *E. conica*, very small, shortly petiolate. Leaves entire, opposite, glabrous, lanceolate, subacute, petiolate, pale green.

E. rubida Deane & Maiden(Pl. xliii., fig.7; Pl. lxix., fig. 16).—Cotyledons small, slightly or hardly at all emarginate, cordate at base, 0·3 × 0·15, petiole 0·15 cm. Leaves entire, opposite, glabrous, glaucous, lanceolate then ovate, obtuse, subsessile. First internode 0·7, second 1·2, third 1·3 cm. First pr. of leaves 0·7 × 0·2, petiole 0·2; second 1·1 × 0·4, subsessile; third 1·7 × 0·8 cm.

E. camphora R. T. Baker(Pl. xlvii., fig.1).—Cotyledons very small, transversely oblong, slightly emarginate, obtuse, shortly petiolate. Leaves opposite, entire, glabrous, lanceolate, then ovate or oval, obtuse, subsessile then shortly petiolate.

E. tereticornis Sm.(Pl.lxvii., fig.1).—Cotyledons transversely oblong, very slightly emarginate, 0·25 × 0·15, petiole 0·2 cm. Leaves entire, opposite, glabrous, lanceolate, obtuse, petiolate, becoming broader till ovate or orbicular. First pr. 0·7 × 0·25, petiole 0·2; second 1·2 × 0·5, petiole 0·4; third 1·5 × 1, petiole 0·5 cm. First internode 0·6, second 0·7, third 1 cm.

E. Parramattensis C. Hall(Pl. lxvii., fig.4).—Proc. Linn. Soc. N.S.Wales, 1912, xxxvii.

E. aggregata Deane & Maiden(Pl. lxvii., fig.6).—Cotyledons very small, transversely oblong, very slightly emarginate, shortly petiolate. Leaves entire, opposite, glabrous, lanceolate, subacute, subsessile, pale green.

E. acaciæformis Deane & Maiden(Pl. lxviii., fig.3).—Cotyledons small, transversely oblong, slightly emarginate, 0·2 × 0 12, petiole 0·25 cm. Leaves opposite, entire, glabrous, lanceolate, obtuse, tapering into a short petiole, then subsessile.

ii.(*e*). Cotyledons larger than in Group ii.(*c*), more deeply emarginate, with divergent lobes. In many, the primary leaves are sessile and glaucous.

E. eudesmioides F.v.M.(Pl. lv., fig.7).—Cotyledons deeply bifid, with divergent lobes, which are obtuse and narrowed at their junction, lamina 0·6 × 0·2, petiole 0·25 cm. Leaves opposite, entire, ovate, obtuse, petiolate. First pr. 0·5 × 0·2, petiole 0·3 ; second 1 × 0·6, petiole 0·3 cm. Leaves and stem covered with short glandular hairs. First internode 0·4, second 0·3 cm.

E. Lehmanni Preiss(Pl. lv., fig.2).—Cotyledons of same form as in *E. eudesmioides* but smaller, 0·5 × 0·17, petiole 0·25 cm. Leaves opposite, entire, ovate, obtuse, petiolate. Leaves and stem covered with short glandular hairs.

E. cosmophylla F.v.M.(Pl. lv., fig.1).—Cotyledons moderately emarginate, cordate at base, lobes obtuse, lamina 0·5 × 0·25, petiole 0·3 cm. Leaves entire, opposite, glabrous, petiolate, ovate, obtuse, venation somewhat oblique, parallel, intramarginal vein away from edge. First pr. 1 × 0·45, petiole 0·4 ; second 2 × 1·1, petiole 0·5 ; third 3·3 × 1·8, petiole 0·5 cm. First internode 0·6, second 0·5, third 0·5, fourth 0·6 cm. Stem terete, glabrous.

E. hemilampra F.v.M.(Pl. xlv., fig.1).—Cotyledons fairly deeply bifid, lobes very divergent, obtuse, lamina 0·6 × 0·25, petiole 0·45 cm. Leaves entire, opposite, alternate after third pr., glabrous, obtuse, lanceolate, petiolate, lateral veins somewhat oblique and parallel, under sides of leaves paler. First pr. 1·2 × 0·45, petiole 0·3 ; second 1·8 × 0·6, petiole 0·5 ; third

3·6 × 1·2, petiole 0·6; fourth 5·4 × 1·5, petiole 0·5 cm. First internode 1, second 0·8, third 1·3, fourth 1·2 cm.

E. corynocalyx F.v.M.(Pl.xlv., fig.2; Pl. lxix., fig.17).—Cotyledons deeply bifid, the lobes diverging at an angle of about 110°, and obtuse, lamina 0·8 broad, petiole 0·5 cm., gradually merging into lamina. Leaves opposite but soon alternate, glabrous, pale on underside, ovate to orbicular, obtuse, sometimes emarginate at apex, petiolate, venation very oblique. First pr. 1 × 0·5, petiole 0·6; second 1·8 × 0·9, petiole 0·9; third 1·5 × 1·2, petiole 0·6 cm. Stem terete, glabrous.

E. elæophora F.v.M.(Pl. liii., fig.1; Pl. lxix., figs.18 and D).—Cotyledons moderately emarginate, lobes obtuse, asymmetrical, base cordate, lamina 0·75 × 0·3, petiole 0·3 cm. Leaves opposite, entire, glabrous, subsessile then sessile, lanceolate then ovate-lanceolate, obtuse, glaucous. First pr. 1·5 × 0·45, petiole 0·18; second 2·4 × 1, subsessile; third 2·7 × 1·2 cm. First internode 1·2, second 1·8, third 2·5, fourth 2·5 cm. Stem terete, glabrous.

E. goniocalyx F.v.M. (Pl. xlvi., fig.6).—Cotyledons resemble those of *E. elæophora*, but are smaller, and the lobes generally more symmetrical, laminæ 0·5 × 0·25, petiole 0·2 cm. Leaves opposite, entire, glabrous, glaucous, lanceolate and subsessile, then sessile, cordate at base, stem-clasping, obtuse or subacute. First pr. 0·9 × 0·25, second 1·8 × 0·6, fourth 3 × 0·9 cm. First internode 0·8, second 1·8, third 1·8 cm. Stem terete at base, then quadrangular, glaucous.

This species and *E. elæophora* are much alike, and have been confused, but, in the seedling, the cotyledons of *E. goniocalyx* are smaller, and the leaves are darker when dry, and are longer and more lanceolate, cordate, with rounded auricles and stem-clasping.

E. Bridgesiana R. T. Baker(Pl. xlvi., fig.5).—Cotyledons as in *E. goniocalyx*, but lobes often unsymmetrical. Leaves entire, opposite, glabrous, glaucous, lanceolate then ovate-lanceolate, obtuse, subsessile or sessile. First pr. 1·1 × 0·45, sessile; second 3 × 1, third 3·3 × 1·2 cm., subsessile. First internode 1, second 1·2, third 2·4 cm. Stem glabrous, glaucous, quadrangular at the nodes, terete at internodes.

The seedling of this species is quite distinct from that of *E. Stuartiana*, which has the cotyledons almost without emargination, and the first leaves ovate, quite sessile, cordate, stem-clasping.

E. urnigera Hook. f. (Pl. li., fig.1).—Cotyledons as in *E. globulus*, but not so deeply emarginate, and consequently less lobed, the lobes also being more divergent, purplish beneath, lamina 0·9 × 0·25, petiole 0·2 cm. Leaves entire, opposite, glabrous, lanceolate then lanceolate-ovate, obtuse, sessile, purplish on undersides. First pr. 0·8 × 0·3, subsessile, alternate, subacute; second pr. 1·2 × 0·45, sessile; third 1·5 × 1 cm.

The shape of the cotyledons and the sessile leaves support the chemical evidence that this belongs to the *globulus*-group, while the urnshaped fruits indicate a return towards the more primitive type of the *corymbosa*-group.

E. unialata Baker & Smith (Pl. li., fig.2).—Cotyledons emarginate, lobed, the lobes obovate-oblong, greatly diverging, asymmetrical, purplish beneath, lamina 0·7 × 0·2, petiole 0·3 cm. Leaves opposite, entire, glabrous, glaucous, ovate-lanceolate, subsessile then sessile, obtuse, cordate at base with rounded auricles. First pr. 2·1 × 0·6, subsessile; second 2·7 × 0·9, sessile; third 3·6 × 1·1 cm. First internode 1·8, second 2·5, third 2·5 cm. Stem greenish, sometimes slightly glaucous, glabrous, at first terete, then quadrangular at the nodes.

This species may be distinguished, in the seedling, from *E. Maideni* in having the emargination of the cotyledons not so deep, and consequently the lobes are not so constricted at their junction; the first pair of leaves larger and broader than in *E. Maideni*, and there is not so much glaucousness on the leaves and stem.

E. Maideni F.v.M.(Pl. xlviii., fig.1).—Cotyledons deeply bifid, lobes obovate, diverging, constricted at junction. Leaves opposite, entire, glabrous, glaucous, lanceolate then ovate-lanceolate, subsessile then sessile, cordate at base, obtuse. First pr. 0·7 × 0·2, petiole 0·2; second 2 × 0·35, subsessile; third 3·3 × 1 cm. First internode 0·8, second 1·0, third 1·2, fourth 2·5 cm.

E. globulus Labill.(Pl. xlviii., fig.3; Pl. lxix., fig.B).—This has been described in Lubbock's "On Seedlings." I would point out that the leaves of the first pair are narrower, and proportionately longer than in *E. Maideni* and *E. unialata*.

E. sp. nov., R. T. Baker(Pl. lxviii., fig.4; Pl. lxix., fig.19).—Cotyledons fairly deeply emarginate, the lobes asymmetrical, obovate-oblong and obtuse, cordate at base, purple on undersides, 0·9 × 0·3, petiole 0·4 cm. Leaves entire, opposite, glabrous, glaucous, ovate, obtuse, sessile, cordate at base, stem-clasping. First pr. 1·8 × 0·7, second 2 × 1·0, third 2·4 × 1·4 cm. First internode 1·4, second 1, third 1·1 cm. Stem glabrous, terete, purplish at first, then quadrangular as in *E. globulus*. This species plainly belongs to the *globulus*-class, and the cotyledons are very similar, but the emargination is not so deep in this species, hence the lobes are more obtuse and almost in a straight line. The leaves are more glaucous and much broader, being ovate and obtuse.

E. gomphocephala DC.(Pl. liv., fig.3; Pl. lxix., fig.20).—Cotyledons deeply bifid, lobes diverging at an angle of 120 degrees, obtuse, asymmetrical, lamina 0·7 cm. across, petiole 0·6 cm. Leaves entire, opposite, glabrous, obtuse, petiolate. First pr. 1·1 × 0·5, petiole 0·3; second 1·8 × 0·8, petiole 0·3 cm. First internode 0·5, second 0·4, third 0·4 cm. The cotyledons of this species show transit from others in this group, such as *E corynocalyx*, to *E. cornuta* and thence to those with still narrower lobes or limbs, as *E. redunca*.

ii.(*d*) Cotyledons so deeply bifid as to represent the letter Y. Lobes narrow to linear, and as long as, or even longer than the petiole. Leaves generally petiolate and glabrous.

E. cornuta Labill.(Pl. liv., fig.2; Pl. lxix., fig.21).—Cotyledons deeply bifid, the lobes unequal and narrower than in

E. gomphocephala, and at an angle of 120°. Longer lobe 0·6 in length, petiole 0·25 cm. Leaves alternate after first pair, entire, petiolate, obtuse, ovate or orbicular, dark green on upper surface, glabrous. Stem terete, glabrous.

E. polyanthema Schau.(Pl. xlix., fig.3).—Cotyledons Y-shaped, limbs very narrow, 0·2, petiole 0·2 cm Leaves lanceolate, then ovate-lanceolate, acute, petiolate, glabrous, opposite till fourth pair, entire, dark green. Stem terete, glabrous.

E. occidentalis.—See Lubbock's "On Seedlings."

E. salubris F.v.M.(Pl. xlix., fig.4 ; Pl. lxix., fig.24).—Cotyledons Y-shaped, the limbs contracted at junction and 2 mm. long, petiole 2 mm. Leaves opposite, entire, glabrous, lanceolate, acute, petiolate. First pr. 1 × 0·15, petiole 0·2 ; second 2·5 × 0·5, petiole 0·3 ; third 2·7 × 0·5, petiole 0·5 cm. First internode 0·2, second 0·3, fourth 0·4 cm. Stem terete, glabrous.

E. leptopoda Benth.(Pl. lii., fig.4).—Seedling greatly resembles that of *E. salubris*, but the leaves are of a slaty-grey colour when dry, the internodes longer, and the cotyledons have a longer petiole.

E. loxophleba Benth. (Pl. lv., fig. 4).—Cotyledons Y-shaped limbs narrow, 0·25, petioles 0·5 cm. Leaves entire, glabrous, opposite, soon alternate, linear then lanceolate, acute, petiolate, internodes long.

E. redunca Schau.(Pl. l., fig.2).—Cotyledons as in *E. loxophleba*. Leaves opposite, entire, glabrous, petiolate, lanceolate, acute.

E. salmonophloia F.v.M. (Pl. liii., fig. 5).—Cotyledons Y-shaped. Limbs linear, 0·2, petiole 0·4 cm. Leaves opposite, entire, linear then linear-lanceolate, tapering into a short petiole, covered with short, glandular hairs, acute. Stem with fine, short, glandular hairs.

E. oleosa F.v.M.(Pl. liii., fig.4).—Cotyledons Y-shaped, limbs longer and wider than in *E. salmonophloia*, constricted at junction. Leaves linear then lanceolate, shorter and more acute than in *E. salmonophloia*, the first two pairs sessile.

E. cneorifolia DC.(Pl. liii., fig.6).—Cotyledons as in *E. oleosa*. Leaves linear, then obovate-lanceolate, obtuse, subpetiolate, glabrous, opposite, after fifth pr. alternate. The leaves are quite distinct from those of the closely allied species in this group.

E. gracilis F.v.M.(Pl. liii., fig.7).—Cotyledons Y-shaped, limbs linear, 0·2, petiole 0·4 cm. long. Leaves linear and acute, then lanceolate and obtuse, opposite, entire, glabrous, tapering into a short petiole. First pr. 1·2, second 1·6, third 1·8, fourth 2·4 cm. First internode 0·6, second 0·5, third 0·8, fourth 0·5 cm. Stem terete, glabrous.

E. pendula A. Cunn.(Pl. xlix., fig.2; Pl. lxix., fig.23).—Cotyledons Y-shaped, the limbs linear and 0·18 cm. long, petiole 0·3 cm. Leaves opposite but soon alternate, glabrous, entire, acute then subacute, linear then lanceolate, shortly petiolate. Internodes longer than in *E. gracilis*.

E. calycogona Turcz.(Pl. lxvi., fig.5; Pl. lxix., fig.22).—Cotyledons Y-shaped, limbs narrowly obovate, asymmetrical, 0·25 cm. long, petiole 0·5 cm. long. Leaves opposite, then after few pairs alternate or even becoming alternate in first pair, entire, glabrous, linear and acute, then lanceolate and subacute, distinctly petiolate. First pr. 1·1 × 0·15, petiole 0·3; second 1·3 × 0·25, petiole 0·3; third 1·5 × 0·3, petiole 0·3 cm. First internode 1·1, second 1, third 0·9 cm. Stem terete, greenish, glabrous.

This species is quite distinct from *E. gracilis* in the seedling, and thus receives confirmation of the evidence for its specific rank. The limbs of the cotyledons are obovate instead of linear as in *E. gracilis*, while the leaves are more characteristically lanceolate and petiolate than in that species. The internodes too are generally longer.

E. uncinata Turcz.(Pl. lxvi., fig.6).—Cotyledons Y-shaped, limbs almost linear but not so narrow as in *E. gracilis*, 0·25 cm. long. Petioles flattened and greenish in their outer half, 0·6 cm. long. Leaves entire, opposite, glabrous, linear or narrowly oblong-linear, obtuse, tapering into a short petiole.

E. squamosa Deane & Maiden(Pl. xlix., fig.5; Pl. l.,fig.1; Pl. lxix., figs.25, C, D).—Cotyledons Y-shaped, more deeply bifid than in any species yet examined, limbs contracting at junction, obtuse, 0·6 to 0·7 cm. long, petiole 0·5 to 0·6 cm. long. Leaves opposite but soon alternate, entire, glabrous, linear then lanceolate or ovate-lanceolate, acute then sub-acute, and ending in an apical point, petiolate, glaucous. Stem terete, glabrous, slightly glaucous. First pr. leaves 1·8 × 0·2, petiole 0·3; second 1·8 × 0·3, petiole 0·4; third 2·6 × 0·5, petiole 0·4; fourth 2·6 × 0·8, petiole 0·6; fifth 3 × 1·2, petiole 0·6 cm., alternate. First internode 1·4, second 1·2, third 1·2, fourth 1 cm.

The slight glaucousness of stem and leaves is worthy of note.

The relation of the groups of the seedlings to the morphology, chemistry, and geographical distribution of the various species, we are now in a position to touch on. I have shown that the *corymbosa*-group is characterised by seedlings with reniform cotyledons, and characteristic primary leaves; but, from the researches of Messrs. Baker & Smith, we know that the mature leaves have the lateral veins transverse to the midrib, and closely set and parallel to one another, and that they yield a pinene oil without eucalyptol, points they share in common with the Angophoras. We also know that the cells of the anthers are parallel and open by longitudinal slits, the flowers corymbose, fruits urceolate and valves deeply enclosed, and that they grow in the warmer, moister, coastal parts of Eastern and Northern Australia, only *E. calophylla* and *E. ficifolia* having penetrated to South-Western Australia. It will probably be found that the other species closely allied to *E. corymbosa*, such as *E. Abergiana*, *E. clavigera*, *E. dichromophloia*, *E. ferruginea*, *E. Foelscheana*, *E miniata*, *E. peltata*, *E. phœnicea*, *E pyrophora*, *E. ptychocarpa*, *E. setosa*, *E. terminalis*, and *E. Watsoniana* will yield seedlings of the same type.

Although the Stringybark-group exhibits such uniformity of resemblance in the seedlings, and also in its other morphological characters, the chemical constituents of the oils vary greatly. Thus we find *E. lævopinea*, *E. dextropinea*, and *E. Wilkinsoniana* give pinene oils; *E. eugenioides* a pinene-eucalyptol oil; *E. macrorhyncha*, *E. capitellata* and *E. nigra* a pinene-eucalyptol-phellandrene oil; and *E. obliqua* a phellandrene-piperitone oil. While not departing greatly from the general form of the group, they have, unlike the Corymbosas, been able to adapt themselves to very varying climatic and physical conditions, as many of them occur in cool, elevated situations; and this they seem to have been able to accomplish, not by morphological change, but by virtue of the oils they elaborate. The presence of phellandrene seems to give, those possessing it, the power to flourish in a cool climate. *E. eugenioides* is the most widely distributed member of the group, being able to exist under very varying conditions of climate and soil. It is very likely that it has been enabled to do this by the help of its comparatively small cotyledons, and its eucalyptol-pinene oil.

Among the emarginate cotyledonary groups, one of the most striking is (*b*), which might, for convenience, be called the "Peppermint"-group, as many members contain piperitone, while others contain pinene, phellandrene, and eucalyptol in varying proportions. It is noteworthy that aromadendral, the characteristic constituent of the "Boxes," is almost entirely absent. The cotyledons in this group are characteristically quadrilateral and the emargination is always slight and sometimes practically absent. Another interesting point is that most of the members of this group have reniform anthers, and many of them a characteristic venation, which may be seen even in the primary leaves, the lateral veins being very oblique, in fact almost parallel to the midrib, and forming a looped arrangement with the intramarginal vein, which is away from the edge. In the case of *E. Rossii*, the evidence of the seedling is useful, as it explains the apparent anomaly of the chemical composition, as this, while giving a eucalyptol-pinene oil, and being classed chemically with species which have generally parallel anthers and a different venation, yet itself has reniform anthers, and a venation more characteristic of the piperitone-group. I would also point out that, while

E. stricta chemically has some relationship to the *E. cneorifolia*-group, yet, morphologically, it has a close relationship to the Peppermint-group, and possesses reniform anthers; and the form of the seedling strongly supports this The seedling of *E. apiculata* also shows its affinity to the Peppermints. It is worth while to draw attention to the fact that the majority of the species with reniform anthers, belong to this group or to the Stringybark-group with entire cotyledons. The members of this group, too, are confined to the Dividing Range and Coastal Districts of Eastern Australia, and some occur also in Tasmania, in other words, in places where the rainfall is fairly abundant, and the climate cold or temperate. Some of them, such as *E. coriacea*, occur in Alpine regions. The deep purplish-red coloration of the cotyledons and leaves seems to be connected with this climatic preference, and may be in response, but cannot be solely due to resistance to cold, because, in *E. coriacea* and *E. stellulata*, two most characteristic Alpine species, it is practically absent.

Let us now take the three large groups, ii.c^1, c^2, c^3. These may be considered to merge, more or less, one into the other, as I have arranged the grouping mainly by the size of the cotyledons. The primary leaves are generally smooth, and either petiolate or sessile, and, if the latter, generally glaucous. Those with the longer cotyledons and glaucous, sessile leaves generally occur in the cold, mountainous regions; and it has been argued that the glaucous bloom is a protection against cold, but against this we must remember that the same condition is also found in species in the dry, hot parts of Australia, and especially of Western Australia, and, in that case, the argument cannot hold. Included in these groups are the "Ironbarks" and "Boxes," with anthers opening in pores; but the majority of the remainder have parallel anthers. While many of the members of these groups occur in the cool, mountainous and warm, moist, coastal regions, yet the great majority of these with the very small cotyledons occur on the western slopes, and in the hot, dry interior, and they seem to be a response to the dry conditions. I would here point out that, although the coastal and mountain regions of Eastern Australia enjoy a high average rainfall, yet even there it is no uncommon thing, especially in the period from August to February, for them to have prolonged times of quite severe drought, when they get very little more rain than in the interior, and vegetation is severely tested thereby. Moreover, it is not uncommon, in the lowlying coastal areas, to have hot westerly winds, raising the temperature to well over 100°F., and this would account for the presence of such species as *E. crebra* and *E. hemiphloia* so near the coast Attention has been drawn by various writers to the fact that *E. Smithii* and *E. microcorys* are aberrant forms, in that, while yielding a eucalyptol-pinene oil, they yet have reniform anthers. The former, I find, has cotyledons of the *globulus*-type, while the primary leaves remind one a great deal of those of *E. amygdalina*, and it may thus have a mixed ancestry. The cotyledons of *E. microcorys*, in shape, have a good deal of the " Peppermint "-type about them, but no purplish-red coloration; while the primary leaves are smooth and petiolate, such as we find in *E. propinqua* and other members of the group in which I have placed it. It, too, probably has a mixed ancestry. By reason of their yielding a pinene oil and having a transverse venation, Messrs. Baker and Smith placed *E. botryoides*, *E. robusta*, and *E. saligna* in the same chemical group as *E. corymbosa*, though, as regards the fruits and many other characters, they have little in common with it. The seedlings show that they are far removed, as they all have emarginate cotyledons, and smooth, petiolate leaves, and so have much more in common with such species as *E. resinifera.* Apart from these exceptions, almost the whole of these groups yield a eucalyptol-pinene oil, and this is the oil most characteristically associated with the emarginate cotyledons. A certain proportion also contain aromadendral, and some others phellandrene. *E. Macarthuri*, with its geranyl-acetate oil, belongs to the group with small cotyledons.

Most interesting of all is the group with the emargination developed to such an extent, that they may be termed the Y-shaped cotyledons. *E. cornuta* seems to connect, through *E. gomphocephala*, with the *globulus*-type. Species with this type of cotyledon seem to be most plentiful in Western Australia, and then to have spread across South Australia to the dry interior of

Eastern Australia. It does not seem to occur in the North and North-Eastern coastal areas of the continent, nor is it found on the high mountain-ranges nor in Tasmania. It is a dry-country type, and many of these species are Mallees; in fact, all the Mallees have either this kind of cotyledon, or the small, oblong, round or reniform cotyledon. The origin of the peculiar rootstock of the Mallee can be well seen by observing the seedling. In nearly all the Eucalyptus seedlings, and also in the Angophoras, there is developed, especially if growth is checked, a small woody swelling in the stem at the point of attachment of the cotyledons. A number of buds will develop on this, and shoots start from them. If the growth of the seedling proceeds in the form of one main stem, this swelling is soon obliterated, but, in the Mallee, these secondary shoots grow almost as quickly as the main stem, and so, instead of a tree in the ordinary sense, we have an enlarged rootstock, from which spring numerous stems, all more or less of the same size. As far as known, the oils of this group contain eucalyptol and pinene, and many of them aromadendral; phellan drene is quite absent. Almost all belong to the Parallelantheræ, *E. uncinata*, of the Porantheræ, being an exception. Generally the anthers of these species are small.

Folding of the Cotyledons in the Embryo.

The shape and size of the seed are largely determined, when endosperm is absent, by the size, shape, and manner of folding of the cotyledons. Moreover, the size and shape of the fruits must be largely determined by the shape, size, and number of fertile and sterile seeds they contain. In *Angophora*, the fruits are large to accommodate the single, large, flat, fertile seed in each cell. So, too, with the "Bloodwoods," where there is one fertile seed in each cell, and a few sterile ones. The occurrence of the single fertile seed permits of the development of the winged appendage of the testa, many of the members of this group possess, and which is impossible in the smaller fruits, with closely packed seeds, of the majority of the Eucalypts.

Three main types of folding may be distinguished:

(i.) That found in *E. corymbosa*, and those species with similar, entire, reniform cotyledons. Here the fold in each cotyledon takes place along the median vein, from petiole to apex. Each folds transversely, thus, into two halves, and one half of each cotyledon lies between the two halves of the other, the radicle lying in the centre between the two innermost halves of each, and at the lower pole of the seed. One half of each, consequently, lies against the testa. The lobed portion at the intero-lateral angle of each half serves to ensheath the radicle. The apex of the seed is occupied by the two apices of the cotyledons. In germination, the radicle emerges from the lower pole, and rupture of the testa then takes place along the keeled, dorsal margin of the seed. We thus see that, in the embryo, each cotyledon has an enveloping half, which lies against the testa, and an enveloped half, which lies against the radicle. In the *corymbosa*-type, these are usually symmetrical. Similar folding occurs in the Angophoras.

(ii.) *E. globulus* may be taken as the type of the moderately emarginate cotyledon. Comparing it with the reniform cotyledon of *E. corymbosa*, we see that it is as if a deep slice had been taken out of the apical portion of the latter, leaving only the intero-lateral, lobed portion of each half, which, as we have just seen, ensheaths the radicle. Folding still takes place along the line of the central vein, which is now very short; consequently, instead of being folded transversely, the halves of the cotyledons are now deflexed and convolute over the radicle. It will thus be seen, that the radicle is still embraced by the lobed portion of one-half of each cotyledon, the other half of each lying against the testa. The apex of the seed, however, now contains the two lines of fold, which, in *E. corymbosa*, are along each lateral margin of the seed. They have, therefore, moved up to the apex. In *E. globulus* and many similar species, the enveloped half of each cotyledon is smaller than the enveloping, hence causing the cotyledons to be asymmetrical; in the seedling, each larger half being opposite each smaller. In *E. marginata*, with its large, slightly emarginate, obcordate, asymmetrical cotyledons, the folding is transverse, the smaller half of each cotyledon being enveloped within the doubled-over other cotyledon. Though the base is cuneate, in the embryo the lateral lobes are brought downwards so as to ensheath the radicle, which is short and thick, while the petioles are also short. In germination, the hypocotyl remains subterranean, no growth of it taking place as is usual in the other Eucalypts, but, to compensate for this, great growth and elongation of the petioles occurs, thus carrying the cotyledons well up above the ground. This is the reason *E. emarginata* has cotyledons with longer petioles than any other Eucalypt.

(iii.) In the Y-shaped cotyledons, such as of *E. squamosa*, the folding is still further modified. One limb of each cotyledon passes through the notch in the other, and thus interlocked, all four bend downwards to embrace the radicle, which, consequently, is now in contact with all four limbs, not with the inner two, as occurs in the other methods. The outer surface of all four is in contact with the testa. It will thus be seen that the plumule is very well protected by the interlocking of the limbs, and thus it and the radicle are able to withstand dessication. Figures A, B, C, of Plate lxix., illustrate diagrammatically a transverse section through the lower part of the embryo of each of the three types.

Third Cotyledon.—Very rarely, different species may be observed to possess three cotyledons. I have seen this in *E. coriacea*, *E. elæophora*, *E. eximia*, *E. Bosistoana*, *E. pilularis*, *E. Stuartiana*, and *E. microcorys*. The primary leaves are then generally in whorls of three, and when they become alternate, the tripartite arrangement is obscured. Again, after being in whorls of three, they may revert to the paired arrangement. In both these instances, a division of the embryo into three has occurred. Again, three cotyledons may be followed by paired leaves, showing that one cotyledon has been subdivided. I have even observed a pair of cotyledons followed by leaves in whorls of three. This tripartite arrangement, I have also observed in *Angophora lanceolata*, and it is common in hybrid Carnations.

Primary Leaves.—This research has established, beyond all doubt, that the so-called "sucker"-leaves are of the same form as the seedling-leaves, and has confirmed the opinion expressed by me in a paper on "The Eucalypts of Parramatta" [These Proceedings, Vol. xxxvii.] that the term primary or juvenile should always be adopted for the early type of foliage, and the term secondary, or adult, or mature for the later type of foliage. Whatever the juvenile type may be, the leaves tend very quickly, after the first pair, to assume that character. Where the primary leaf-type is sessile, it is usual for the first pair to be shortly petiolate. The leaves of the various species of the Corymbosa-group have a great resemblance to one another, being petiolate, alternate, often peltate, and covered with glandular hairs. In the Stringybark-group, the primary leaves are ovate-lanceolate, shortly petiolate or almost sessile, and also hairy. In the Peppermint-group, the leaves are usually sessile and smooth; while in *E. globulus* and its near relatives, they are sessile, smooth, and glaucous. The majority of the species with small cotyledons have smooth and petiolate, primary leaves. Those with Y-shaped cotyledons usually have almost linear leaves at first, these tapering into a short petiole. If a branch springs from the axils of the cotyledons, its leaves are always of the same form as those of the main stem. A curious abnormality of the leaves is often seen. It is symmetrical, and occurs in both members of a pair of the early leaves, and has been observed in a number of species. It consists of a rounding off and shortening of an otherwise subacute leaf, which terminates, instead, in a short, rounded boss. It is well illustrated in the figure of *E. melanophloia*, in Plate lxviii., fig.7.

Evolutionary Considerations.—Messrs. Baker & Smith, on botanical and chemical results, have outlined a scheme of the probable course of evolution of the Eucalypts; and Mr. E. C. Andrews has recently given us his views on "The Development of the *Myrtaceæ*." This research has demonstrated, in an unexpected way, the great part in the evolution taken by the cotyledon-leaves. *Tristania*, *Angophora*, and *Eucalyptus* probably all had a common ancestor. The two former failed to adapt themselves to the varying conditions of climate and soil, while *Eucalyptus* acquired that knack. The same type of cotyledon prevails in all the Angophoras, the same type of leaf and oil, and not being able to depart therefrom, they have not been able to spread far afield, to leave the particular environment they affect. The group of the Eucalypts, that possesses the same type of cotyledon and oil, viz., the Corymbosa-group, has, in some manner or other, acquired the power of varying to some extent, by developing the vertical, petiolate leaf at an early stage, and by varying the size of the cotyledon. Chemically, they do not seem to have made much progress, and have failed to develop eucalyptol, phellandrene, piperitone, or aromadendral, and so have been unable to leave a sandstone-formation, or to penetrate to the high alpine regions or dry interior. They prefer plenty of moisture, but can resist heat, and so confine themselves to the warm, moist, tropical, coastal areas. Their large foliaceous cotyledons could germinate and maintain the young seedling, if plenty of moisture was available, and served to protect the young radicle just penetrating into the soil. To make their advance, the Eucalypts found it was necessary to reduce the size of the cotyledons, from such relatively enormous ones as those of *E. calophylla*. This was done in two ways: firstly, by a simple reduction in size; secondly, by cutting out portion of the cotyledon by the introduction of emargination. The first method, we see well illustrated in the Stringybarks. In *E. lævopinea*, *E. dextropinea*, and *E. Wilkinsoniana*, the oil is still a simple pinene one, and the primary leaves, shortly petiolate, still have the glandular hairs, but they have reduced the size of the cotyledons, and have managed to ascend to the mountainous cooler areas. *E. eugenioides* has reduced its cotyledons very greatly, and developed a eucalyptol-pinene oil, and so has been able to penetrate all the Eastern States, and, in a dwarf form, to exist on the high parts of the Blue Mountains, and it can grow on soil of almost any description.

E. macrorhyncha and *E. capitellata*, also with fairly reduced cotyledons, and by the development of a pinene-eucalyptol-phellandrene oil, have been enabled to spread over the South-Eastern States, and to work on to the mountains; while *E. obliqua*, by the development of a phellandrene-piperitone oil, has been able to establish itself over the mountains from the Queensland border to Southern Tasmania. *E. fastigata* and *E. regnans* are probably offshoots from the Stringybarks. Such forms of "entire" cotyledon as we see in *E. dumosa*, *E. incrassata*, *E. populifolia*, and *E. quadrangulata*, are either reductions, or, more probably, due to a return to the ancestral type after reduction through an emarginate ancestor. In the emarginate type of reduction, we see what the Eucalypts have found the most suitable, and so given the preference to. They evidently found it better to cut out and reduce, than to reduce only. In *E. marginata*, we see how the size, still great, has been slightly reduced by the emargination. In *E. Planchoniana*, the same obtains, and this species, with its parallel anthers, but an oil and leaves like those of *E. pilularis*, probably represents most closely the ancestral prototype of the group to which *E. pilularis*, with its reniform anthers and smaller cotyledons, belongs. I have represented diagrammatically in fig. D of Plate lxix., the reduction from the cotyledon of *E. corymbosa* to that of *E. elæophora* of the *globulus*-type. It will be seen that the lightly shaded, apical portion has been entirely removed, but the lobed part still remains. When one takes away, in addition, the deeply shaded lobed portion and the remainder of the part at the bottom of the notch, we have a cotyledon of the type of *E. cornuta*, leading up to *E. squamosa*. The narrowing of the angle and reduction of the size of the limbs have led to the extreme form of Y-shaped cotyledon seen in *E. gracilis* and *E. pendula*. From the predominance of such forms in Western Australia, it seems likely they arose there in the first instance, and gradually spread east along the Australian Bight. Hence we find, in the far west of New South Wales, and in Victoria and South Australia, such species as *E. gracilis*, *E. cneorifolia*, *E. pendula*, *E. uncinata*, *E. calycogona*, and *E. oleosa*. The most interesting of all of this type is *E. squamosa*. This occurs near Sydney on the Hawkesbury Sandstone, and also near Rylstone on the western slopes of the Dividing Range. It appears to be a retrograding species, as the moist conditions do not seem to be suitable; and everything points to its having migrated from the hot, dry west, and crossed the Dividing Range. The longer cotyledon-limbs indicate a response to the cooler, moister conditions. In the three subdivisions of the great *globulus*-type of cotyledon, the larger cotyledons are usually found in the cool mountain-areas. Some of these are *E. globulus*, *E. Maideni*, *E. unialata*, and *E. urnigera*. This last species shows a peculiar atavistic character in its urn-shaped fruit, thus returning to the *corymbosa*-type. In the group of very small cotyledons, a great many, such as *E. viridis*, *E. rostrata*, *E. Woollsiana*, and *E. polybractea*, are found in the hot, dry interior. In the Peppermint-group, with the exception of *E. Planchoniana*, which is an aberrant member, a great uniformity of size exists among the cotyledons, and the emargination is slight or may be practically suppressed. When we come, however, to the species found on the higher mountains, such as *E. amygdalina*, *E. dives*, *E. radiata*, and especially *E. coriacea* and *E. stellulata*, we find that the cotyledons are considerably reduced in size; this on account of the great radiation, and keen, searching winds of these altitudes.

As Tasmania has been separated from the mainland for such ages, it is well to review the types of cotyledon occurring there. Those of the *globulus*-group are *E. globulus*, *E. urnigera*, *E. unialata*, *E. viminalis*, *E. Gunnii*, *E. Perriniana*, *E. cordata*, *E. Muelleri*, *E. acervula*, and *E. Rodwayi*, the last having the smallest cotyledons of all. In the Peppermint-group, there are *E. linearis*, *E. phlebophylla*, *E. Risdoni*, *E. Delegatensis*, *E. virgata*, *E. tæniola*, *E. coccifera*, and *E. amygdalina*; while in the Stringybark group, we have *E. obliqua* and *E. regnans*. The *corymbosa*- and Y-shaped groups are unrepresented.

The reason for all this great reduction in the large foliaceous cotyledons of the *E. corymbosa*-type, will now be evident. In a tropical climate, with fairly abundant rains, these would be the suitable type. But when droughty conditions and an abnormally dry atmosphere, with continuous, searching winds, had to be contended against, a reduction in size became necessary, so as to lessen the area of evaporation, and the area of exposure, both in the seed and in the germinating plant. Hence we get the very small, oblong cotyledon, as in *E. conica*; and the small Y-shaped one as in *E. pendula*, or, in a few cases, the very small round or reniform shape, as in *E. dumosa* and *E. incrassata*. As far as seen, all the far inland species are of one or other of these types. *E. pendula* has the smallest, bifid cotyledons of all, yet has proved itself most eminently adapted to the dry interior of Australia, being found in New South Wales, Queensland, Victoria, South Australia, and Western Australia. The same is also true of *E. uncinata* and *E. oleosa*, also of this class.

Not only have the Eucalypts altered the *corymbosa*-cotyledon, but they have also changed from the urn-shaped fruit of that group, with its deeply enclosed valves, and contracted neck. It must have been found that the winged prolongation of the testa caused a difficulty in the exit of the seeds, on the opening of the valves. Accordingly, as evolution proceeded, the appendage was abandoned (in *E. corymbosa* itself, it has almost vanished), the everted rim was cut out, and the valves became higher and higher, till the ovary became quite domed, and the valves exserted after dehiscing. Thus the ready exit of the seeds was provided for.

Seed was obtained, from Mr. Staer, of *E. eudesmioides*, a member of the small group of Eucalypts found in North-Western Australia, which Robert Brown proposed to raise to generic rank under the name *Eudesmia*. The cotyledons of this species proved to have well marked emargination, with divergent lobes. The leaves were petiolate, opposite, and covered with glandular hairs. So although the opposite leaves, notched calyces, and peculiar stamens indicate characteristics of the early type of Eucalypts, the well marked emargination shows that they have undergone great evolutionary advance in that respect. Hence, in the former characteristics, they may have undergone a reversion to the earlier type, just as we see the same in the urn-shaped fruit of *E. urnigera*.

To sum up, then, the evidence of the seedlings of the Eucalypts, and especially of their cotyledon-leaves, agrees with the theory set forth by Messrs. Baker & Smith, based on their botanical and chemical results, that the Corymbosas are the most primitive group of the genus. Later chemical and botanical knowledge, and now the new light thrown by the cotyledons, will necessitate a recasting of the genealogical tree in "A Research on the

Eucalypts," which was stated, at the time, by the authors to be tentative. This examination of the seedlings strongly confirms the main principles laid down, however. The ancestor of the Corymbosas had comparatively large, entire, reniform cotyledons. In *E. calophylla*, we see the extreme in size. To meet Australian conditions, it was necessary to reduce the size, and this we see first in the Corymbosas themselves, till we get the smaller cotyledons of *E. trachyphloia*. The Stringybarks appear to have arisen as an offshoot of the Corymbosas, and have smaller cotyledons of similar type, and hairy, primary leaves, but have developed reniform anthers. At the extreme end of this group, *E. regnans*, with smoother leaves, has lost its "stringy" bark, while *E. fastigata*, its very near relative, retains it. It is difficult to say where emargination first arose. Traces of it are seen in *E. intermedia*; and *E. Planchoniana* and *E. marginata*, with large, emarginate cotyledons, may be descendants of the earlier examples of it. The former seems to be a transition-form to the great group of Peppermints, and their allies. It has cotyledons and primary leaves of the same type, but parallel anthers of the *corymbosa*-type. Chemically, it resembles *E. pilularis* and others of that group. The seedling of *E. Smithii* confirms its probable mixed ancestry. The cotyledons and oil are of the *globulus*-type, and the primary leaves and anthers betoken a relationship to *E. amygdalina*. If ever a species has claims to a hybrid ancestor, it has.

In the emarginate *globulus*-type, the rule has been to make a general reduction in size of the cotyledon. But in Western Australia, to combat the specially dry conditions there, a special type of cotyledon was evolved, of a deeply bifid form, and this has spread along the southern coast to Eastern Australia, and even up into the far western parts of Queensland. Accompanying these changes in the cotyledons, there has been a change in the essential oils. The *corymbosa*-type is associated with a pinene oil without eucalyptol. That of the Peppermint-group is associated with eucalyptol, phellandrene, and piperitone in varying proportions. The *globulus*-type of cotyledon is mainly associated with a eucalyptol-pinene oil, and in its reduced form aromadendral frequently appears. Finally, the Y-shaped cotyledon is also usually associated with eucalyptol, pinene, and aromadendral. Eucalyptus is not merely a wonderful genus economically and botanically, it also yields important information to the student of Evolution, in that so many of its connecting links appear to have survived, and we are now in a better position to perceive the important part in that process, which has been taken by the cotyledons.

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EXPLANATION OF PLATES XXXVIII.-LXIX.

Eucalypt Seedlings.

Plate xxxviii.

Fig.1.—*E. calophylla* R.Br.; W.A.
Fig.2.—*E. intermedia* R. T. Baker; Mallangarell
Fig.3.—*E. trachyphloia* F.v.M.; Murrumbo.
Fig.4.—*E. corymbosa* Sm.; Parramatta.

Plate xxxix.

Fig.1.—*E. eximia* Schau.; Springwood.
Figs.2-3.—*E. perfoliata R.Br.*
Fig.4.—*E. marginata* Sm.; W.A.

Plate xl.

Fig.1.—*E. lævopinea* R. T. Baker; Armidale.
Fig.2.—*E. lævopinea*; Rydal.
Fig.3.—*E. lævopinea;* Lilydale, Vic.
Fig.4.—*E. dextropinea* R. T. Baker; Monga.

Plate xli.

Fig.1.—*E. Todtiana* F.v.M.; W.A.
Fig.2.—*E. Wilkinsoniana* R. T. Baker; Stroud.
Fig.3.—*E. umbra* R. T. Baker; Lismore.
Fig.4.—*E. umbra*; Lismore (later stage).

Plate xlii.

Fig.1.—*E. Muelleriana* A. W. Howitt; Victoria.
Fig.2.—*E. botryoides* Sm.; National Park.
Fig.3.—*E. saligna* Sm.; Parramatta.
Fig.4.—*E. robusta* Sm.; Parramatta.
Fig.5.—*E. nova-anglica* Deane & Maiden; Tenterfield.
Fig.6.—*E. diversicolor* F.v.M.; W.A.

Plate xliii.

Fig.1.—*E. maculata* Hook.; Smithfield.
Fig.2.—*E. eugenioides* Sieb.; Parramatta.
Fig.3.—*E. microcorys* F.v.M.; Tumbulgum.
Fig.4.—*E. propinqua* Deane & Maiden; Stroud.
Fig.5.—*E. affinis* Deane & Maiden; Grenfell.
Fig.6.—*E. Baeuerleni* F.v.M.; Sugarloaf Mountain.
Fig.7.—*E. rubida* Deane & Maiden; Laurel Hill.

Plate xliv.

Fig.1.—*E. Bosistoana* F.v.M.; Blacktown.
Fig.2.—*E. paniculata* Sm.; Parramatta.
Fig.3.—*E. intertexta* R. T. Baker; Gunbar.
Fig.4.—*E. paludosa* R. T. Baker; Braemar.
Fig.5.—*E. lactea* R. T. Baker; Mt. Kosciusko.
Fig.6.—*E. conica* Deane & Maiden; Girilambone.
Fig.7.—*E. quadrangulata* Deane & Maiden; Mittagong.

Plate xlv.

Fig.1.—*E. hemilampra* F.v.M.; Moss Vale.
Fig.2.—*E. corynocalyx* F.v.M.
Fig.3.—*E. resinifera* Sm.; Parramatta.
Fig.4.—*E. Behriana* F.v.M.; Inglewood, Victoria.

Plate xlvi.

Fig.1.—*E. dealbata* A. Cunn; Narrandera.
Fig.2.—*E. tereticornis* var. *linearis* Baker & Smith; Woodburn.
Fig.3.—*E. maculosa* R. T. Baker; Tarago.
Fig.4.—*E. punctata* DC.; Parramatta.
Fig.5.—*E. Bridgesiana* R. T. Baker; Bungendore.
Fig.6.—*E. goniocalyx* F.v.M.; Monga.

Plate xlvii.

Fig.1.—*E. camphora* R. T. Baker; Heydon's Bog.
Fig.2.—*E. populifolia* Hook.; Nyngan.
Fig.3.—*E. cinerea* F.v.M.; Barber's Creek.
Fig.4.—*E. longifolia* Link & Otto; Parramatta.
Fig.5.—*E. Smithii* R. T. Baker; Monga.

Plate xlviii.

Fig.1.—*E. Maideni* F.v.M.; Barber's Creek.
Fig.2.—*E. pulverulenta* Sm.; Bathurst.
Fig.3.—*E. globulus* Labill.; Jenolan Caves.
Fig.4.—*E. Morrisii* R. T. Baker; Coolabah.
Fig.5.—*E. sideroxylon* A. Cunn.; Tenterfield.
Fig.6.—*E. Rossii* Baker & Smith; Rylstone

Plate xlix.

Fig.1.—*E. Stuartiana* F.v.M.; Ringwood, Vic.
Fig.2.—*E. pendula* A. Cunn.; Sylvanham
Fig.3.—*E. polyanthema* Schau.
Fig.4.—*E. salubris* F.v.M.; W.A.
Fig.5.—*E. squamosa* Deane & Maiden; National Park (advanced stage).

Plate l.

Fig.1.—*E. squamosa*; National Park (early stage).
Fig.2.—*E. redunca* Schau.
Fig.3.—*E. Rodwayi* Baker & Smith; Interlaken, Tas.
Fig.4.—*E.*, sp. nov., R. T. Baker.
Fig.5.—*E. santalifolia* F.v.M.; S.A.

Plate li.

Fig.1.—*E. urnigera* Hook.f.; Mt. Wellington, Tas.
Fig.2.—*E. unialata* Baker & Smith; Hobart.
Fig.3.—*E. fasciculosa* F.v.M.; S.A.
Fig.4.—*E. corynocalyx* F.v.M.; S.A.
Fig.5.—*E. Muelleri* T. B. Moore; Mt. Wellington, Tas.

Plate lii.

Fig.1.—*E. occidentalis* Endl.; W.A.
Fig.2.—*E. Perriniana* F.v.M.; Mt. Kosciusko.
Fig.3.—*E. megacarpa* F.v.M.; W.A.
Fig.4.—*E. leptopoda* Benth.; W.A.

Plate liii.

Fig.1.—*E. elæophora* F.v.M.; Bungendore.
Fig.2.—*E. dumosa* A. Cunn.; Wyalong.

Fig.3.—*E. polybractea* R. T. Baker; Inglewood, Vic.
Fig.4.—*E. oleosa* F.v.M.; Nyngan.
Fig.5.—*E. salmonophloia* F.v.M.; W.A.
Fig.6.—*E. cneorifolia* DC.; Cygnet River, S.A
Fig.7.—*E. gracilis* F.v.M.; Shuttleton.

Plate liv.

Fig.1.—*E. platyphylla* F.v.M.; W.A.
Fig.2.—*E. cornuta* Labill.; W.A.
Fig.3.—*E. gomphocephala* DC.; W.A.
Fig.4.—*E.* sp. nov., R. T. Baker.
Fig.5.—*E. stricta* Sieb.; Wentworth Falls.

Plate lv.

Fig.1.—*E. cosmophylla* F.v.M.; S.A.
Fig.2.—*E. Lehmanni* Preiss; W.A.
Fig.3.—*E. striaticalyx*; W.A.
Fig.4.—*E. loxophleba* Benth.; W.A.
Fig.5.—*E. odorata* Behr; S.A.
Fig.6.—*E. platyphylla* F.v.M.; W.A.
Fig.7.—*E. eudesmioides* F.v.M.; W.A.
Fig.8.—*E. saligna* var. *pallidivalvis* Baker & Smith.

Plate lvi.

Fig.1.—*E. melliodora* A. Cunn.; Bathurst.
Fig.2.—*E. viridis* R. T. Baker; Girilambone.
Fig.3.—*E. Woollsiana* R. T. Baker; Rest Down.
Fig.4.—*E. albens* Miq.; Rylstone.
Fig.5.—*E. hemiphloia* F.v.M.; Parramatta.

Plate lvii.

Fig.1.—*E. acmenioides* Schau.; Parramatta.
Fig.2.—*E. carnea* Baker & Smith; Dunoon.
Fig.3.—*E. hæmastoma* Sm.; Parramatta.
Fig.4.—*E. phlebophylla* F.v.M.; Tunbridge, Tas.

Plate lviii.

Fig.1.—*E. viminalis* Labill.; Moss Vale.
Fig.2.—*E. rostrata* Schlecht.; S.A.
Fig.3.—*E. ovalifolia* R. T. Baker; Rylstone.
Fig.4.—*E. Dawsoni* R. T. Baker; Rylstone.
Fig.5.—*E. fastigata* Deane & Maiden; Monga.
Fig.6.—*E. macrorhyncha* F.v.M.; Rylstone.
Fig.7.—*E. capitellata* Sm.; Cronulla.

Plate lix.

Fig.1.—*E. nigra* R. T. Baker; Woodburn.
Fig.2.—*E. pilularis* Sm.; Parramatta.
Fig.3.—*E. Planchoniana* F.v.M.; Woodburn.
Fig.5.—*E. Fletcheri* R. T. Baker; St. Mary's.

Plate lx.

Fig.1.—*E. Risdoni* Hook f.; Hobart, Tas.
Fig.2.—*E. coccifera* Hook. f.; Mt. Wellington, Tas.
Fig.3.—*E. piperita* Sm.; Parramatta.
Fig.4.—*E. Gunnii* Hook. f.; Interlaken, Tas.
Fig.5.—*E. linearis* A. Cunn.; Mt. Wellington, Tas.
Fig.6.—*E. campanulata* Baker & Smith; Tenterfield.

Plate lxi.

Fig.1.—*E. crebra* F.v.M.; Parramatta.
Fig.2.—*E. melanophloia* F.v.M.; Wee Waa.
Fig.3.—*E. siderophloia* Benth.; Parramatta.
Fig.4.—*E. amygdalina* Labill.; Laurel Hill, N.S.W.

Plate lxii.

Fig.1.—*E. amygdalina* Labill.; Yarra Junction, Vic.
Fig.2.—*E. amygdalina* Labill.; Hobart.
Fig.3.—*E. Luehmanniana* F.v.M.; National Park.
Fig.4.—*E. oreades* R. T. Baker; Lawson.
Fig.5.—*E. Sieberiana* F.v.M.; Mt. Ash.

Plate lxiii.

Fig.1.—*E. coriacea* A. Cunn.; Guy Fawkes.
Fig.2.—*E. Delegatensis* R. T. Baker; Laurel Hill.
Fig.3.—*E. obliqua* L'Hér.; Tasmania.
Fig.4.—*E. dives* Schau.; Rydal.

Plate lxiv.

Fig.1.—*E. obliqua* L'Hér.; Mt. Gambier, S.A.
Fig.2.—*E. Andrewsi* Maiden; Tenterfield.
Fig.3.—*E. phlebophylla* F.v.M.; Tasmania.
Fig.4.—*E. radiata* Sieb.; Monga.
Fig.5.—*E. Macarthuri* Deane & Maiden; Bowral.
Fig.6.—*E. patentinervis* R. T. Baker; Ashfield.
Fig.7.—*E. stellulata* Sieb.; Rydal.

Plate lxv.

Fig.1.—*E. citriodora* Hook.; Parramatta (cultivated).
Fig.2.—*E. apiculata* Baker & Smith; Wentworth Falls

Fig.3.—*E. virgata* Sieb.; St. Mary's, Tas.
Fig.4.—*E. virgata.*
Fig.5.—*E. obtusiflora* DC.; The Spit, Sydney.

Plate lxvi.

Fig.1.—*E. regnans* F.v.M.; Mt. Wellington, Tas.
Fig.2.—*E. Moorei* Maiden & Cambage; Blackheath.
Fig.3.—*E. incrassata* Labill.; Dimboola, Vic.
Fig.4.—*E. acervula* Hook. f.; Hobart, Tas.
Fig.5.—*E. calycogona* Turcz.; Dimboola, Vic.
Fig.6.—*E. uncinata* Turcz.; Dimboola, Vic.
Fig.7.—*E. pulverulenta* Sm.; Bathurst.
Note three cotyledons and leaves in whorls of three.

Plate lxvii.

Fig.1.—*E. tereticornis* Sm.; Parramatta.
Fig.2.—*E. Bosistoana* F.v.M.; Blacktown. (Note three cotyledons, and leaves in pairs.
Fig.3.—*E. Parramattensis* C. Hall; Fairfield.
Fig.4.—*E. Marsdeni*, sp. nov., C. Hall; Toongabbie.
Fig.5.—*E. leucoxylon* F.v.M.; Dimboola, Vic.
Fig.6.—*E. aggregata* Deane & Maiden; Rydal.
Fig.7.—*E. hæmastoma* var. *micrantha*, DC.

Plate lxviii.

Fig.1.—*E. sideroxylon* var. *pallens* Baker & Smith.
Fig.2.—*E. tæniola* Baker & Smith; St. Mary's, Tas.
Fig.3.—*E. acaciæformis* Deane & Maiden; Tenterfield.
Fig.4.—*E.* sp. nov., R. T. Baker.
Fig.5.—*Syncarpia laurifolia* Ten.; Parramatta. (Note the reniform cotyledons, with incipient emargination and flattened petioles. Leaves and stem pubescent.).
Fig.6.—*Angophora lanceolata* Cav.; National Park.
Fig.7.—*E. melanophloia* F.v.M.; Wee Waa; showing peculiar modification of third pair of leaves, occasionally seen in early leaves of Eucalypts, and always bilateral.

Plate lxix.

Examples of Eucalyptus Cotyledons.

Fig.1*a*.—*Angophora lanceolata.*
Fig.1*b*.—*Eucalyptus calophylla.*
Fig.2.—*E. citriodora.*
Fig.3.—*E. corymbosa.*
Fig.4.—*E. lævopinea.*
Fig.5.—*E. dumosa.*
Fig.6.—*E. marginata.*
Fig.7.—*E. Planchoniana.*
Fig.8.—*E. acmenioides.*
Fig.9.—*E. piperita.*

Fig.10.—*E. Luehmanniana.*
Fig.11.—*E. amygdalina*, Vic.
Fig.12.—*E. microcorys.*
Fig.13.—*E. resinifera.*
Fig.14.—*E. Stuartiana.*
Fig.15.—*E. affinis.*
Fig.16.—*E. rubida.*
Fig.17.—*E. corynocalyx.*
Fig.18.—*E. elæophora.*
Fig.19.—*E.* sp. nov., R. T. Baker.
Fig.20.—*E. gomphocephala.*
Fig.21.—*E. cornuta.*
Fig.22.—*E. calycogona.*
Fig.23.—*E. pendula.*
Fig.24.—*E. salubris.*
Fig.25.—*E. squamosa.*

A, diagrammatic transverse section of seed of *E. corymbosa; t*, testa; *r*, radicle; c^1, c^2, cotyledons.

B, diagrammatic transverse section of seed of *E. globulus;* c^1, c^1, halves of one cotyledon; c^2, c^2, halves of the other.

C, diagrammatic transverse section of seed of *E. squamosa.*

D, diagram of reduction by emargination. The whole represents a cotyledon of *E. corymbosa;* remove *a* for *E. Planchoniana;* remove *ab* for *E. elæophora;* remove *abcee* for *E. squamosa.*

NOTE ON THE BACTERIOTOXIC ACTION OF WATER.

By R. Greig-Smith, D.Sc., Macleay Bacteriologist to the Society.

The presence of bodies, toxic to bacteria, have been known to occur in water for some time, just as their existence in soils has been suggested. Sidney Martin,* in 1900, showed that when typhoid bacteria are added to a well moistened, cultivated soil, they rapidly die out, and are not usually obtained two days afterwards. The same occurs when the typhoid bacillus is added to a culture of a soil-microbe in bouillon; it rapidly disappears. Sidney Martin explained this phenomenon by the bacteria in general being destroyed by the products of putrefaction, which exist in most cultivated soils. Referring to the growth of the typhoid bacillus, he said that it cannot grow except in the presence of organic matter containing nitrogen, and, on this account, it grows for only a short time in sterilised distilled or tap-water. That there is something more than the absence of organic matter to explain its disappearance in sterilised water, may be inferred from his experiment with the bouillon-culture of the soil-bacillus.

Typhoid bacteria rapidly disappear in sewage which contains a certain amount of nitrogenous, organic matter. For example, Houston† added 205 per 0·01 c.c. of sewage, and as he could recover only 20, he concluded that the remainder had been destroyed.

With regard to the growth of bacteria in waters, Miguel,‡ in 1891, noted that a rapid, but transitory, increase occurred in spring waters, while, in impure waters, the increase was slow but

* Loc. Govt. Rept. 1900. Suppl., p.487.

† Metrop. Water Board, Ninth Research Rept., through Journ. Soc. Chem. Ind. 1913, 764.

‡ Frankland, Micro-organisms in Water, London, 1894.

persistent. He found that, after a water had supported the multiplication of a particular species of micro-organism, the latter, on being reintroduced into the same water, will not only not again multiply, but, in many cases, will actually suffer rapid destruction. He compared this immunity of the water to the generation by the bacteria of soluble and toxic products, which inhibit their further growth and multiplication. These soluble products can be concentrated by evaporation at a low temperature, but are destroyed by boiling.

The effect of boiling is noteworthy, for while Martin says that typhoid bacteria soon perish in sterilised (*i.e.*, boiled) water, Meade Bolton found that water-bacteria increase enormously when introduced into sterilised water kept at 22°. That this depends upon the individual species of bacteria, has been shown by Rosenberg, who introduced a series of water-organisms into sterilised distilled water, and found that, while the majority of the individual varieties multiplied quickly, three of the species rapidly died out.

Having shown that bacteriotoxins can be demonstrated in soils, that they are produced there and are leached out by rain, it appeared to me to be a natural corollary that they should be found in drainage-waters. Furthermore, they ought to occur in natural waters in which bacteria are growing, although the quantity will, in all probability, be small and somewhat proportional to the number of bacteria which are present. In pursuance of the idea underlying my work upon the bacteriotoxins of soils, a few experiments were made with Sydney tap-water. This is an unfiltered water; the only purification to which it is subjected, consists of being strained through a series of sieves of a fine mesh at the city-reservoirs. It contains few bacteria; for example, on September 22nd, 1913, the date of the first experiment, at a temperature of 16°, it was found to contain 140 bacteria per c.c. when seeded into Lipman's synthetic agar.

The experimental method consisted in filtering the water through porcelain filters (Chamberland F) and adding one c.c. of a suspension of *Bac. prodigiosus* to 10 c.c. of the water, unboiled and after having been boiled for 15 and 60 minutes under a reflux condenser. The suspensions were incubated overnight, usually for 20 hours, at 22°, and were then counted by the plate-method. The experimental error was minimised by making four tests of each, and making five plate-counts of each test.

EXPERIMENT i.

Date.	Temperature of water.	100 cells of *Bac. prodigiosus* became		
		Unboiled.	Boiled	
			15 minutes.	60 minutes.
Sept. 22nd, 1913	16°	136	182	259
Oct. 13th, 1913.........	19°	246	191	73
Oct. 15th, 1913.........	20°	155	50	25
Oct. 23rd, 1913	20°	230	162	66
Oct. 29th, 1913.........	19°	480	164	112
June 10th, 1914	15°	134	156	71
June 17th, 1914	14°	217	202	130
July 1st, 1914	14°	98	108	119
	Average ..	212	152	107

The following numbers for raw filtered water are taken from the control-tests of other experiments.

	100 cells of *Bac. prodigiosus* became
May 25th, 1914	74
June 4th, 1914	49
June 12th, 1914	71
June 18th, 1914	136
June 30th, 1914	86
July 2nd, 1914	112

The action of unboiled and boiled filtered tap-water upon *Bac. prodigiosus* is irregular, possibly on account of the water itself varying, but the general tendency is for the boiled and cooled water to retard the growth of the bacteria suspended in it.

A sewage-effluent was obtained through the kindness of Dr. Stokes, Medical Officer to the Metropolitan Water and Sewerage Board, and tested in a similar manner. The sample was received on the 7th of October, 1913, when it was examined. It was then stored in a laboratory cupboard for a fortnight and again tested. It contained 90,000 bacteria per c.c. on October 21st. The temperature during storage was 22°.

EXPERIMENT iii.

Date.	100 cells of *Bac. prodigiosus* became		
	Unboiled effluent	Boiled effluent.	
		15 minutes.	60 minutes.
October 7th	400	86	31
October 21st	463	41	35
Average	431	63	33

The unboiled, filtered effluent was nutritive to *Bac. prodigiosus*, and the boiled effluent was decidedly toxic.

While *Bac. prodigiosus* has been taken as an organism capable of indicating the existence or otherwise of the toxic or nutritive effect, it appeared advisable to test *Bac. typhi*. Accordingly, cultures of two strains were obtained from Dr. Cleland, of the Board of Health, and the previous experiments with tap-water were repeated.

EXPERIMENT iv.

Date.	Temperature of water.	Strain.	1,000 cells *Bac. typhi* became		
			Unboiled.	Boiled.	
				15 minutes	60 minutes.
Nov. 5th, 1913	20°	"976"	460	2	0
Nov. 11th, 1913	20°	"L.I.P.M."	452	11	6
June 2nd, 1914	14°	"L.I.P.M."	557	2	0

Bac. typhi is very susceptible to the action of tap-water, which is toxic to it; and, as in the previous experiments, boiling increased the toxicity.

One of the quadruplicate tests of the last experiment was incubated for a further period of 24 hours to determine if the toxic action continued.

EXPERIMENT V.

	1,000 cells of *Bac. typhi* at 22° became	
	in 20 hours	in 44 hours.
Water unheated................	431	192
Water boiled 15 minutes ..	6	6
Water boiled 60 minutes	2	2

The toxic action continued in the unheated water, while, in the boiled water, the bacteria persisted unaltered.

The reduction in the numbers of bacteria put into ordinary filtered water points to some injurious factor, and the increased reduction in the same water, when boiled, seems to indicate that the effect is not caused by an absence of organic matter. If, however, we ignore the action of the boiled water, a possible explanation for the destructive effect of raw water might be found in the shock given the bacteria by the transference from a saline media, such as ordinary nutrient agar, to water virtually devoid of saline matter. To test this possibility, the bacteria were grown in sodium chloride-free nutrient agar for several generations, and the experiment again made.

EXPERIMENT VI.

Date.	Temperature of water.	Strain.	1,000 cells *Bac. typhi* became		
			Unboiled.	Boiled.	
				15 minutes.	60 minutes.
Nov. 26th, 1913	22°	"L.I.P.M."	562	10	3

The experiment shows that the reason for the destruction of the bacteria is not to be found in the lessened saline content of the media. We are justified, therefore, in concluding that ordinary tap-water contains substances of the nature of bacterio-toxins, the toxicity of which is increased by boiling.

NOTE ON THE DESTRUCTION OF PARAFFIN BY *BAC. PRODIGIOSUS* AND SOIL-ORGANISMS.

By R. Greig-Smith, D.Sc., Macleay Bacteriologist to the Society.

In an earlier research, in which dried blood had been saturated with paraffin or vaseline, and subsequently fermented, it was found that the treatment did not prevent the blood from being attacked by soil-bacteria, or by a pure culture of *Bac. prodigiosus.* This was not expected, as it was believed that the inert hydrocarbon would offer a barrier to the attack of the bacterial enzymes. The failure was possibly due to the organic matter swelling upon being moistened, and thus breaking the paraffin-covering, but, that some other action was possible, was suggested by the behaviour of the fermented blood when shaken up with water, as compared with the fermented controls.

It has recently been shown that certain bacteria and moulds are capable of utilising both solid and liquid hydrocarbons,* and an experiment was undertaken to see if there might be a similar utilisation by *Bac. prodigiosus.*

Sifted dried blood was saturated with paraffin, and the excess removed as completely as possible. The paraffined blood was again sifted and thoroughly mixed. Two-gram portions were mixed with 50 grams of sand and moistened with a suspension of *Bac. prodigiosus.* The tests were kept at the temperature of the laboratory for varying periods, then dried and extracted with ether.

	Paraffin recovered.
Control	0·169 grams.
	0·164 ,,
	0·164 ,,
Fermented for 10 days	0·155 ,,
	0·157 ,,
Fermented for 17 days	0·155 ,,
Fermented for 57 days	0·157 ,,

* Rahn, Centrlbl. f. Bakt. 2te Abt. 16, 362; and Söhngen, *ibid.* 37, 595.

The loss of paraffin is approximately 5 %. The melting points of the recovered paraffin from the control and 10 days' tests were determined, and both were found to be the same, viz., 45°.

Powdered casein, the granules of which passed through a No.30 sieve, was used in the next experiment. About ten grams of paraffin were added to 130 grams of casein, and the mixture was heated at 100° and stirred until it was considered that the hydrocarbon had been evenly distributed. It was then cooled, powdered, and sifted. Fifteen-gram portions were weighed out, placed in beakers, mixed with four grams of kieselguhr, and moistened with 20 c.c. of water containing a suspension of *Bac. prodigiosus.*

	Paraffin recovered.
Control	{ 1·37 grams. { 1·35 ,,
Fermented 11 days at 37°...	1·05 ,,
Fermented 11 days at 22°...	1·20 ,,
Fermented 17 days at 22°...	1·17 ,,
Fermented 24 days at 22°...	1·07 ,,

The loss of paraffin ranges from 11 % to 22 %.

During the direct estimation of the total paraffin, several observations showed that the method of recovery was capable of improvement. When the cultures were spread out to dry, previous to the ethereal extraction, a strong odour of ammonia was given off, and this was followed by a pungent gas, sometimes resembling formaldehyde, at others acrolein. This led to the 17 and 24 days' tests being mixed with sodium carbonate and powdered lime, respectively, before drying. But even this did not prevent the presence of volatile acids in the recovered paraffin. A trace of lecithin was also present. A method was accordingly employed in the later experiments that eliminated these objectionable substances.

The method simply consists in digesting the paraffin recovered by the Soxhlet apparatus, with 5 c.c. of 10 % sodium hydrate, transferring to a 50 c.c. graduated Wehrner-Schmit tube, allow ing the alkaline liquid to measure about 20 c.c., adding ether to the 49 c.c. mark, and, in the casein tests, adding 1 c.c. of rectified spirit. After a vigorous shaking, the ethereal layer is read off, and 10c.c. portions pipetted out into flat-bottomed, metal evaporating dishes. The ether is allowed to evaporate at 30°, and then dried for two hours in the water-oven. The procedure is similar to that employed in the estimation of fat in milk by the Wehrner-Schmit process.

Fifteen grams of paraffined casein were mixed with one gram of kieselguhr and one gram of calcium carbonate, placed in two-ounce bottles, and, after sterilisation in the autoclave, treated with 5 c.c. of a suspension of *Bac. prodigiosus* or of soil-organisms (5 grams of soil to 100 c.c. of water). The bottles were incubated at 28°.

	Paraffin recovered.
Control	1·21 grams. 1·22 ,,
Fermented with soil-organisms, 15 days ...	1·10 ,, 1·07 ,,
Fermented with *Bac. prodigiosus*, 25 days ...	1·18 ,, 1·16 ,,

The average loss for the soil-organisms is 11·1 %, and for *Bac. prodigiosus* 3·7 %.

Finally, an experiment was made in whieh the bulky, organic, nitrogenous matter was dispensed with. Kieselguhr was treated with paraffin, ground and sifted. Four grams were mixed with 20 grams of sand and one gram of calcium carbonate, and the bottles containing the mixture were sterilised in the autoclave. Ten c.c. of water containing 0·1 % dipotassium phosphate, 0·05 % magnesium sulphate, 0·05 % sodium chloride, and either 1 % peptone, 0·5 % asparagin, or 0·5 % ammonium sulphate were added. The bottles were then steamed for an hour, and infected with 2 c.c. of a suspension of *Bac. prodigiosus*, containing 12 million cells, or 2 c.c. of a suspension of soil-organisms (10 grams of soil to 100 c.c. of water). The bottles were kept at 28°, and water was added occasionally to maintain the original weight.

	Paraffin recovered.	
	Bac. prodigiosus	Soil-organisms.
Control	0·92 grams.	0·92 grams.
Peptone, 10 days	0 92 ,,	0 66 ,,
Asparagin, 11 days	0·90 ,,	0·72 ,,
Ammonium sulphate, 21 days	0·79 ,,	0·66 ,,
Peptone, 25 days	0·80 ,,	0·52 ,,
Asparagin, 33 days	0·79 ,,	0·47 ,,

There is a loss of 14% of paraffin occasioned by *Bac. prodigiosus*, and of 49% by the soil-organisms, in about a month at 28°. The decomposition appears to be uninfluenced by the nature of the nitrogenous matter.

ORDINARY MONTHLY MEETING.

October 28th, 1914.

Mr. W. S. Dun, President, in the Chair.

The President announced that the Council was prepared to receive applications for four Linnean Macleay Fellowships, tenable for one year from April 1st, 1915, from qualified Candidates. Applications should be lodged with the Secretary, who will afford all necessary information to intending Candidates, not later than 30th November, 1914.

The President called attention to copies of a new issue of the "Scientific Australian," a quarterly journal published by Bishop Bros. (24 Bond Street, Sydney), hitherto devoted to applied science in a popular way, but of which the publishers hoped to extend the scope so as to take in pure science; and to issue it in monthly parts. Such a Journal as was contemplated was very much needed, and was deserving of support.

The Donations and Exchanges received since the previous Monthly Meeting (30th September, 1914), amounting to 2 Vols., 38 Parts or Nos., 19 Bulletins, one Report, and 2 Pamphlets, received from 35 Societies, etc., and one private donor, were laid upon the table.

On the invitation of the President, Dr. T. Mortensen, of Copenhagen, who had been for some time actively interested in the effort of the International Congress of Zoologists to deal with difficulties of nomenclature, stated his views in opposition to a strict application of the Law of Priority, and in favour of an official list of *nomina conservanda.* Discussion followed.

NOTES AND EXHIBITS.

Mr. Fred Turner exhibited fruits of, and contributed notes on, *Fusanus spicatus* R.Br., a "Quandong" from the Swan River, Western Australia. The fruit of this small tree is globular, and nearly one inch in diameter, with a reddish epicarp, when mature, and a nearly smooth putamen. This species appears to be limited to the western portion of the continent. There are three other indigenous species of *Fusanus*, viz., *F. acuminatus* R.Br., *F. persicarius* F.v.M., and *F. crassifolius* R.Br., and all of them appear to be endemic in Australia. *F. acuminatus*, the "Quandong" or "Native Peach," is figured and fully described in Turner's "Forage Plants of Australia" (non-grasses), p.91. There is a very distinct variety of this species with golden-yellow fruit, which the exhibitor had named *chrysocarpus*, but it is not common. It is found west of Wyalong, in the Cobar district, and on the eastern and western watershed of the Darling River in New South Wales. *F. persicarius*, often popularly called "Native Peach," and sometimes confused with the previously mentioned species, has a similar geographical range, but its fruit is not nearly so valuable from an economic point of view. This small tree produces a globular, reddish fruit having a rather thin, dry pericarp, and a minutely pitted putamen. *F. crassifolius* is a dwarf shrub having small fruit of no known economic value. The "Quandong" of the warmest coast districts is the fruit of *Elæocarpus grandis* F.v.M.

Mr. A. A. Hamilton exhibited a series of specimens from the National Herbarium, comprising *Curcurbita pepo* Linn., "Pumpkin" (Sydney Botanic Gardens; W. Ransley; April, 1914), portion of a fasciated stem, showing the fusion, for part of their length, of three branches, later reduced to two, and finally to a single branch. The normal plant has simple leaves, distant along the branches, but in the portion represented by the three adherent stems, the leaves are in whorls of three, each having in its axil a tendril, and at each joint a whorl of three rootlets is noted. The length of the three-branched fasciated stem is 4 ft., and that of the two-branched part 2ft. 6in.—*Tetragonia expansa* Murr.,(McMahon's Point; W. M. Carne; October, 1914) showing heterotaxy. Adventitious buds are noted springing from the base of the persistent lobes of the adnate calyx, subtended usually by a spathulate leafy bract; in some cases the bract alone is found. The flowers of this species are arranged in pairs in the axils of the leaves, and in this example one of the pair, when in fruit, is much reduced in size, the other remaining normal. Where the fruit is beset with two adventitious buds, one of them is sessile and the other pedicellate, and they are placed opposite to each other. The adventitious flowers had in several cases produced fertile fruits.—*Sonchus oleraceus* Linn., (Pennant Hills; T. Steel; November, 1913) showing foliar, and floral, spiral contortion. The stem-leaves, and bracts of the involucre are produced into elongated, spirally contorted points.—*Epacris reclinata* Cunn., three forms of this Blue Mountain species with differing characteristics: the typical form, reclining in the crevices of dripping rocks; a second form, decumbent on the top and sloping sides of partially dry rocks; and a third, erect form growing on open hillsides. The foliage of the typical form is soft and pilose, the plants are few-flowered, and the corolla, as described in the Fl. Austr., is uniformly red. In the decumbent form, the foliage is harsher and less hairy, the flowers are more numerous, and the corolla-lobes are pale. In the erect form, the hairiness has almost disappeared, the branches are very floriferous, and the pale corolla-lobes have become white, closely approaching those of the particoloured *E. longiflora* Cav. —*Hakea propinqua* Cunn., (Blackheath; A. A. Hamilton; September, 1914) the colour of the flowers of plants of this species growing on the higher elevations of the Blue Mountains is an attractive, bright yellow. Coastal examples from the National Park and Hornsby show the customary white flowers. The yellow colouring of the flowers of this species is also noted (by the collectors) on specimens in the National Herbarium from Cox's River (J. H. Maiden and R. H. Cambage; October, 1904). The mountain specimens have shorter and stouter leaves, the flowers are more crowded and on shorter pedicels, and the fruits are smaller than those of the coastal plants.—*Kennedya monophylla* Vent.,(*Hardenbergia*) showing leaf-variation. The leaves vary in shape from linear to rotundate, their apices are acute, obtuse, apiculate, and emarginate, and their bases ovate, cordate, or hastate. Dimensions: $4\frac{1}{2} \times 1\frac{3}{4}$in., $4 \times \frac{1}{2}$in., 3×2in., $2\frac{3}{4} \times \frac{3}{8}$in., $2 \times 1\frac{1}{2}$ in., $2\frac{1}{2} \times \frac{1}{4}$ in., 1×1 in., $1\frac{1}{4} \times \frac{1}{4}$ in.—*Persoonia lanceolata*

Andr., (Maroubra Bay; A. A. Hamilton; August, 1914) showing leaf-variation, chiefly in proportion of length to breadth.

Dr. J. B. Cleland exhibited leaves of *Eucalyptus eximia*, grown from seed, showing small white crusts of a saccharine substance ("manna," with slight sweet taste) on the torn edges. Also a branchlet of *Bœckea linifolia* on which, last year, a small, similar mass of manna appeared when a branch had been accidentally broken.

Dr. Ferguson exhibited. (1)Two specimens of a longicorn beetle, said to have been injuring young Chrysanthemum plants at Narromine, by eating the leaf-stalks, from the top. White ants are also reported to be proving destructive to these plants.—(2)*Echidnophaga liopus* Roth., a rather rare flea from the Echidna, originally recorded from West Australia. These specimens were sent to the Bureau from the Sydney Zoological Gardens, some years ago, and had recently been identified by Rothschild.—(3)*Parapsyllus australiacus* Roth., a flea procured by Dr. Cleland at Flinders Island on *Puffinus tenuirostris* and *Eudyptula minor*. The types of this species were originally taken by Dr. Cleland in West Australia on the latter.—(4) A tick (*Aponomma* sp.) from the Brown Snake, showing larval, nymphal and adult stages on the same reptile.—(5) Two large distended females of another tick (*Aponomma* sp.) from *Tachyglossus aculeatus*, which had deposited numerous eggs in a test-tube.—(5) Two new species of *Culicidæ* described in a recent paper by F. H. Taylor. *Culex biocellatus*, a pale golden mosquito from the Hawkesbury River, and *Culicada Fergusoni* bred from larvæ taken on Milson Island, Hawkesbury River. The larva of the latter was also exhibited.

Mr. W. S. Dun exhibited, on behalf of the Mines Department, the type-specimen of *Phialocrinus princeps* Eth.fil., recently presented to the Department by the Maitland Scientific Society. The specimen is of great scientific interest, as it is not only the largest species of the genus, but the largest dicyclic Crinoid. The specimen is from Bow Wow, Mt. Vincent, 16 miles from West Maitland.

THE LEPIDOPTERA OF EBOR SCRUB, N.S.W.

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

Ebor is a small township, fifty miles north-north-east of Armidale, in the New England district of New South Wales. Situated on the edge of the New England Plateau, at an altitude of 4,000 feet, it has an abundant rainfall, and is watered by many creeks, which run through deep gullies, carved in the edge of the Range, into the head-waters of the Clarence River. The road from Armidale runs over granite-country, which gradually becomes rougher in character, until it passes through some granite-hills, locally known as the "Snowies," where snow falls and lies for some days, several times in each winter. Shortly before reaching Ebor, one passes into a rich, red-soiled, basaltic area, which grows good crops of potatoes. Walking some five or six miles towards the south-east, across poor granite-country, one comes again to the basalt, which forms a bold spur, known as "Thompson's Lookout," 4,500 feet in height, from which there is a magnificent view of very rugged, densely forested hills and gullies, which contain the sources of the Bellinger River. The lepidoptera of this plateau are akin to the Victorian fauna, the most conspicuous examples being large, showy species of the Geometrid genus *Cidaria*. To the right of the track, for about one mile before reaching the "Lookout," there is a wide, but deep gully, filled with scrub-vegetation. It is something of a surprise to come upon large trees of apparently tropical vegetation, at an altitude of 4,000 to 4,500 feet, where snow falls in winter. But a closer inspection shows that many characteristic trees of the coastal scrubs of New South Wales and Queensland are absent. I saw no figs, no nettle-trees, no trees with buttressed trunks; while the large trees appeared to be referable to few species. Large, cable-stemmed climbers were also not seen, though there were a few of small dimensions. The undergrowth consists largely of ferns, including dense groves of tree-ferns. The stems of all the trees are thickly coated with green moss, and not these only, but the lower branches, and even small twigs, are bearded with moss six to eight inches long, and with foliaceous lichens. As might be expected, the lepidoptera of this scrub are not numerous in individuals; and those found were mostly small and inconspicuous. Collecting in a scrub is exciting, as one is by no means sure of catching every example that flies up, many, especially the larger and stronger fliers, disappearing in the undergrowth, where they cannot be followed. But it was specially exciting in this instance, for the fauna appeared to be entirely new. In six strides, one left the Victorian fauna behind, and every species captured appeared to be new to science. It was like landing on an isolated, oceanic island, none of whose animals had ever before been seen by man.

I was able to collect in this scrub for three afternoons, and obtained some 30 species of lepidoptera belonging to the following groups:—

ARCTIADÆ;	*Lithosianæ*	2	species.
GEOMETRIDÆ:	*Larentianæ*	1	,,
	Boarmianæ	1	,,
PYRALIDÆ:	*Pyralinæ*	1	,,
TORTRICIDÆ:	*Tortricinæ*	4	,,
	Eucosmidæ	2	,,
TINEIDÆ:	*Gelechianæ*	2	,,
	Œcophorinæ	14	,,
	Heliodininæ	1	,,
	Gracilarianæ	1	,,
	Hyponomeutinæ	1	,,
	Tineinæ	1	,,
		31	species.

The general aspect of the lepidoptera reminded me of those taken on Mount Tambourine, Southern Queensland, at a considerably lower elevation, not quite 2,000 feet. I did not, however, find more than two species common to the two localities. One species of Gelechianæ, which is a doubtful member of the fauna, as I may have taken it at the edge of the scrub, and the species of Heliodininæ, which is allied to *Stathmopoda*, I shall not describe at present; but the others will be dealt with here. The types are in my collection. I hope to be able to revisit this interesting and productive locality, and make further additions to its lepidopterous fauna. My captures were made on January 7th, 9th, and 11th, 1914.

Fam. ARCTIADÆ.

Subfam. LITHOSIANÆ.

Gen. TRISSOBROCHA, nov.

τρισσοβροχος, with threefold noose.

Frons smooth. Tongue developed. Palpi moderate, recurved, ascending, slender, smooth-scaled; terminal joint about half second, acute. Antennæ of ♂ simple, slightly laminate towards apex, moderately ciliated. Thorax smooth above and beneath. Posterior tibiæ with two pairs of long spurs. Forewings with all veins present in both sexes, 2 from $\frac{3}{4}$, 3 from before angle, 4 from angle, 7, 8, 9 stalked, 9 arising before 7, 10 from before angle, well separated at origin from 7, 8, 9, 11 free. Hindwings with all veins present, 3 and 4 connate, 5 from below middle of discocellulars, curved toward 4 at origin, 6 and 7 stalked, 8 from cell at $\frac{1}{3}$.

Allied to *Hectobrocha*, but more primitive in structure. In that genus, vein 5 is absent in ♂ (but not in ♀), and 10 is from a point with 7, 8, 9.

TRISSOBROCHA EUGRAPHICA, n.sp.

εὐγραφικος, clearly inscribed.

♂. 22 mm. Head white. Palpi dark fuscous. Antennæ grey, towards base tinged with ochreous, basal joint white; in ♂ evenly and moderately ciliated(1) Thorax white, a transverse line behind tegulæ crossing bases of patagia, and a posterior spot black. Abdomen whitish-ochreous, tuft ochreous; beneath dark fuscous towards base. Legs pale ochreous;

anterior pair fuscous anteriorly; a fuscous spot on apex of middle tibiæ. Forewings triangular, costa strongly arched, apex round-pointed, termen slightly curved, oblique; clear pale ochreous; markings black; a broad line from base of costa not reaching beyond middle; a dot on $\frac{1}{4}$ costa, a sharply dentate line from $\frac{1}{4}$ costa to $\frac{1}{4}$ dorsum; a circular pale-centred median discal spot; a dentate line from $\frac{3}{4}$ costa to $\frac{3}{4}$ dorsum, bent outwards beneath costa, and inwards in disc; a faint interrupted dentate subterminal line, several suffused spots on termen; cilia ochreous with a few dark fuscous scales. Hindwings with termen gently rounded; pale ochreous; a faint suffused fuscous subterminal line; cilia pale ochreous. Underside similar but less defined.

One specimen.

THALLARCHA EROTIS, n.sp.

ἐρωτις, a darling.

♂. 18 mm. Head pale ochreous; face fuscous-whitish. Palpi 1; dark fuscous. Antennæ fuscous, basal joint pale ochreous; in ♂ with short pectinations(1) and longer ciliations(2). Thorax fuscous, tegulæ pale ochreous, apex of patagia and a posterior spot whitish. Abdomen ochreous-whitish, with some fuscous suffusion towards apex, tuft and underside ochreous. Legs ochreous; dorsal surface of anterior and posterior pairs fuscous. Forewings elongate-ovate, costa strongly arched, apex rounded, termen obliquely rounded; white; markings fuscous; an ochreous suffusion at base, on basal half of costa, above mid-dorsum, and edging some of the markings; a thick line on costa to $\frac{1}{6}$ continued narrowly to middle; an outwardly curved wavy line from $\frac{1}{6}$ costa to $\frac{1}{4}$ dorsum; three fine parallel lines from costa between $\frac{1}{3}$ and middle, outwardly toothed beneath costa, thence inwardly curved, and confluent on mid-dorsum, leaving a clear white dorsal blotch between them and basal line; a fuscous blotch in disc at $\frac{3}{5}$ connected by a line with dorsum at $\frac{3}{4}$; a large spot on $\frac{4}{5}$ costa; a subapical spot on termen; a large tornal blotch enclosing a white spot on termen; cilia pale ochreous, on apex white, on subapical spot and again on midtermen fuscous. Hindwings with termen evenly rounded; pale ochreous; cilia pale ochreous.

One specimen.

Fam. GEOMETRIDÆ.

Subfam. LARENTIANÆ.

DIPLOCTENA PANTŒA Turn.

One ♂; although wasted, I do not think there is any doubt as to the identification. This species is recorded previously from Lorne, Victoria, where a series was taken by Mr. Geo. Lyell.

Subfam. BOARMIANÆ.

Gen. PHILOLOCHMA, nov.

φιλολοχμος, loving the thickets.

Frons flat. Tongue well-developed. Palpi moderately long, porrect or slightly ascending; second joint densely clothed with rough hairs; terminal joint moderate, obtuse. Antennæ in ♂ thickened, simple, minutely ciliated. Thorax not crested, hairy beneath. Abdomen not crested. Femora hairy. Posterior tibiæ in ♂ dilated, with all spurs present. Forewings in ♂ without fovea, but with a small triangular patch bare of scales in situation of fovea: 10 and 11 arising from cell and not anastomosing. Hindwings with 3 and 4 separate, 6 and 7 separate.

PHILOLOCHMA CELÆNOCHROA, n.sp.

κελαινοχροος, darkly coloured.

♂. 29 mm. Head fuscous-ochreous. Palpi 2; fuscous-ochreous. Antennæ dorsally grey, laterally brownish; ciliations in ♂ $\frac{1}{8}$. Thorax fuscous-ochreous. Abdomen fuscous; dorsum of first two segments and underside fuscous-ochreous. Legs fuscous irrorated and tarsi annulated with fuscous. Forewings triangular, costa strongly arched near base, thence nearly straight to near apex, apex rounded, termen bowed, moderately oblique; whitish-ochreous, thickly strigulated with with dark fuscous, and suffused with orange-ochreous along veins; markings dark fuscous; a moderate fascia from $\frac{1}{6}$ costa to before mid-dorsum; a second fascia from before midcosta to beyond mid-dorsum, obscure and interrupted in disc; a large triangular costal blotch from $\frac{2}{3}$ to apex containing two short fine pale lines from costa; a blotch on dorsum before tornus, continuous with second fascia, and bisected by a narrow curved pale line from dorsum; cilia pale ochreous barred with fuscous. Hindwings with termen rounded; fuscous finely strigulated with orange-ochreous; cilia pale ochreous obscurely barred with fuscous.

One specimen.

Fam. PYALIDÆ.

Subfam. PYRALINÆ.

Gen. ABOETHETA, nov.

ἀβοηθητος, helpless.

Frons oblique, flat. Tongue well-developed. Labial palpi long (several times breadth of eye), porrect, thickened with dense appressed hairs above and beneath: terminal joint concealed. Maxillary palpi strongly dilated. Antennæ of ♂ thickened, subdentate, shortly ciliated. Posterior tibiæ with outer spurs about $\frac{2}{3}$ of inner. Forewings with 4 and 5 stalked, 7, 8, 9 stalked. Hindwings with 3 and 4 stalked, 7 anastomosing for half its length with 8.

Apparently nearest *Myrmidonistis* Meyr.

ABOETHETA PTERIDONOMA, n.sp.

πτεριδονομος, dwelling among ferns.

♂ ♀. 14-20 mm. Head white. Palpi dark fuscous: internal surface and apex of maxillary palpi white; labial palpi $2\frac{1}{2}$. Antennæ whitish, ciliations in ♂ $\frac{1}{5}$. Thorax whitish, slightly ochreous-tinged. Abdomen whitish-ochreous with transverse fuscous bars, tuft fuscous, underside white. Legs white; anterior tibiæ, femora, and inner surface of coxæ fuscous. Forewings triangular, costa straight, arched towards apex, apex rounded, termen nearly straight, oblique, whitish-ochreous, on margins and veins ochreous, markings dark fuscous; a thick streak on costa to $\frac{1}{4}$, thence a narrow costal suffusion of fuscous and ochreous, with some dark fuscous costal dots; a straight thick line from $\frac{1}{4}$ costa to $\frac{1}{4}$ dorsum; a squarish median discal dot beneath costa; a doubly sinuate line from $\frac{3}{4}$ costa to beyond mid-dorsum; a fine subterminal line; a suffused fuscous longitudinal streak from first line above middle to termen below middle, thicker posteriorly, joined by a suffuse fuscous streak from apex external to second line; a streak from second line just before dorsum along dorsum to tornus; a short line on termen below middle; cilia dark fuscous, below apex and above tornus ochreous-whitish. Hindwings with termen rounded; white, towards termen ochreous-tinged; a fuscous postmedian line; a fuscous terminal line; cilia ochreous-whitish mixed with fuscous.

This delicate and fragile species was common among the ferny undergrowth. I took 20 specimens (14♂, 6♀).

Fam. TORTRICIDÆ.

Subfam. TORTRICINÆ.

CAPUA EURYOCHRA, n.sp.

εὐρυωχρος, broadly pale.

♂. 10 mm. Head, palpi, thorax, and abdomen fuscous. Antennæ grey-whitish annulated with dark fuscous; ciliations in ♂ 1. Legs whitish; anterior pair and all tarsi annulated with fuscous. Forewings elongate, suboblong; in ♂ without fold; fuscous; some dark fuscous costal dots and a larger spot at $\frac{5}{6}$; a very broad transverse ochreous-whitish fascia before middle, not reaching costal edge, leaving a broad fuscous basal patch; a dark fuscous median fascia immediately following pale fascia; cilia fuscous dotted with dark fuscous. Hindwings and cilia grey.

One specimen in fair condition.

CAPUA sp.

A small, brownish species. One ♀ example badly rubbed, and unfit for description.

TORTRIX sp.

One ♀ example, with unusually long palpi(5), too wasted for recognition.

TORTRIX PARAPLESIA, n.sp.

παραπλησιος, resembling, akin.

♀. 25 mm. Head pale fuscous-brown. Palpi moderate($2\frac{1}{2}$); pale fuscous-brown. Antennæ pale fuscous-brown, towards apex fuscous. Thorax pale fuscous-brown with a transverse fuscous line near anterior edge behind tegulæ and crossing patagia. Abdomen grey-whitish. Legs ochreous-whitish with some ochreous and fuscous irroration; tarsi annulated with fuscous; anterior femora and tibiæ fuscous on dorsal surface. Forewings oblong, costa strongly arched near base thence straight, apex rounded-rectangular, termen not oblique, rounded towards tornus; brown-whitish irrorated with reddish-brown; towards costa strigulated with fuscous; a pale fuscous spot on $\frac{1}{4}$ dorsum followed by two or three strigulations; an oblique central fascia slightly darker than ground-colour, its anterior edge defined, irregularly dentate, from $\frac{1}{3}$ costa to $\frac{2}{3}$ dorsum, its posterior edge suffused; a fuscous erect line from tornus to beyond middle of disc; three short fuscous lines or strigulæ between this and termen; cilia reddish-brown, apices whitish, bases barred with fuscous. Hindwings with termen gently rounded; grey faintly strigulated with darker grey; cilia whitish with a grey sub-basal line.

Similar to *T. sobriana* Wlk., but the palpi considerably shorter. The palpi in *T. sobriana* are $3\frac{1}{2}$.

One specimen.

Subfam. EUCOSMINÆ.

SPILONOTA sp.

One ♂ specimen, which was accidentally destroyed, resembling *S. semicanella* Wlk.

Spilonota deloschema, n.sp.

δηλοσχημος, with clear, distinct pattern.

♀. 12 mm. Head white. Palpi 3; fuscous, apex and inner surface whitish. Thorax white, anterior edge and a posterior spot dark fuscous, some ochreous scales in patagia. Abdomen grey. Legs grey-whitish; anterior pair, except tarsi, fuscous. Forewings narrow-oblong, costa gently arched, apex round-pointed, termen obliquely rounded; fuscous; costa with short whitish strigulations; an elongate whitish spot somewhat irregularly outlined on dorsum near base, and another similar spot on mid-dorsum, ill-defined in disc, strigulated with fuscous on dorsum, and partly suffused with ochreous; a blackish triangular blotch in disc before middle connected narrowly with dorsum between whitish spots; a sharply defined blackish blotch on dorsum before tornus, projecting into disc posteriorly; a blackish apical spot, connected with a blackish subapical blotch; from the latter proceed two silvery streaks to tornus, the intervening space suffused with ochreous; cilia fuscous, bases whitish. Hindwings and cilia grey.

One example, which buried itself in wet moss, but fortunately re-emerged, so that I was able to capture it.

Fam. TINEIDÆ.

Subfam. Gelechianæ.

Gen. Enchoptila, nov.

ἐγχοπτιλος, with spear-shaped wing.

Head loosely scaled. Tongue feebly developed. Palpi short, slender, subascending; second joint shortly rough-haired beneath. Antennæ longer than forewings; in ♂ simple; basal joint rather stout and long, with strong pecten. Thorax not crested. Forewings elongate, costa obtusely angled; 7 and 8 stalked, 7 to costa. Hindwings slightly broader than forewings, termen sinuate; 3 and 4 coincident (4 absent), 5, 6, 7 parallel.

ENCHOPTILA IDIOPIS, n.sp.

ἰδιωπις, peculiar, distinct.

♂. 14-15 mm. Head brownish; face and palpi brown-whitish. Antennæ whitish, sharply annulated, except near base, with dark fuscous. Thorax brown, apices of patagia white. Abdomen brown-whitish. Legs brown-whitish. Forewings narrow-elongate, costa slightly arched near base, thence nearly straight to $\frac{4}{5}$, where it is obtusely angled, thence straight to apex, apex acute, termen straight, extremely oblique; brown; a broad white line from mid-dorsum obliquely outwards, curved in middle of disc, and returning to tornus; apical $\frac{1}{4}$ of costa and termen narrowly white; a black apical spot sending inwards a very short longitudinal streak; cilia brownish with a brown basal line, at apex fuscous. Hindwings with termen strongly sinuate beneath apex; whitish, towards apex and termen suffused with grey; cilia whitish.

Three specimens.

Subfam. ŒCOPHORINÆ.

Gen. DASYCERCA, nov.

δασυκερκος, hairy-tailed.

Head smooth, sidetufts small, loosely appressed. Palpi rather short, second joint not reaching base of antennæ, smooth-scaled, terminal joint shorter, slender, recurved. Antennæ in ♂ moderately ciliated(1), basal pecten developed. Thorax smooth. Abdomen in ♂ with large dense tufts of hair from lateral aspects of fifth segment, and from dorsal aspect of succeeding segments, apical tuft well developed. Forewings elongate, termen very oblique; vein 7 to termen. Hindwings lanceolate.

A development of *Macharetis*, distinguished by the abdominal tufts of ♂.

DASYCERCA APOCRYPHA, n.sp.

ἀποκρυφος, hidden, obscure.

♂ ♀. 11-13 mm. Head and thorax whitish-ochreous. Palpi whitish-ochreous with a few fuscous scales. Antennæ fuscous.

Abdomen whitish-ochreous, sometimes suffused with purplish, in ♀ fuscous towards apex, tufts whitish-ochreous (in Tambourine examples grey). Legs whitish-ochreous; anterior and middle pairs more or less infuscated. Forewings narrow, elongate, costa moderately arched, apex pointed, termen very obliquely rounded; whitish-ochreous more or less irrorated with fuscous; in ♂ without markings, or with a single fuscous dot on fold at $\frac{1}{4}$, in ♀ usually with dots also in disc at $\frac{1}{3}$ and $\frac{2}{3}$, and a fourth dot on dorsum near tornus; cilia whitish-ochreous with fuscous irroration. Hindwings grey or whitish-grey; cilia whitish-ochreous, sometimes with a grey sub-basal line.

Nine specimens (3 ♂, 6 ♀). Also from Mt. Tambourine, in October and November (5 ♂, 1 ♀).

Machæretis heteropa, n.sp.

ἑτερωπος, different, unlike.

♀. 12 mm. [Head rubbed]. Palpi whitish-ochreous; terminal joint fuscous. Antennæ fuscous; basal joint whitish-ochreous. Thorax dark fuscous. Abdomen fuscous. Legs whitish-ochreous; anterior pair except tarsi fuscous; middle tibiæ and all tarsi annulated with fuscous. Forewings narrow-elongate, costa gently arched, apex round-pointed, termen very obliquely rounded; ochreous-whitish with fuscous markings; a narrow basal fascia; a costal streak extending from this to median fascia; a very broad median fascia, enclosing an ochreous-whitish spot on costa before middle, and another on dorsum beyond middle; posterior edge extending obliquely to tornus; a large apical blotch; cilia fuscous. Hindwings lanceolate; brownish-ochreous; cilia grey.

Readily distinguished by the colour of the hindwings.

One specimen.

Ocystola symbleta, n.sp.

συμβλητος, comparable.

♂ ♀. 15-16 mm. Head and palpi pale yellow. Antennæ whitish-ochreous, ciliations in ♂ $2\frac{1}{2}$. Thorax yellowish, anterior edge fuscous. Abdomen grey, with an ochreous bar on dorsum of segments 4 to 9. Legs pale yellow; anterior pair fuscous anteriorly. Forewings suboblong, rather broad, costa gently arched, apex round-pointed, termen nearly straight, moderately oblique; pale ochreous, more or less suffused with fuscous except towards base; a transversely elongate dark fuscous discal spot at $\frac{2}{3}$; base of costa fuscous; cilia yellow-ochreous, on tornus grey. Hindwings elongate-ovate; dark grey, on costa and beneath apex pale ochreous.

Allied to *O. acroxantha* Meyr. The complete absence of basal discal dots should be noticed.

Two specimens.

Ocystola tanythrix, n.sp.

ταννθριξ, long-haired, in allusion to antennæ.

♂. 15 mm. Head, palpi, and thorax pale ochreous. Antennæ whitish-ochreous; ciliations in ♂ extremely long(10). Abdomen pale brownish-ochreous, apices of segments whitish. Legs whitish-ochreous; anterior pair fuscous. Forewings moderately narrow, posteriorly dilated, costa gently arched, apex round-pointed, termen nearly straight, moderately oblique; pale yellowish; a fuscous suffusion along costa; a fuscous discal dot at $\frac{1}{3}$, a second beyond it on fold, and a third at $\frac{2}{3}$; a broad fuscous terminal band not quite reaching tornus; cilia pale yellowish, on tornus fuscous. Hindwings elongate-ovate; whitish; cilia whitish.

One specimen.

Cœsyra bathrophæa, n.sp.

βαθροφαιος, with dusky base.

♂ ♀. 16-18 mm. Head ochreous-yellow. Palpi fuscous; inner surface and terminal joint ochreous. Antennæ fuscous; ciliations in ♂ 1. Thorax ochreous-yellow, bases of patagia dark fuscous. Abdomen fuscous, apices of segments ochreous-whitish. Legs fuscous; tarsi annulated with pale ochreous; posterior pair wholly pale ochreous. Forewings elongate, not dilated, costa gently arched at base, thence nearly straight, apex rounded, termen very obliquely rounded; ochreous-yellow; markings dark fuscous: a moderate basal fascia; a dot in disc at $\frac{1}{3}$, a second on fold beyond it, a third above middle, a fourth at $\frac{2}{3}$; a scanty irroration between last dot and tornus; an inwardly oblique streak from $\frac{5}{6}$ costa, abruptly bent outwards beneath costa, and continued narrowly and interruptedly, near and parallel to termen, to tornus; cilia ochreous-yellow. Hindwings elongate-ovate; grey; cilia whitish-ochreous.

Three specimens; one wasted ♂, and two ♀ in good condition.

Cœsyra syneches, n.sp.

συνεχης, connecting.

♂. 12-15 mm. Head pale ochreous. Palpi fuscous; terminal joint whitish-ochreous. Antennæ fuscous; ciliations of ♂ 1. Thorax brownish-fuscous. Abdomen fuscous, tuft ochreous-whitish. Legs fuscous; hairs on posterior tibiæ ochreous-whitish. Forewings scarcely dilated, costa moderately arched, apex round-pointed, termen very obliquely rounded; pale brownish-fuscous, markings dark fuscous; a dot in disc at $\frac{1}{3}$, a second just beyond it on fold, and a third, much larger and transversely oval, at $\frac{2}{3}$; an ill-defined spot on midcosta; a very fine line from $\frac{5}{6}$ costa obliquely inwards, bent outwards beneath costa, and continued parallel to termen, ending in a suffused spot on tornus; cilia brown-whitish, with an ill-defined fuscous median line. Hindwings elongate-oval; grey; cilia pale grey.

A generalised form related to some species of *Machæretis*, but the hindwings are not lanceolate.

Eleven specimens, all males.

Protomacha leucophara, n.sp.

λευκοφαρος, white-robed.

♀, 15 mm. Head white. Palpi very long, second joint much exceeding base of antennæ, shortly rough-haired towards apex above and beneath, terminal joint long, about $\frac{1}{2}$ second, slender; white, terminal joint fuscous. Antennæ fuscous. Thorax fuscous. Abdomen grey, bases of middle segments ochreous-grey. Legs ochreous-whitish; anterior pair fuscous. Forewings elongate, slightly dilated, costa slightly arched, apex round-pointed, termen very obliquely rounded; white with suffused fuscous markings; a short streak on costa from base; discal dots at $\frac{1}{3}$ and $\frac{2}{3}$ with some fuscous irroration between; a suffused spot on fold between these and extending to tornus; an apical blotch, its anterior margin outwardly curved and extending from $\frac{4}{5}$ costa to tornus; cilia white mixed with fuscous. Hindwings whitish, towards apex whitish-grey; cilia whitish.

Two specimens.

PROTOMACHA CATHARA, n.sp.

καθαρος, spotless.

♂ 16 mm. Head white. Palpi very long, second joint extremely long, loosely rough-haired above and beneath towards apex; whitish, middle of outer surface of second joint and a subterminal ring fuscous, terminal joint fuscous. Thorax white. Abdomen grey, bases of segments brownish-ochreous. Legs ochreous-whitish; anterior pair fuscous. Forewings elongate, posteriorly dilated, costa slightly arched, apex round-pointed, termen obliquely rounded; shining white, towards margins very faintly ochreous-tinged; cilia white. Hindwings and cilia grey.

Smaller than *P. cara* Butl., the palpi more fuscous, and differing in their structure, which approaches more to that of the genus *Pleurota*.

One specimen.

COMPSOTROPHA PASTEODES, n.sp.

παστεωδης, speckled.

♂♀. 19-20 mm. Head white. Palpi whitish, outer aspect of second joint fuscous from base to beyond middle and again at apex. Antennæ ochreous-whitish with fine dark fuscous annulations; cilia in ♂ 3. Thorax whitish more or less mixed with fuscous. Abdomen brownish-ochreous, apices of segments grey, tuft ochreous-whitish. Legs whitish-ochreous: anterior pair fuscous; middle tibiæ and tarsi annulated with fuscous. Forewings elongate, posteriorly dilated, costa moderately arched towards base, thence nearly straight, apex round-pointed, termen obliquely rounded; whitish, rather thickly irrorated with dark fuscous; markings dark fuscous; a spot on base of costa giving off a short subcostal streak; a spot on base of dorsum; a discal spot at $\frac{1}{3}$, a second beneath it on fold, and a third in disc at $\frac{2}{3}$; a broadly suffused line from costa before apex to midtermen, continued along termen to tornus; cilia whitish mixed with dark fuscous. Hindwings whitish-grey, towards base whitish; cilia whitish.

This species has the facies of a *Phlœopola*, but the antennal ciliations are long, and vein 7 runs distinctly to termen. I can find no indication of thoracic crest or antennal pecten.

Two specimens, ♂♀, of which the former is in good condition.

PHILOBOTA ALYPA, n.sp.

ἄλυπος, cheerful.

♀. 17 mm. Head snow-white. Palpi white, basal half of second joint dark fuscous. Antennæ fuscous. Thorax dark fuscous, posterior edge white. Abdomen whitish, bases of segments 5 to 8 ochreous-fuscous. Legs ochreous-whitish with some fuscous suffusion; anterior pair mostly fuscous. Forewings elongate, scarcely dilated, costa moderately arched, apex round-pointed, termen very obliquely rounded; white, markings dark fuscous; an elongate spot on base of costa; a broad slightly oblique fascia from costa before middle, to dorsum beyond middle, dilated towards dorsum, its anterior edge slightly curved, posterior edge bent outwards below middle of disc; a second broad fascia from $\frac{3}{4}$ costa to termen just above tornus; a discal dot at $\frac{3}{5}$, sometimes connected with both fasciæ; a triangular subapical spot on termen; cilia pale ochreous, with some fuscous irroration on bases. Hindwings whitish, with some grey suffusion towards termen; cilia whitish-ochreous.

One specimen.

HOPLITICA MILTOPSARA, n.sp.

μιλτοψαρος, reddish-grey.

♀. 22 mm. Head ochreous-grey. Palpi whitish, apex of third joint fuscous. Antennæ ochreous-grey annulated with dark fuscous. Thorax ochreous-fuscous. Abdomen whitish-grey obscurely barred with brownish-ochreous. Legs ochreous-whitish; femora whitish; anterior pair fuscous anteriorly, tarsi barred with whitish. Forewings suboblong, not dilated, costa rather strongly arched, apex rounded-rectangular, termen obliquely rounded; whitish-grey finely irrorated with brick-red, so as to appear reddish-grey; markings pale fuscous; costal edge whitish; a minute dot in disc at $\frac{1}{4}$, a second beyond it on fold, and a third in middle; a very slender finely dentate line from midcosta very obliquely outwards, bent at a right angle in disc, and thence curved to dorsum before tornus; a series of minute dots on apical fourth of costa and throughout termen; cilia reddish-grey, apices whitish. Hindwings and cilia grey-whitish.

One specimen.

Phlœopola chloreis, n.sp.

χλωρηΐς, greenish.

♂. 26-30 mm. Head and thorax ochreous-whitish. Palpi ochreous-whitish; terminal joint partly suffused with fuscous. Antennæ ochreous-whitish; ciliations in ♂ 1. Abdomen ochreous-whitish, irrorated, except at apices of segments, with fuscous. Legs ochreous-whitish; anterior pair fuscous; anterior and middle tarsi fuscous annulated with ochreous-whitish. Forewings elongate, scarcely dilated, costa strongly arched, apex rounded, termen obliquely rounded; whitish with patchy greenish suffusion, and a few scattered fuscous scales; markings dark fuscous; base of costa dark fuscous; some dark fuscous irroration beneath costa towards base; a dot in disc at $\frac{1}{4}$, a second in disc before middle, a blotch on fold beneath and between these two dots, and a rather large roundish spot in disc beyond middle; a subapical costal blotch giving off a curved line to tornus; a spot on tornus; cilia whitish, with a few fuscous scales. Hindwings whitish irrorated with grey; cilia whitish.

Recognisable by its large size, and greenish colouring. The two specimens are not in good condition; the thoracic crests are denuded, and vein 7 is below apex, but I think the species must be referred here.

Gen. Epithymema, nov.

ἐπιθυμημα, an object of desire.

Palpi very long, recurved: second joint extremely long, slightly thickened at apex, with smoothly appressed scales, slightly rougher in ♀; terminal joint slender, less than half second. Antennæ with strong basal pecten; ciliations in ♂ moderate (1). Thorax not crested. Forewings with vein 7 to apex. Hindwings elongate-ovate.

Differs from *Eulechria* in the extremely long palpi, the second joint being especially long (about 6).

Epithymema disparile, n.sp.

Disparilis, dissimilar, unequal.

♂. 18-19 mm. Head ochreous-yellow. Palpi whitish-ochreous; anterior edge of terminal joint and basal half of external surface of second joint fuscous. Antennæ fuscous; ciliations in ♂ 1. Thorax orange-ochreous, anterior edge blackish. Abdomen dark fuscous, towards base ochreous-tinged, tuft pale ochreous. Legs pale ochreous, dorsal surfaces fuscous. Forewings elongate, scarcely dilated, costa nearly straight, apex rounded, termen obliquely rounded; orange-ochreous; costal edge blackish towards base; cilia orange-ochreous, on tornus dark fuscous. Hindwings ochreous, apical half suffused with dark fuscous; cilia dark fuscous with a narrow ochreous basal line on costa and apex apices broadly ochreous.

♀. 18-20 mm. Head blackish, face ochreous. Palpi blackish. Thorax blackish, outer half of patagia and two lateral stripes reddish-orange. Legs blackish; apices of coxæ and ventral surface of tarsi ochreous-whitish. Forewings reddish-orange; whole of disc, except margins and some longitudinal streaks, uniformly and more or less deeply suffused with fuscous. Hindwings with ochreous colour more restricted to base.

A remarkable form, showing sexual dimorphism, very unusual in this subfamily. Seven specimens, 5 ♂, 2 ♀.

Eulechria bathrophæa, n.sp.

βαθροφαιος, with fuscous base.

♀. 21 mm. Head whitish, sidetufts ochreous. Palpi whitish. Antennæ fuscous. Thorax whitish, patagia dark fuscous. Abdomen ochreous-fuscous finely irrorated with whitish-ochreous, apices of segments whitish-ochreous. Legs ochreous-whitish; anterior pair fuscous; middle pair with some fuscous irroration. Forewings moderate, slightly dilated, costa rather strongly arched, apex round-pointed, termen obliquely rounded; whitish; costal edge faintly ochreous-tinged; markings dark fuscous; a narrow basal fascia, prolonged along costa to $\frac{1}{4}$, and along dorsum to $\frac{1}{6}$; a narrow discal mark at $\frac{1}{4}$, a second beyond it on fold, a third above middle at $\frac{3}{8}$, and a fourth rather larger in middle; the last is suffusedly connected with costa at $\frac{3}{5}$ and dorsum at $\frac{5}{6}$, forming an incomplete fascia; some minute longitudinal strigulæ in terminal part of disc, on terminal part of costa, and on termen; cilia ochreous-whitish. Hindwings grey; cilia whitish-ochreous.

The basal (not subbasal) fascia is a noteworthy characteristic.

One specimen.

Subfam. GRACILARIANÆ.

CYPHOSTICHA BRYONOMA, n.sp.

βρυονομος, dwelling in moss.

♂♀. 14-16 mm. Head greenish. Palpi with a long tuft of hairs on lower surface of apex of second joint nearly as long as terminal joint; dark fuscous. Antennæ whitish annulated with dark fuscous. Thorax moss-green. Abdomen dark grey, towards base paler and sometimes greenish. Legs fuscous mixed with greenish; middle tibiæ with a central and an apical dense scale-tuft; middle tarsi not thickened. Forewings moss-green, with white strigulæ in places, and more or less dotted with dark fuscous; costa dark fuscous, its middle half shortly strigulated with white, sometimes also some white strigulations near base; sometimes a white dot on dorsum at $\frac{1}{3}$, a second at $\frac{2}{3}$, and a third at tornus, but these are usually obsolete; cilia greenish mixed with dark fuscous, on dorsum grey. Hindwings and cilia grey.

Variable in its mimetic colouring. Six specimens (1 ♂, 5 ♀) taken, resting on moss on tree-trunks.

Subfam. HYPONOMEUTINÆ.

ZELLERIA CYNETICA Meyr.

Two specimens. Also from Brisbane, Mount Tambourine, and Killarney, Queensland; Murrurundi, Sydney, and Katoomba, N.S.W.; Gisborne, Victoria; Launceston, Deloraine, George's Bay, and Hobart, Tasmania.

Subfam. TINEINÆ.

XYSMATODONA POLYSTONA, n.sp.

πολυστονος, sorrowful.

♀. 16 mm. Head brown-ochreous-whitish. Palpi and antennæ fuscous. Thorax and abdomen fuscous. Legs fuscous; tarsi annulated with ochreous-whitish. Forewings rather elongate, costa rather strongly arched, apex rounded, termen very obliquely rounded; ochreous-whitish densely irrorated with fuscous, markings obscure, due to absence of fuscous irroration; a large subbasal dorsal blotch nearly reaching to costa; ill-defined costal spots at middle, $\frac{2}{3}$, and $\frac{5}{6}$; a dark fuscous spot preceding, and two following last pale spot; a broad interrupted dark fuscous terminal line; cilia fuscous. Hindwings and cilia grey.

One specimen. Veins 7 and 8 of forewings are long-stalked, 7 to termen.

DESCRIPTION OF A NEW TIGER-BEETLE FROM NORTH-WESTERN AUSTRALIA.

By Thomas G. Sloane.

Cicindela gilesi, n.sp.

Elongate-oval. Glabrous (including sternal side-pieces and posterior coxæ), legs (including four anterior coxæ) clothed with white hairs. Head, prothorax, and undersurface cupreous (sixth ventral segment in ♂ bronzy, in ♀ brownish); labrum and base of mandibles lacteous; palpi pallid, apical joint viridescent; legs æneous, coxæ and apex of femora dark testaceous; front in ♂ bright green, in ♀ cupreous; antennæ with four basal joints cupreous; elytra cream-coloured, with suture and two longitudinal stripes on each elytron cupreous, inner discal stripe uniting with the sutural stripe beside scutellum, and with outer stripe at apex (sutural stripe reaching apex of elytra, discal stripes terminating some distance from the apical margin).

♂. Head shagreened, 2·6 mm. across eyss. Labrum truncate at apex; lateral angles rounded; four submarginal setæ in a transverse row. Prothorax small, broader than long (1·7 × 2·1 mm.), wide across base (2 mm.); sides lightly arcuate on anterior half; apex arcuate (very slightly prominent in middle); base truncate; pronotum depressed, shagreened, transversely impressed before and behind, posterior transverse impression limited at each end by the antebasal nodes; these nodes near basal margin, prominent, obtuse, truncate behind. Elytra oval (6 × 3·5 mm.); each elytron at apex separately roundly produced, a very short mucro at end of suture.

♀. Differs from ♂ by the larger size; front cupreous; labrum with a very small triangular prominence on each side of middle; prothorax widest across basal nodes (1·7 × 2·6 mm.), basal nodes more prominent and preceded by a light lateral sinuosity, base emarginate; elytra (6·5 x 4) with sutural mucrones stronger.

Length, ♂ 10, ♀ 10·5; breadth, ♂ 3·5, ♀ 4 mm.

Hab.—Western Australia, Condon (discovered by Mr. H. M. Giles, of the Zoological Gardens, Perth, at Condon, where it was plentiful. Four specimens (3 ♂, 1 ♀) have been examined).

This is the species which I had taken to be *C. tetragramma* Boisd., when I described *C. lineifera* (These Proceedings, 1913, p.401). Dr. Walther Horn, of Berlin, to whom I sent a cotype of my *C. lineifera*, has assured me that *C lineifera* Sl., is the true *C. tetragramma* Boisd., and I recognise that his view is the correct one. I have not now a specimen of *C. tetragramma* Boisd., for comparison, but my note on *C. lineifera* shows that *C. gilesi*(♀) differs from *C. tetragramma*(♀) by the metallic colour being cupreous, not viridiæneous; prothorax not roundly ampliate on sides, not narrowed at base, lateral basal nodes much more strongly developed.

C. trivittata Macl., and *C. albolineata* Macl., are distinct species, differing from one another, and from *C. tetragramma* Boisd., and *C. gilesi* Sl. I have compared *C. gilesi*(♀) with the type-specimen(♀) of *C. trivittata*, and the type-specimens (two females) of *C. albolineata* in the Macleay Museum. From *C. trivittata* (which I had wrongly concluded to be a variety of *C. tetragramma*, cf. These Proceedings, 1906, p.320), *C. gilesi* differs by pattern of elytra (discal cupreous stripes not linked together by two bars); prothorax with basal nodes less prominent, stouter and far more obtuse at apex, not evidently in front of basal margin and not with a marked sinuosity behind them.

From *C. albolineata*, *C. gilesi* differs by pattern of elytra (not with a broad metallic sutural area common to both elytra behind scutellum); prothorax with lateral basal nodes far more prominent, pronotum far less strongly and closely shagreened; labrum not rounded or subprominent in middle of anterior margin, only four submarginal setæ in a transverse row (not one on each side and from four to six in middle).

It will be useful to note here, that the valid species of the *tetragramma*-group of the genus *Cicindela* are, at the present time, the following, viz., *C. tetragramma* Boisd.,(= *C. macleayi* Cast., = *C. lineifera* Sl.), *C. trivittata* Macl., *C. albolineata* Macl., *C. aurita* Sl., *C. queenslandica* Sl., and *C. gilesi* Sl.

I take advantage of the present occasion to draw attention to the fact, that Dr. Walther Horn has recently described three new forms of Cicindela from Australia in the "Archiv für Naturgeschichte," 1913—*C. sparsim-pilosa*, n.sp., Darwin; *C. iosceles* Hope, subsp. *setoso-abdominalis*, n.subsp., Darwin; and *C. nigrina* Macl., subsp. *rugicollis*, Australia.

REVISIONAL NOTES ON AUSTRALIAN CARABIDÆ.

PART V.

BY THOMAS G. SLOANE.

Tribe HELLUONINI.

Hope, Coleopterist's Manual, 1838, ii., 110; Lacordaire, Genera des Coléoptères, 1854, i., 90; Horn, G. H., Trans. Amer. Ent. Soc., ix., 1881, 160.

Head punctate, one or two supraorbital sensitive hairs on each side. Antennæ stout, rising under distinct frontal plates (these plates punctate-setose). Mandibles with a single tooth near base, setose on outer side. Labrum large and prominent, with two, four, or six sensitive hairs. Labium with ligula large, corneous (in Australian genera setose on sides, and often on upper and lower sides); paraglossæ cartilaginous or corneous, small, narrow, pointed, not reaching to apex of ligula, very small and reduced in Australian genera. Maxillæ with inner lobe hooked (the hook behind the apex in some Australian genera); inner sides sometimes with a median protuberance. Palpi stout. Prothorax punctate. Elytra truncate (except in *Helluarchus*), striate; dorsal punctures present or not on third interstice; base not bordered near scutellum. Ventral segments not bordered on sides. Tarsi setose on upper surface, in ♂ biseriately squamose beneath (only the second and third joints with two narrow median rows of squamæ in all Australian genera); ungues simple.

All the genera known, to me, to belong to the tribe *Helluonini*, will be found tabulated below. The following genera are excluded here, mostly following former authors: *Helluodes*, *Planetes*, *Polystichus*, *Acrogenys*, *Lachnoderma*, *Litho-*

strotus (= *Lestianthus*), and *Parallelomorpha*. In regard to the last-mentioned genus, which is unknown to me in nature, an examination of the original figure and description has convinced me that it is not a member of the present tribe.

Primitive characters.—The following appear to be primitive characters in the Helluonini. *Body* and its members (including interstices and epipleura of elytra) densely punctate-setose; wings present. *Head* with two sensitive hairs on each side above eyes. *Antennæ* with three basal joints cylindrical and sparsely setose. *Mandibles* short. *Labrum* with six sensitive hairs. *Mentum* punctate, median tooth triangular. Ligula wide; two anterior sensitive setæ; margin not fringed with setæ. Paraglossæ narrow, cartilaginous, nearly as long as ligula, adnate to it, except just at tip (e.g., *Omphra*). *Abdomen* with sensitive apical hairs. *Legs*: anterior femora without a triangular prominence on lower side near base; tarsi, in ♂, with joints 1-4 dilatate and biseriately squamose on lower side. According to the degree to which the characters mentioned above are represented in a species, so may it be regarded as approaching the ancient Helluonid type; and in accordance with the degree to which they become lost, so may it be supposed to depart from the original type.

Primitive characters of the Australian group.—Head with orbits protuberant and setose behind eyes. *Antennæ* with fourth joint less cylindrical than third and densely pubescent (e.g., *Helluodema*). *Labrum* with more than two sensitive hairs. *Mentum* with a prominent triangular median tooth. *Ligula* with a fringe of setæ. *Paraglossæ* cartilaginous, rudimentary. *Palpi* with penultimate joint short. *Pronotum* densely punctate and longitudinally rugose. *Abdomen* with apical sensitive hairs (e.g. *Dicranoglossus**). *Legs*: anterior femora with an antebasal prominence on lower side; anterior tarsi in ♂, with second and third joints dilatate and biseriately squamulose in middle of lower side.

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* Probably a case of reversion.

Following the views given above, the tribe may be divided into two divisions or groups, as under.

i. Anterior femora without antebasal protuberance. Ligula not fringed with setæ. Head always with two supraorbital hairs on each side.................................*Extra-Australian group.*

ii. Anterior femora with a triangular prominence on lower side near base. Ligula setose on sides. Head with one supraorbital sensitive hair on each side (except *Epimicodema*)... ....*Australian group.*

i. *Extra-Australian group.—Table of Genera.*

1(4). Mentum with a long spiniform median tooth.
2(3). Tarsi with fourth joint entire........................ .... *Macrocheilus.*
3(2). Tarsi with fourth joint bilobed............................ *Creagris.*
4(1). Mentum with a strongly developed stout tooth.
5(8). Tooth of mentum long and pointed.
6(7). Elytra with odd dorsal interstices costate, even dorsal interstices depressed, pluripunctate; prothorax with basal angles distant from peduncle...... *Triænogenius.*
7(6). Elytra with dorsal interstices equal; prothorax with basal angles near peduncle................ .... *Meladroma.*
8(5). Tooth of mentum triangular.
9(10). Apterous Asiatic genus....... .... *Omphra.*
10(9). Winged American genera.
11(12). Labrum not triangularly prominent in middle....... *Helluomorpha.*
12(11). Labrum triangularly prominent in middle .... *Pleuracanthus.*

Genus Creagris.

Nietner, Journ. Asiat. Soc. Beng., 1857: *Pseudhelluo* Castelnau, Trans. Roy. Soc. Victoria, viii., 1868, 104.

There seem to be two species of the genus *Creagris* in Queensland, *C. labrosus* Niet., and *C. wilsoni* Cast. Following Gestro, these can be separated as under:—

Prothorax with basal angles obtuse............... *C. labrosus* Niet.
Prothorax with basal angles acute.................. *C. wilsoni* Cast.

Creagris labrosus Nietner.

Journ. Asiat. Soc. Beng., 1857, 139; Gestro, Ann. Mus. Civ. Genova, vii., 1875, 871.

A single specimen, given to me by Mr. C. French as from Mackay, is in my collection. I cannot differentiate it from a specimen from Java, which is evidently *C. labrosus.* Length 9 mm.

Hab.—Queensland, Java, Ceylon.

C. wilsoni Cast., from Brisbane, is unknown to me. Gestro described it, and gives a figure of the prothorax, showing the sharply marked basal angles of the prothorax; he gives the length as "10½ mm."(*l.c*, pp.869, 872).

ii. *Australian group.—Table of Genera.*

1(10). Head with large postocular prominences.
2(5). Labrum convex, apex pointed and with more than four sensitive hairs; clypeus emarginate.
3(4). Mentum with strong triangular median tooth; ligula rounded at apex.................. .... *Helluonidius.*
4(3). Mentum edentate. Ligula furcate. (Colour cyaneous).... .... *Dicranoglossus.*
5(2). Labrum depressed, apex widely rounded, never with more than four sensitive hairs; clypeus truncate. (Mentum with triangular median tooth. Colour black).
6(9). Labrum with four sensitive hairs.
7(8) Prothorax strongly sinuately constricted to base; ligula narrow, elongate, rounded at apex; maxillæ not extending forward beyond apical hook..... ..... *Helluosoma.*
8(7). Prothorax lightly narrowed to base; ligula wide, short, emarginate at apex; maxillæ with apex projecting beyond hook...................................... *Helluodema.*
9(6). Labrum bisetose. (Ligula wide, emarginate at apex) *Epimicodema.*
10(1). Head with postocular prominences small or obsolete.
11(16). Apterous; metasternum shorter between middle and posterior coxal cavities than length of posterior coxæ, episterna short, wide posteriorly; elytra with ninth interstice not disproportionately narrow in comparison with eighth.
12(13). Mentum with lobes elongated to a point at apex, median tooth triangular; maxillæ with inner side not protuberant in middle; elytra with third, fifth, and seventh interstices costate, or carinate. .... *Helluo.*
13(12). Mentum with lobes ordinary, median tooth short, wide; maxillæ with a strong triangular median prominence on inner side; elytra with interstices not costate.
14(15). Elytra rounded at apex, depressed on disc, strongly declivous to sides and apex .... *Helluarchus.*
15(14). Elytra truncate, gently convex........................... *Helluapterus.*

16(11). Winged; metasternum much longer between middle and posterior coxal cavities than length of posterior coxæ, episterna elongate; elytra with ninth interstice very narrow in comparison with eighth.

17(23). Ligula wide, rounded at apex; elytra with eighth interstice pluripunctate.

19(20). Mentum with a short wide median tooth; maxillæ with a strong triangular prominence on inner side (except in *G. longipenne*)................................ *Gigadema.*

20(19). Mentum edentate; maxillæ with inner side not triangularly protuberant in middle.

21(22). Prothorax hexagonal, strongly narrowed to base, anterior angles marked in ♂, rounded in ♀, basal angles close to peduncle; ♂ with humeral angles of elytra rounded.. *Neohelluo.*

22(21). Prothorax transverse, lightly narrowed to base, anterior angles rounded, basal angles distant from peduncle; ♂ with humeral angles of elytra dentate. *Ænigma.*

23(17). Ligula furcate; elytra with eighth interstice biseriately punctate.. *Ametroglossus.*

Phylogeny.—In studying the phylogeny of the Helluonini, attention should be given to the "primitive characters" previously mentioned, and to those which follow; a careful consideration of all of them is necessary in seeking for evidence, on which to base conclusions as to the position of genera in the tribe, or of species in the genera. This part of the subject is treated here only in reference to the Australian Helluonini; and to enable the bearing of some obscure and perplexing phases in the study of phylogeny to be better comprehended, the following note on convergence is offered.

Convergence.—The term convergence has been used by Darwin to denote those resemblances which are so often found between living things, but which are not due to inheritance from a common ancestral type. Few facts in natural history fill the mind with more astonishment than many of the cases of convergence between animals not at all nearly allied. For instance, the resemblance in external form between whales and fish (Origin of Species, sixth ed., Chapter iv., p.100).

In the Insecta, there are innumerable instances of convergence between distant members of the class. Wallace gives many such in his book "Darwinism" (Chapter ix., p.258). I have seen at Mulwala, N.S.W , a moth that resembled a common ichneumon wasp; and, at Brisbane, running on the trunks of trees, a Mantispa that looked like a tiger-beetle. There are instances of convergence between insects of different Orders, which are attributed by naturalists to "mimicry," and (as in cases of resemblance due to protective colouring among animals, birds, and insects) we can here see a cause for convergence.

Coming to the Order Coleoptera, there are many cases of convergence, as when longicorn beetles resemble weevils and Malacoderms (perhaps mimicry). Often when the general resemblance is not great, there is similarity in different parts of the body. For example, the large, convex labrum covering the mandibles in *Dystipsidera* (Cicindelidæ) and *Helluonidius* (Carabidæ); the elytra, with lateral parts inflexed (*pseudo-epipleuræ*), in *Manticora* and *Amblychila* (Cicindelidæ), and *Storthodontus*, *Dyscherus*, and *Crepidopterus* (Carabidæ); the posterior trochanters pointed at apex in *Amblychila* and *Parroa* (Carabidæ).

Taking the Carabidæ, the following instances of convergence may be noted; doubtless many others would be found by careful study.

Clypeus and mandibles armed—some species of the genera *Carenidium* and *Carterus*. Maxillæ with outer lobe in one piece—*Amerizus*, *Callistus*, *Stenochila* and *Homothes*. Submentum armed—*Dioctes* and some species of *Gigadema*. Elytra multistriate in the genera *Pamborus*, *Loricera*, *Tachys* (*T. nervosus* Sl.), *Planetes* (*P. australis* Macl.), *Catascopus* (*C. mirabilis* Bates). Ventral segments with a transverse sulcus—*Clivina*, *Dicælus*, *Baripus*, *Cratogaster*, etc. Anterior femora more or less dentate on lower side in ♂—*Blethisa*, *Mystropomus*, some species of *Chlænius*, *Rhæbolestes*, etc. Penultimate joint of tarsi bilobed—*Amblytelus*, *Colpodes*, *Helluonidius*, *Sarothrocrepis*, etc.

These are all cases in which the resemblances seem more likely to be due to convergence than to reversion; but, as the natural groups in which resemblances are found become smaller, inheritance may be given more weight, so that, speaking generally, we need seldom go beyond reversion to explain such resemblances; but, it is not always the case that heredity, or atavism, is the true key to the riddle of similarity, even in species that are not remote from one another.

The difficulty of distinguishing between convergence and reversion is often very great, and the interpretation of such cases depends largely on the mental attitude of the inquirer. The nearer the relationships between the species involved, the greater becomes the perplexity as to whether doubtful instances of likeness in structure should be assigned to convergence, or to reversion. There is a third category in which should be placed cases of reversion with convergence, as, when two or more descendants, from the same stem, independently converge towards such ancestral stem along the same lines of reversion. It may be said this is merely reversion; but, when two descendants from one ancient type, after differentiation and modification of more than one character, revert towards their common ancestral form, each by a different character, there is reversion but no convergence; so when there is both reversion and convergence, a distinctive term, such as *reversionary convergence*, becomes useful.

The resemblance between the form of the lobes of the mentum and the inner lobe of the maxillæ in the genus *Helluo*, and in *Gigadema longipenne*, I believe to be due to reversionary convergence. As I interpret the perplexing case of the resemblances between the mentum and the inner lobe of the maxillæ in *Helluo* and *G. longipenne*, these resemblances are due more to convergence than to reversion. The following evidence may be offered in support of this view. The long, pointed lobes of the mentum and the ordinarily shaped maxillæ of *G. longipenne* are exceptional in the genus *Gigadema*, but are the ordinary form in *Helluo* (two species, not nearly allied). Therefore we may feel justified in believing the prototype of *Helluo* had these characters, which are also found in

Ænigma. The matter becomes far more intricate when we come to *G. longipenne*. All the other species of *Gigadema* have the mentum without the long points to the lobes that are found in *G. longipenne*, and have the inner lobe of the maxillæ with a strong triangular median prominence in the middle of the inner side. Only in *G. longipenne* do these parts resemble the form found in *Helluo*; but *G. longipenne* is certainly a *Gigadema*, and not a *Helluo*, nor, as far as I can see, is it a representative of the primitive type of *Gigadema*. I believe the ancient type of *Gigadema* is represented rather by *G. sulcatum*. In my conception of the phylogeny of the species of *Gigadema*, *G. longipenne* is far removed from *G. sulcatum*, and more allied to *G. nocte*. It probably branched at a remote period from the stem of which *G. nocte* is a present-day representative. [The corneous, rudimentary paraglossæ of *G. longipenne*, resembling those of *G. bostocki* of the *G. nocte*-group (together with other characters), have helped to influence me in coming to this conclusion.]. If this view be correct, the maxillæ of *G. longipenne* have converged towards those of *Helluo* by an independent reversionary line in the direction of the ancient type from which both *Gigadema* and *Helluo* are derived, and leading away from its congeners. In this case, an inherited tendency towards ordinary maxillæ may have helped, as an influence of reversion; but, it is also a case of convergence, or, it may be said, of reversionary convergence. With the simplification of the maxillary lobe, the long, pointed lobes may have arisen by correlation, but, still, also as a case of reversionary convergence.

The long, curved, sharp, horn-like points of the lobes of the mentum in *G. longipenne*, which are formed by the epilobes, may be an example of the cause which often seems to result in many different parts of the body throughout the animal kingdom, such as ornaments, weapons, or even structures which do not seem of vital importance, becoming so exaggerated in their development, that their presence would appear to be a detriment, rather than a benefit, to their possessors. Such cases of what appears to be over-development of characters have always been advanced as an objection to the theory of natural selection; because, no character could have been carried by natural selection beyond the limit of usefulness or benefit to the species. It has appeared to me, in such cases of hypertrophy of a character, the reason may have been that it had become, as it were, an essential endowment of the species, and may have kept on gaining in size, when not injurious to the species, by the accumulated force of such endowment. Such a force of endowment could, of course, only operate within bounds limited by natural selection; as soon as the point of injury to the species was reached it would be checked by natural selection.

Bringing the scope of our inquiry into resemblances due to convergence within the narrow limits of the Helluonini of the Australian group, we find the following cases which seem to be instances of convergence rather than of reversion. Whether any of them are due to reversionary convergence; or, whether all of them are merely instances of convergence, unassisted by hereditary influences, are subjects which it is probably not profitable to worry about. In any case, such reversionary influences as may have given them any primary impulse of origination, or direction, are very obscure, and have not been perceived by me.

(1). A pointed labrum in *Pleuracanthus* and *Helluonidius* (also in *Dicranoglossus*). This is more likely to be due to the adoption of the same habits of catching similar prey, having led to analogous development rather than to reversion.

(2). A furcate ligula in *Dicranoglossus* and *Ametroglossus* I see no evidence of any near relationship between these genera, and regard the presence of a forked ligula in each (which is found nowhere else in the tribe) as a case of convergence, though these forms may have been derived from a common, remote, ancestral stem in which the ligula was excised.

(3). The presence of long, pointed lobes to the mentum, and an ordinarily shaped, inner lobe to the maxillæ in *Helluo* and

G longipenne, seem to me (as argued above) not decided evidence of close relationship. This is likely a case of reversionary convergence.

(4). An edentate mentum in *Dicranoglossus* and *Ænigma*. *Dicranoglossus* is far more closely related to *Helluonidius*, than it it is to *Ænigma* and *Neohelluo*, the only other genera without a median tooth to the mentum. However, convergence by loss of a character is of far less taxonomic importance, and less difficult to explain (such reduction of characters occurs in every direction among insects), than the great development of, or acquisition of a character.

(5). Elytral sculpture in *Helluo costatus* and the African *Triænogenius*.—The resemblance in this case may be due to reversion; it is a question on which I have not formed an opinion. But the relationship between *Helluo* and *Triænogenius* must be exceedingly remote.

(6). Colour.—The green colour of *Helluonidius* and *Ænigma* has probably been acquired independently. Chaudoir also reports *Pleuracanthus cribricollis* as having the elytra of a bluish tint.

Chætotaxy.—In the Australian group of the Helluonini, the following hairs are of importance. *Head*, with one sensitive hair above each eye in all our genera, except *Epimicodema;* in all genera of the extra-Australian group there are two hairs. *Labrum*: in all the genera of the extra-Australian group there are six sensitive hairs on the labrum, but, in the Australian group, only *Dicranoglossus* has more than four sensitive hairs (ten); in *Helluonidius*, *Helluosoma*, and *Helluodema* there are four hairs; in the rest of our genera only two fully developed, one near each anterior angle, rising from a conspicuous puncture. *Clypeus*: *Helluonidius* and *Dicranoglossus* have two, long, sensitive hairs on each side of the clypeus, all other genera one hair on each side. *Ligula* always fringed with setæ in the Australian group, and with the usual two, anterior, sensitive setæ (in *Helluosoma*, *Ametroglossus*, and *Dicranoglossus* the sensitive setæ are unusually distant from the apex); generally, there are some other setæ on the lower side of the ligula, besides the two, anterior, sensitive ones, but, these may be wanting (e.g., *Helluonidius*, *Dicranoglossus*, and *Ametroglossus*); sometimes the lower side of the ligula is pluripunctate (*Gigadema bostocki*, etc.); the inner surface of the ligula is not usually setose, except near the margins; but in *Ænigma*, there are a few long setæ on the basal part of the inner side, and in *Neohelluo* the basal half is plurisetose. *Labial palpi*: the penultimate joint has always two well developed setæ on the inner side, and, also, some smaller setules, which were ignored by Dr. G. H. Horn, when he described the penultimate joint of the labial palps in the tribe *Helluonini* as with two setæ. In *Gigadema nocte* and allied species, the elongate joint is plurisetose, with no great difference in development among the setæ; in *Helluonidius*, there are four, long setæ. *Prothorax*, normally with two lateral, marginal, sensitive hairs; the anterior hair is always present at the widest part, but, in our genera, the posterior hair is generally so reduced in size, and so confused with other setæ, that it cannot be distinguished. *Abdomen*: the apical ventral segment is always furnished with long "anal hairs" in the extra-Australian genera: but these are only found in *Dicranoglossus* among the genera of the Australian group. *Mandibles*: the outer side of the mandibles is setose in the *Helluonini;* often the setæ are hardly perceptible, and placed on the upper edge of the scrobe, as in *Ænigma*. *Nuridius* (Pterostichini) and *Dioctes* (Harpalini) are the only other Carabs in which I have observed setæ on the outside of the mandibles.

Note.—Dr. Walther Horn has indicated that, in the Cicindelidæ, the primitive colour of the setæ is dark; the same thing applies to the Carabidæ. In the Helluonini, I have observed a tendency for pale setæ to appear only in *Helluonidius*, *Dicranoglossus*, and *Ænigma*.

Colour: probably a more or less brownish tint was the primitive colour of the Helluonini (e.g. *Helluomorpha* *texana*); but, in most of the present-day species, this has deepened into piceous, or black. *Macrocheilus* has yellowish spots on the elytra, *Helluonidius cyanipenne* has the elytra bright greenish-blue, *Dicranoglossus resplendens*, and *Ænigma iris* have the whole upper surface cyaneous. One concludes that species of a polished, black colour are derived from duller coloured ancestors, and that those with bright colours are still more advanced in the matter of colour.*

Important Characters.—Antennæ: the longer and more slender the antennæ are, the more they depart from the ancestral type; as the fourth joint becomes more cylindrical and less pubescent, so does it become more specialised. *Palpi*: the penultimate joint of both the labial and maxillary palps varies greatly in length, being shortest in *Helluodema unicolor*, and longest in *Gigadema bostocki* and allied species. *Ligula*: the form is very variable in different genera, as given in the generic diagnoses which follow. [It may be noted that I follow Dr. G. H. Horn in applying the term labium to the whole organ (*i.e.*, ligula and paraglossæ), and in restricting the term ligula to the central piece alone.] *Paraglossæ*: the form of the labium in the Helluonini, in respect to its paraglossæ, has been the subject of controversy. Bonelli, when diagnosing the genus *Helluo*, described the labium as *without paraglossæ;* this view was adopted by Lacordaire in his "Genera des Coléoptèrs," though he was aware that Schmidt-Goebel, in 1847 (Coleop. Birman.), had described the paraglossæ of *Macrocheilus* as *united with the ligula, and appearing as if wholly wanting;* Dr. G. H. Horn adopted Schmidt-Goebel's opinion in his "Genera of Carabidæ"(1881), and declared the usual idea that the labium was without paraglossæ to be "quite erroneous." The view of Schmidt-Goebel is strictly correct, but Bonelli's idea is not "quite erroneous."

* In this connection, I note from my collection: one specimen of *Gigadema bostocki* var. *intermedia*, from Jerilderie, N. S. W., shows a distinct, dull reddish spot near the apex of one elytron; and two specimens of *G. nocte*, from Cooktown, two similar spots, one on each elytron.

In Australian genera (all have been dissected by me except *Helluapterus* and *Helluarchus*), it is only possible to observe the paraglossæ with accuracy from the inner side of the labium; in all our genera they are very rudimentary, in some being reduced merely to the lateral parts of the cartilaginous basal support of the ligula (e.g. *Helluosoma* and *Helluo*). In *Omphra* (the only foreign genus examined by me), the narrow, cartilaginous paraglossæ may be seen attached to the sides of the wide ligula, their point being free and not extending to the apical angle of the ligula.

Maxillæ: the cardo is triangularly prominent at the external angle in *Gigadema maxillare* ♂; a slight tendency to this form is noticeable in *Neohelluo angulicollis;* inner lobe of variable form. It is of ordinary form in most genera (e.g. *Helluo*), but the following are variations, (*a*) apex carried forward beyond the apical hook (the hook set almost at right angles to the galea, e.g., *Helluodema* and *Neohelluo*); (*b*) apex with a tuft of hair (e.g., *Ametroglossus* and *Neohelluo*); (*c*) galea triangularly protuberant in middle [*Gigadema* (except *G. longipenne*), *Helluapterus*, and *Helluarchus*]; the outer lobe is of variable shape, in *Dicranoglossus* long, slender, and glabrous, in *Gigadema* stout, and setose. *Prothorax*: the form varies; in *Neohelluo*, the anterior angles are marked; in *Gigadema grande*, the anterior margin is prominent in the middle (especially in ♂); the distance of the basal angles from the peduncle varies, in *Gigadema* near the peduncle, in *Ænigma* distant from it; the base is truncate in *Helluapterus* and *Helluarchus* (angles not near peduncle), but slopes forward to the basal angles on each side of the peduncle in *Helluo*. The anterior and basal margins are fringed with hair; sometimes the fringing hairs are wanting on the lower part of the base, sometimes present (e.g., *Gigadema*, *Helluo*). *Elytra*: the stem, from which the Helluonini are derived, evidently had the interstices of the elytra closely setigero-punctate; but a tendency for these punctures to be reduced to two rows, on some of the interstices, must have appeared as a very early character in the tribe. The biseriate disposition of the punctures seems to have originated on the odd interstices, spreading backwards from the base (in *Neohelluo* with triseriate interstices, the punctures become biseriate just before the apex on the second, third, and fourth interstices). The eighth interstice has remained pluripunctate in more cases than any other interstice, and here a tendency to loss of punctures is a recent character, but no proof of affinity (e.g., it occurs in South American species of *Helluomorpha*, and in the Australian *Ametroglossus niger;* a large species ticketed *Helluomorpha gagates* Chaud., in the Ehlers collection, has the second, fourth, and sixth interstices impunctate, the fifth and seventh uniseriately punctate near stria on outer side). The unusually narrow, ninth interstice, in comparison with the wide eighth, is characteristic of the small Australian section including *Gigadema*, *Neohelluo*, *Ænigma*, and *Ametroglossus*. *Prosternum*: this varies in convexity (depressed in *Epimicodema* and *Ametroglossus*, convex in *Ænigma*). Sometimes there is a transverse sulcus along the anterior margin (e.g., *Gigadema*), but sometimes this is wanting (e.g., *Ametroglossus*). The intercoxal declivity varies; it is strongly declivous in *Helluo* and *Helluapterus*, more gently so in *Gigadema nocte* and *Helluarchus;* sometimes it ends in a flattened flange against the peduncle, sometimes the flange is wanting (e.g., *Helluarchus*). *Legs*: there are varying forms of the anterior tibiæ; (*a*) stout, wide at apex, inner notch deep, upper spine at about one-half the length of the tibia, often nearer base than apex (type, *Helluo*); (*b*) long, narrow, with inner notch shallow and much nearer apex (type, *Gigadema*). In *Helluarchus*, *Helluapterus*, *Ænigma*, and *Ametroglossus*, the anterior tibiæ incline towards the form found in *Gigadema*, which is more recent than the form found in *Helluo*.

Characters peculiar to the Australian group.

Head with one sensitive hair on each side. *Antennæ* with fourth joint long, sparsely setose (*e.g.*, *Gigadema*). *Clypeus* emarginate (*Helluonidius* and *Dicranoglossus*). *Labrum* bisetose:

form convex, pointed (*Helluonidius* and *Dicranoglossus*). *Mentum* with epilobes developed into strong mucrones (*e.g.*, *Gigadema longipenne*). *Ligula* setose on sides, form deeply furcate. *Maxillæ* with galea prominent at apex. *Legs*: anterior femora with an antebasal prominence; tibiæ long, with notch towards distal end. *Secondary sexual characters of* ♂: mandibles often very long; submentum armed (*e.g.*, *G. grande* Macl.); maxillæ with cardo strongly triangularly prominent at external angle (*G. maxillare* Sl.); prothorax protuberant (*G. grande*); elytra with humeral angles dentate (*Ænigma*).

Genus Helluonidius.

Chaudoir, Rev. & Mag. Zool., 1872, 216; *Helluosoma* Castelnau, (partim), Trans. Roy. Soc. Victoria, viii., 1868, 107.

Winged. Setosity white. Head convex, sharply narrowed to neck; eyes large, convex, enclosed at base in large setose orbits; one supraorbital sensitive hair on each side. Clypeus emarginate, glabrous in middle, two sensitive hairs on each side. Labrum long, convex; middle of anterior margin triangularly prominent; a fine hair-like seta on each side of median prominence, a larger seta at each anterior angle of labrum. Mentum with lobes short, wide; epilobes forming the short, stout, pointed apex; median tooth wide, triangular, prominent. Ligula rather narrow, convex, rotundate at apex. Palpi elongate; labial with apical joint lightly securiform, shorter than penultimate. Maxillæ with inner lobe a little inflated on inner side opposite origin of outer lobe. Prothorax punctate, ampliate and rounded on sides anteriorly, strongly sinuate-angustate to base; disc with three indistinct longitudinal ridges. Elytra striate; interstices not raised or nitid in middle, closely punctate, third with a row of widely spaced dorsal punctures. Tarsi setose; penultimate joint bilobed. Type, *Ænigma cyanipenne* Hope.

The genera *Helluonidius* and *Dicranoglossus* form a little terminal group, derived from the primitive Australian Helluonini along a different line of descent from any other of the present-day genera. These two genera have been placed first in the Table of genera given in this paper, because of their extreme isolation, to prevent a break in the arrangement of the other genera. Some remote general affinities towards *Helluosoma* may be detected, but none to any of the genera with the labrum bisetose. The species of *Helluonidius* are found under bark on tree-trunks. There are four species in Australia, and one (*H. chrysocomes* Maindron) has been reported from New Guinea.

The Australian species may be divided into two groups by their colour.

Species wholly black	*H. aterrimus* Macl. *H. latipennis* Macl.
Species with elytra cyaneous	*H. cyaneus* Cast. *H. cyanipennis* Hope.

HELLUONIDIUS ATERRIMUS Macleay.

Helluosoma aterrimum Macleay, Trans. Ent. Soc. N. S. Wales, ii., 1873, 323.

I have seen the type of *Helluosoma aterrimum* Macl., in the Macleay Collection, and have noted that it has the labrum and clypeus of *Helluonidius*, to which genus it belongs. Length 8 lines, after Macleay. I have the following note, made at the Macleay Museum, with both *H. aterrimus* and *H. latipennis* Macl., before me. "Differs from *H. latipennis* by size smaller, prothorax less coarsely and closely punctate; elytra narrower, interstices flat (not the least convex), less coarsely punctate. It is another species."

HELLUONIDIUS LATIPENNIS Macleay.

Helluosoma latipenne Macleay, Proc. Linn. Soc. N. S. Wales (2), ii., 1887, 217.

Black. Head 3·65 mm. across eyes, strongly constricted behind eyes; orbits large and setigerous behind eyes; clypeus emarginate; labrum long, convex, pointed at apex. Prothorax small, transverse (2·8 × 4 mm.), truncate at base and apex, wider at apex (3·3 mm.) than at base (2·5 mm.). Elytra much wider than prothorax (10·5 × 6·5 mm.), punctate-striate; interstices 3-seriately punctate, even interstices a little wider and more closely punctate than the odd ones. Length 19-21 mm.

Hab.—Tropical Queensland: Kuranda and Mareeba (Dodd), Atherton (Sloane).

HELLUONIDIUS CYANEUS Castelnau.

Helluosoma cyanea Cast., Trans. Roy. Soc. Victoria, viii., 1868, 109; *Helluonidius cyaneus* Gestro, Ann. Mus. Civ. Genova, vii., 1875, 875.

Black, elytra dark cyaneous. Differs from *H. cyanipennis* Hope, by elytra duller-coloured; puncturation of elytra stronger, etc. Length 17·5-19 mm.

Hab.—Coastal districts north from Sydney: Sydney (Carter), Clarence River and Rockhampton (*fide* Castelnau), Coff's Harbour.

HELLUONIDIUS CYANIPENNIS Hope.

Ænigma cyanipenne Hope, Proc. Ent. Soc., 1842, 46; Ann. Nat. Hist., ix., 1842, 462; Castelnau, Trans. Roy. Soc. Victoria, viii., 1868, 109: *Helluonidius cyanipennis* Chaudoir, Rev. & Mag. Zool., 1872, 216; Gestro, Ann. Mus. Civ. Genova, vii., 1875, 875: *Ænigma viridipenne* Macleay, Proc. Linn. Soc. N. S. Wales, (2), ii., 214.

H. cyanipennis is distinguished by its bright blue elytra. Length 18 mm. I have seen the type of *Helluosoma viridipenne* Macleay, in the Macleay Museum, and consider it identical with Hope's species.

Hab.—Tropical Australia, from Townsville to King's Sound.

Genus DICRANOGLOSSUS.

Chaudoir, Rev. & Mag. Zool., 1872, 217.

Winged. Setosity pale. Form rather narrow. Head wide; vertex setigero-punctate; neck wide; eyes prominent; orbits rather small behind eyes, pilose; several elongate hairs near eyes on each side. Antennæ not long, thick; four basal joints cylindrical. Clypeus emarginate, with angles prominent, setose, with two longer prominent hairs on each side. Labrum convex; anterior margin triangularly prominent, 10-setose. Mentum without median tooth. Ligula deeply excised, bilobed; lobes obtuse and ciliate at apex. Palpi: labial with apical joint stout, truncate; maxillary with penultimate joint small, apical joint lightly securiform. Maxillæ with inner lobe sharply hooked; apex projecting a little beyond hook, and ciliate. Prothorax setigero-punctate, strongly and roundly ampliate at anterior fourth, strongly sinuate-angustate to base; disc with three subobsolete longitudinal ridges. Elytra with interstices 1-7 lightly convex, biseriately punctate. Tarsi setose; penultimate joint small, simple. Type, *Helluosoma resplendens* Cast.

The genus *Dicranoglossus* is a terminal one, allied only to *Helluonidius*, and derived from the same stem. Found under bark on tree-trunks.

Dicranoglossus resplendens Castelnau.

Helluosoma resplendens Castelnau, Trans. Roy. Soc. Victoria, viii., 1868, 109: *Dicranoglossus resplendens* Chaudoir, Rev. & Mag. Zool., vii., 1872, 217; Gestro, Ann. Mus. Civ. Genova, vii., 1875, 874: *Ænigma parvulum* Macleay, Trans. Ent. Soc. N.S. Wales, ii., 1873, 323.

Upper surface bright blue. Prothorax small (1·9 × 2·8 mm.); basal angles near peduncle; elytra oblong (7 × 4 mm.); eighth interstice not divided from ninth, coarsely punctate. Last ventral segment with several long setæ on apical margin. Length 12·5 mm.

I have identified *Ænigma parvulum* Macl., as identical with *H. resplendens* from Macleay's types.

Hab.—Tropical Australia, from Rockhampton to King's Sound.

Genus Helluosoma.

Castelnau, Trans. Roy. Soc. Victoria, viii., 1868, 107.

Elongate, depressed, winged, black. Head sharply narrowed to neck; one supraorbital sensitive seta on each side; eyes convex, enclosed behind in large orbits. Antennæ rather long, compressed; three basal joints cylindrical, fourth short, subcylindrical. Labrum large, convex in middle of apex, four-setose. Mentum with a short triangular median tooth; lobes short, pointed (point formed by the epilobes). Ligula convex, narrow, elongate, roundly obtuse at tip; two sensitive hairs distant from apex. Palpi stout. Maxillæ with inner lobe narrow, without a median prominence on inner side; apical hook lightly inturned, its outer edge curving evenly with outer side of galea. Prothorax a little broader than long; sides ampliate and rounded at anterior two-thirds, strongly sinuate-angustate to base; basal angles near peduncle; border reaching base; disc with three, indistinct, longitudinal ridges. Elytra one-half wider than prothorax; interstices biseriately punctate towards base, eighth densely punctate. Anterior tarsi wide; penultimate joint short, wide, deeply emarginate. Type, *H. atrum* Castelnau.

Habits unknown to me, but, I believe, terrestrial.

An isolated terminal genus of ancient origin, containing two species, *H. atrum* Cast., and *H. longicolle* Macl.

HELLUOSOMA ATRUM Castelnau.

Trans. Roy. Soc. Victoria, viii., 1868, 107; Chaudoir, Rev. & Mag. Zool., 1872, 216.

H. atrum can be identified from the generic diagnosis given above. Dimensions: length 15·5; proth., 2·75 × 3; el., 8 × 4·5 mm.

Hab.—Tropical Australia, from Rockhampton to Pine Creek.

H. LONGICOLLE Macl., Proc. Linn. Soc. N.S.Wales,(2), ii., 1887, 217.

I have seen the types of *H. longicolle* in the Macleay Museum, and have noted it as a species distinct from *H. atrum* Cast., but without recording the differences; and I cannot now indicate them.

Genus HELLUODEMA.

Castelnau, Trans. Roy. Soc. Victoria, viii., 1868, 105: *Simoglossus* Chaudoir, Rev. & Mag. Zool., 1872, 217.

Parallel, depressed, winged, black. Head punctate, constricted to a neck behind; one supraorbital sensitive hair on each side; eyes strongly enclosed behind in large orbits. Antennæ short, compressed; joints 1-3 cylindrical. Labrum large; anterior margin arcuate, slightly prominent in middle, 4-setose. Mentum with a prominent, triangular, median tooth; lobes triangular, pointed. Ligula wide, emarginate in middle of apex. Palpi short, stout. Maxillæ with inner lobe lightly and roundly inflated on inner side opposite origin of outer lobe, sharply hooked; apex extending forward greatly beyond hook. Prothorax very little wider than head, punctate, lightly narrowed to base; sides lightly rounded, not ampliate; lateral border terminating a little before base. Elytra narrow, parallel, interstices costate with summits nitid, biseriately punctate. Legs short; tarsi short, penultimate joint of anterior tarsi short, wide, emarginate. Type, *Ænigma unicolor* Hope.

Habits terrestrial.

It is a terminal genus, not closely allied to any other.

HELLUODEMA UNICOLOR Hope.

Ænigma unicolor Hope, Proc. Ent. Soc., 1842, 47; Ann. Nat. Hist., ix., 1842, 426: *Helluomorpha batesi* Thomson, Arch. Ent., 1857, 134: *Helluodema batesi* Castelnau, Trans. Roy. Soc. Victoria, viii., 1868, 105; Gestro, Ann. Mus. Civ. Genova, vii., 1875, 882: *Simoglossus niger* Chaudoir, Rev. & Mag. Zool., 1872, 217; Col. Nov., 1883, 17.

I have no doubt but that I am right in considering this narrow, black species as *Ænigma unicolor;* it is also evident, from Thomson's description, that Castelnau identified *Helluomorpha batesi* rightly; but how Castelnau, Chaudoir, and Gestro mistook Hope's species for one, the size of which was 20 x 6 mm. (the dimensions given by Gestro for *Gigadema minutum* Cast., which these three authors thought probably identical with *Æ. unicolor* Hope), surprises me, seeing that Hope gives the size of his species as "Long.7, lat.1½ lin." Chaudoir, in the "Coleopterorum Novitates," says that he had received his *Simoglossus niger* from Mr. William Macleay under the name of *Helluosoma atrum* Cast.; and that is the name that Sir W. Macleay applied to *H. unicolor* Hope, in his Collection. The generic diagnosis given above is sufficient for the identification of *H. batesi.* Dimensions: length, 13·5; proth., 2·5 x 2·75, el., 6·5 x 3·3 mm.

Hab.—Eastern Coastal Districts, from Clarence River to Cooktown.

EPIMICODEMA, n.gen.

Elongate, depressed, winged, brown. Head small, strongly constricted to a narrow neck; orbits strongly developed behind eyes, setigerous; two supraorbital sensitive hairs on each side. Antennæ short, stout, compressed. Clypeus truncate; one sensitive hair at each side. Labrum large, rounded; one sensitive hair at each side. Mentum with lobes sharply pointed; median tooth prominent, triangular. Ligula wide, rounded on each side; apex emarginate in middle; a sensitive hair at each side of apical emargination a little behind margin. Labial palpi stout; apical joint wide, truncate, about as long as penultimate joint. Maxillæ: inner lobe with apical hook long, sharp, set almost at right angles; inner margin with a lightly developed median prominence; palpi with penultimate joint very short, apical joint wide. Prothorax small, narrow, strongly narrowed to base; upper surface setigero-punctate. Elytra striate; scutellar striole elongate; interstices biseriately punctate (punctures of second and fourth tending to become 3-seriate towards apex); eighth biseriately punctate, not wider than ninth. Prosternum depressed, without anterior marginal sulcus. Anterior tarsi short; penultimate joint short, wide, lightly emarginate. Type, *Helluosoma mastersi* Macl.

Habits: on tree-trunks, under bark.

A monotypic genus evidently isolated from all others. By the form of its ligula, it is more allied to *Helluodema* than to *Helluosoma*. Though more related to *Helluodema* and *Helluosoma* than to any other genera, there seems no near affinity to either.

EPIMICODEMA MASTERSI Macleay.

Helluosoma mastersi Macl., Trans. Ent. Soc. N. S. Wales, ii., 1871, 83.

Dimensions: length 14 mm.; head 2·2 mm. across eyes; proth. 2·35 × 5; el. 7 × 4 mm.

Hab.—Northern New South Wales to Rockhampton (Brunswick River, N.S.W., Carter; Gayndah, Q., Masters).

Genus Helluo.

Bonelli, Mém. Acad. Turin, 1813, (Obs. Ent., Pt. ii., p.23).

Depressed, apterous. Head large, punctate; neck wide; eyes convex, lightly enclosed at base; postocular part of orbits small, oblique; one supraorbital sensitive seta on each side. Labrum large, depressed; anterior margin roundly prominent; one sensitive seta on each side. Mentum punctate; median tooth triangular, short, wide, prominent; lobes long, pointed. Ligula wide, convex; anterior margin rounded. Maxillæ with inner lobe not dilatate on middle of inner side; apex lightly but strongly hooked. Prothorax broader than long, punctate, ampliate and rounded at widest part; sides strongly sinuate-angustate to base. Elytra with odd interstices costate. Anterior tarsi wide, hairy; penultimate joint short, deeply circularly emarginate. Type, *H. costatus* Bon.

Habits terrestrial.

An isolated genus belonging to the central group of the Australian Helluonini.

The two species may be differentiated as below :—

Elytra with even interstices depressed, and closely setigero-punctate.. *H. costatus* Bon.

Elytra with even interstices glabrous, and only punctate on each side near striæ.......................... *H. insignis* Sl.

Helluo costatus Bonelli.

Mém. Acad. Turin, 1813; Castelnau, Trans. Roy. Soc. Victoria, viii., 1868, 104; Chaudoir, Rev. & Mag. Zool., 1872, 214; Gestro, Ann. Mus. Civ. Genova, vii., 1875, 872 : *H. carinatus* Chaudoir, Bull. Soc. Imp. Nat. Mosc., 1848, i., 107.

Notwithstanding Chaudoir's reclamation in the Revue et Magasin Zoologique, 1872, I follow Castelnau's view that *H. carinatus* Chaud., is conspecific with *H. costatus* Bon. It is one of our best known carabs. Length, 20-26 mm.

Hab.—Eastern Coastal Districts, from Melbourne to Brisbane.

Helluo insignis Sloane.

Proc. Linn. Soc. N. S. Wales, (2), v., 1890, 642.

Length 27 mm.

Hab.—New South Wales: Walgett, Bourke, and Garah.

Genus HELLUAPTERUS, n.gen.

Convex, apterous. Head large: neck wide; eyes prominent; postocular parts of orbits small, oblique to neck. Antennæ stout, elongate, compressed; four basal joints cylindrical, sparsely setose. Labrum large, depressed, widely rounded at apex, sparingly punctate; one sensitive seta on each side near anterior angles. Mentum deeply emarginate; bottom of sinus forming a short wide prominence in middle; lobes triangular. Ligula wide, roundly prominent at apex; a median double row of widely placed setigerous punctures. Palpi: labial stout; penultimate joint thick, incrassate; apical joint claviform, a little shorter than penultimate: maxillary with penultimate joint short, two-thirds the length of apical; this larger and stouter than apical joint of labial. Maxillæ with inner lobe stout, sharply hooked at apex; inner margin strongly triangularly angulate in middle, beset with separate spiniform setæ on anterior part. Prothorax transverse, strongly ampliate at widest part, strongly sinuate-angustate to base; base truncate. Elytra truncate-oval, convex; interstices 3, 5, and 7 costate; inflexed margins wider and more sparsely setose than usual in the tribe. Metasternal episterna shorter than usual ($4 \times 2{\cdot}5$ mm.). Tarsi with penultimate joint narrow, simple; anterior with second and third joints biseriately squamose beneath in ♂.

Habits terrestrial.

This genus differs from *Helluo* by the longer basal joints of antennæ (fourth much longer and less densely pubescent); mentum with lobes shorter, median tooth much shorter and wider; maxillæ with inner lobe far less hairy, and with a very strong triangular prominence on middle of inner side; inflexed margins of elytra wider and less setose; joints of tarsi longer, etc. From *Gigadema*, it differs by facies (elytra convex); absence of wings; short metasternal episterna, etc. It is evidently derived from the primitive central stem of the tribe, from which *Helluo*, *Helluarchus*, and *Gigadema* also come.

HELLUAPTERUS NIGER, n.sp.

Robust, oval, convex, sparsely punctate. Elytra truncate-oval, punctate-striate; third, fifth, and seventh interstices raised above others. Black.

Head large (6 mm. across eyes), punctate; front with a rounded rugulose impression on each side; eyes prominent. Mandibles in ♂ very long, decussate. Prothorax broader than long (5·5 × 8 mm.), of equal width at base and apex (4·9 mm.); disc convex; margins wide, explanate; upper surface strongly punctate, the punctures closely placed on lateral margins, more dispersed on disc; sides roundly ampliate just before middle, strongly narrowed to apex in an even curve, obliquely narrowed to posterior fourth and straightened before meeting base; anterior margin truncate behind head; anterior angles widely rounded, hardly advanced; base widely emarginate above peduncle, truncate on each side; basal angles distant from peduncle, well marked, upturned, obtuse at summit. Elytra opaque, convex, much wider than prothorax (17 × 12·3 mm.), oval, truncate at apex, not covering apex of abdomen, widest a little behind middle, lightly but decidedly rounded on sides; humeral angles rounded off; striæ with small separate punctures in their course; interstices shagreened, biseriately punctate; punctures small and distant from one another; third, fifth, and seventh interstices lightly costate; even interstices hardly convex, more irregularly punctate. Abdomen convex, hardly punctate except near sides—especially on first and second segments. Length 30, breadth 12·3 mm.

Hab.—Western Australia: Murchison District. I first received this fine species in 1894, from Mr. C. French of Melbourne; recently Mr. W. W. Brown has found it at Anketell, near Cue.

This large, robust species differs greatly in facies from the species of *Helluo* and *Gigadema*; and from *Helluarchus* by facies (elytra truncate, and not depressed on disc, and declivous to sides and apex).

Var. *punctata*. Differs from the typical form by upper surface more nitid, interstices of elytra nitid, not shagreened; head, prothorax, and elytra far more strongly punctate; elytra less convex, odd interstices less convex (particularly third); puncturation much stronger (punctures larger and deeper) particularly towards sides; striæ more or less interrupted by large punctures, especially towards sides; puncturation of ninth interstice and lateral channel much stronger; under surface generally more strongly punctate (on head, prothorax, peduncle, metepisterna, posterior coxæ and abdomen). Length 30 mm.

Hab.—Shark Bay. (One specimen from Mr. French).

This may be a distinct species; but having only one specimen, and thinking it possible that forms connecting it with *H. niger* may be found, I have put it tentatively under *H. niger*, as a variety.

HELLUARCHUS, n.g.

Oval, body very large; apterous. Head large; neck wide; eyes prominent; postocular parts of orbits small, oblique to neck. Antennæ stout, not incrassate; four basal joints cylindrical, sparsely punctate, third as long as basal joint, second three-fourths length of third. Labrum large, depressed, rounded at apex, punctate (except near base); one sensitive seta on each side near anterior angles. Mentum punctate; sinus with a short, wide, median prominence; lobes not long, triangular. Ligula cordate, oblique on each side and roundly obtuse at apex. Palpi: labial with apical joint stout, cylindrical, truncate; maxillary with penultimate joint two-thirds length of apical; this stout, truncate, a little larger than apical joint of labial. Maxillæ with inner lobe stout, strongly hooked at apex; inner side sparingly spinose; a prominent, triangular, median prominence. Prothorax transverse, strongly ampliate at widest part, strongly sinuate-angustate to base. Elytra inflated, oval, depressed on disc, striate, rounded at apex; fifth interstice costate, bordering the depressed discal area; sides and apex sharply declivous; inflexed margins wider and more sparsely setose than usual in the tribe. Metasternal episterna shorter than usual ($4 \times 2{\cdot}5$ mm.). Tarsi stout; joints sparsely setose; fourth joint widely triangular, hardly emarginate at apex. Habits terrestrial.

The strangely shaped elytra of *Helluarchus*, which are those of an integripenne and not of a truncatipenne, make this one of the most abnormal forms to be found amongst the Carabidæ, and place it quite by itself. Its affinity is evidently towards *Helluapterus*. In general appearance, *H. robustus* resembles the genus *Cuneipectus*.

Helluarchus robustus, n.sp.

Stout, oval, glabrous; body very large. Black.

Head large (6·5 mm. across eyes), punctate. Prothorax broader than long (6·3 × 9 mm.); sides inflated and rounded at middle, narrowed in a curve to apex, strongly sinuate at posterior fourth; basal angles distant from peduncle, well marked, obtuse; base (6 mm.) wider than apex (5 mm.); disc sparsely punctate; lateral margins explanate, punctate. Elytra oval (21 × 14 mm.), rounded at apex in an even curve, not quite covering apex of abdomen; disc depressed, bordered by the strongly costate fifth interstice; striæ punctate; interstices sparsely seriate-punctate: punctures small, disposed in two rows on third, fifth, and seventh interstices, more irregular on the others (third interstice raised just before apical declivity, fifth costate, seventh subcostate, the others depressed). Under surface generally more or less punctate; abdomen convex, sparsely punctate towards middle, strongly punctate towards lateral margins. Length 36, breadth 14 mm.

Hab.—Western Australia: Anketell, near Cue (H. W. Brown). Colls. Sloane (type); National Museum, Melbourne; South Australian Museum, Adelaide.

Genus Gigadema.

Thomson, Arcan. Ent., 1859, 93; Castelnau, Trans. Roy. Soc. Victoria, viii., 1868, 105; Chaudoir, Rev. & Mag. Zool., 1872, 215: *Penichrodema* Gestro, Ann. Mus. Civ. Genova, vii., 1875, 880.

Depressed, black; winged. Labrum large; one sensitive seta on each side near anterior angle. Labium variable, always wide and rounded on sides. Mentum with a short median tooth; lobes short, triangular, pointed (in *G. longipenne* very long and sharply pointed). Palpi variable; apical joint more or less triangular. Maxillæ with inner lobe sharply pointed; inner side with a median prominence (except in *G. longipenne*). Prothorax roundly ampliate at widest part, strongly angustate at base; basal angles near peduncle. Elytra strongly striate; interstices punctate; apex truncate, membranous. Anterior tibiæ elongate, narrow, inner notch towards distal end; tarsi setose, fourth joint entire, in ♂ second and third joints lightly dilatate, and biseriately squamulose beneath. Habits either terrestrial, or on tree-trunks, under bark.

Gigadema represents the central stem of the Australian *Helluonides*, with affinities in different directions towards *Helluapterus*, *Helluarchus*, *Ametroglossus*, *Neohelluo*, and *Ænigma*. Its most puzzling species is *G. longipenne*, which, though evidently a true *Gigadema*, resembles *Helluo* in the form of its mentum, ligula, and maxillæ.

Variations.—Antennæ: length and setosity of four basal joints (compare *G. sulcatum* and *G. bostocki*). *Mentum*: median tooth prominent and excised at apex (e.g., *G. nocte*), short with apex rotundate (e.g., *G. rugaticolle*). *Ligula*: convex and non-setose (*G. longipenne*), or more or less depressed and setose; paraglossæ membranous (*G. sulcatum*), corneous (*G. bostocki*). *Maxillæ*: form of inner side, of apex; set of hook; setosity (compare *G. maxillare*, *G. longipenne*, and *G. bostocki*). *Palpi*: length, especially of penultimate joints (compare *G. sulcatum* and *G. bostocki*). *Prothorax*: form and puncturation. *Elytra*: interstices pluripunctate (*G. maxillare*), biseriate-punctate (*G. bostocki*). *Trochanters*: posterior oval or pointed (only *G. grande*); intermediate triangularly prominent in middle (*G. longipenne*).

Secondary sexual characters of ♂: mandibles very long and decussate (*G. grande* var. *prominens*); right mandible notched towards apex (*G. bostocki*). *Submentum* armed (in *G. grande*-group). Maxillæ with cardo armed (*G. maxillare*).

Phylogeny.—The *sulcatum*-group is the most ancient by short joints of palpi; strong tooth of mentum; membranous paraglossæ with apex free; closely punctate disc of prothorax; setose inflexed margins of elytra, etc. The *grande*-group must also be placed below the *nocte*-group by form of palpi; form of ligula, including membranous paraglossæ; the *nocte*-group is the most recent. *G. longipenne* may have diverged from the stem from which *G. nocte* is derived, and converged towards a more ancient generalised type by reversionary atavism (*antea*, p.574). The species of *Gigadema* may be arranged in four groups, viz., the *sulcatum-*, *grande-*, *bostocki-*, and *longipenne*-groups; of these, the two last are most closely related; the *sulcatum-*, *grande-*, and *bostocki*-groups have little relationship to one another, but are bound together by evidence of descent from a common central type.

Table of Species.

1(22). Ligula with median depression; inner lobe of maxillæ triangularly protuberant in middle of inner side.

2(7). Pronotum with the whole upper surface closely punctate. (Palpi short).

3(4). Elytra with even interstices closely and confusedly punctate........................*G. froggatti* Macl.

4(3). Elytra with even interstices biseriately punctate.

5(6). Interstices 2-7 convex, nitid in middle; punctures coarse and close together.. *G. sulcatum* Macl.

6(5). Interstices opaque, depressed on apical third, weakly costate towards base, punctures not coarse..........................*G. biordinatum* Sl.

7(2). Pronotum with an impunctate central space. (Palpi with penultimate joint longer than in Section 2).

8(15). Labial palpi with apical joint at least two-thirds the length of penultimate. (Gula, or cardo of maxilla armed in ♂).

9(10). Prothorax strongly sinuate on sides posteriorly; ♂ with gula unarmed; cardo of maxilla prominently dentate......*G. maxillare* Sl.

10(9). Prothorax lightly sinuate on sides posteriorly; ♂ with gula armed; cardo of maxilla unarmed.

11(14). Pronotum with apex truncate, not produced above head; posterior trochanters obtuse.

12(13). ♂. Pronotum with middle part of apex slightly more prominent than anterior angles; process of submentum short, wide, its outer angles tuberculiform and pointed outwards.........*G. gulare* Sl.

13(12). ♂. Pronotum with anterior angles more prominent than middle part of apex; process of submentum bifid, the lobes short, triangular, pointed downwards..................................*G. rugaticolle* Blkb.

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* *Note.*—It is certain that there is never, in any species, such a variation in the shape of the prothorax, as is indicated by Gestro for *G. grande*. He has confused the sexes of two different species (*postea* p.600).

14(11). Pronotum with apex roundly produced over head, much more prominent than anterior angles in both sexes; posterior trochanters sharply pointed at apex.................................*G. grande* Macl.

15(8). Labial palpi with apical joint short, not one-half length of penultimate, this unusually long, bowed, and with lower apical angle prominent. (Neither gula nor maxilla armed in male).

16(19). ♂. Right mandible simple.

17(18). Head with decided postocular prominences; pronotum with middle of anterior margin slightly more advanced than anterior angles... ....*G. obscurum* Sl.

18(17). Head without postocular prominences; pronotum with middle of anterior margin not more prominent than anterior angles.. ....*G. nocte* Newm.

19(16). ♂. Right mandible with a notch on inner side near apex.

20(21). Elytra with interstices biseriately punctate.........*G. bostocki* Cast.

21(20). Elytra with second, fourth, and sixth interstices more or less confusedly punctate towards apex.................*G. mandibulare* Blkb.

22(1). Ligula convex, glabrous; inner lobe of maxillæ not protuberant in middle of inner side.......................... .....*G. longipenne* Germ.

The *sulcatum*-group.

Mandibles short. Paraglossæ cartilaginous. Maxillæ with inner lobe moderately setose on upper surface, triangularly prominent at middle of inner side. Palpi short; penultimate joint of maxillary shorter than apical. Prothorax with disc wholly punctate. Male without unusual secondary sexual characters. Gestro has suggested that a distinct name, *Penichrodema*, should be used for this group, but I have not adopted his suggestion. Habits terrestrial.

GIGADEMA FROGGATTI Macleay.

Proc. Linn. Soc. N.S.Wales, (2), iii., 1888, 449.

This species is distinguished from *G. sulcatum* Macl., by smaller size; prothorax narrower, more strongly sinuate to base; elytra with even interstices more densely punctate. Length 17 mm.

Hab.—Queensland: Cooktown (Olive). I have two specimens (♂) from Mr. Olive, of Cooktown, which I have compared with the types of *G. froggatti* Macl., in the Macleay Museum, and have considered identical. It requires studying with more material than I possess.

GIGADEMA SULCATUM Macleay.

Helluo sulcatus Macleay, Trans. Ent. Soc. N.S.Wales, 1864, i., 108; ? *G. paroensis* Castelnau, Trans. Roy. Soc. Victoria, viii., 1868, 106; Gestro, Ann. Mus. Civ. Genova, vii., 1875, 877; *G. minuta* Castelnau, *l.c.*, 107; *G. thomsoni* Castelnau, *l.c.*, 107; *G. dameli* Macleay, Trans. Ent. Soc. N.S.Wales, 1873, ii., 323.

Black. Elytra strongly striate; interstices biseriately punctate, convex (particularly towards base), seventh, at least, carinate. Length 20-24, breadth 7·5-9 mm.

The elytra usually have the interstices from second to seventh biseriately punctate, but sometimes the fourth and sixth are triseriately punctate on the apical part of elytra. One specimen, from Katherine River, has the prothorax narrower, more strongly sinuate towards base; elytra with interstices costate towards base, and with the even ones confusedly punctate: these are the distinguishing characters of *G. paroensis*, as given by Gestro, and this inclines me to believe that *G. paroensis* Cast., is conspecific with *G. sulcatum* Macl. *G. minuta* Cast., is represented in the Howitt Collection, where I have seen it, and recognsied it as conspecific with *G. sulcatum*. I have seen the types of *G. dameli* Macl., and could not differentiate it from *G. sulcatum*.

Hab.—New South Wales (I have it from Mulwala, Germanton, Urana, Junee, Lachlan River, and Bingara): Queensland (Gayndah, Coomooboolaro, Townsville, Port Denison and Cunnamulla): Northern Territory (Katherine River): Western Australia (Onslow).

GIGADEMA BIORDINATUM, n.sp.

Oval. Prothorax with surface wholly punctate (punctures separate, not confused, derm not rugose in centre of disc); elytra striate, interstices biseriately punctate, opaque, summits not forming nitid ridges. Black.

Head wide across eyes (5 mm.), punctate (the punctures separate), longitudinally strigose near eyes; one supraorbital sensitive hair on each side; front lightly and widely bi-impressed. Mentum with median tooth short, wide, not excised at apex. Prothorax subconvex, transverse (4·15 × 6 mm.); apex with median part truncate; anterior angles widely rounded, a little more prominent than median part; sides ampliate, roundly subangulate at widest part, strongly angustate and sinuate to base; basal angles subrectangular with summit rounded; upper surface punctate, more closely so towards sides; punctures separate, and derm not rugulose towards centre. Elytra much wider than prothorax (13·2 × 8·4 mm.); striæ shallow, finely and closely punctate; interstices finely shagreened, biseriately punctate; the punctures separate, not coarse, not interrupting the summits of interstices. Length 20-23·5, breadth 6·8-8·4 mm.

Hab.—Prince of Wales Island, Torres Straits. I am indebted to Mr. H. J. Carter for a specimen, and two others are in his collection.

Allied to *G. sulcatum* Macl., and *G. froggatti* Macl.; but differing from *G. sulcatum* by punctures of head fewer, smaller and not so close together; prothorax roundly subangulate at widest part, more strongly angustate to base, punctures not so coarse or so close together: elytra with interstices more opaque and depressed, not raised into prominent ridges, the punctures of each row on interstices 2-7 finer, more distant from one another, not causing any crenulation or interruption of the summits of the interstices as in *G. sulcatum.* From *G. froggatti*, by head and prothorax less closely punctate; prothorax much wider; elytra with interstices less costate, even interstices not confusedly punctate, etc. It might be thought to be a well marked variety of *G. sulcatum*, but I have preferred to regard it as a distinct species.

The *grande*-group.

Paraglossæ cartilaginous, free at apex. Maxillæ with inner lobe densely setose on upper side and apex, triangularly prominent at middle of inner side. Palpi long; penultimate joint of maxillary not shorter than apical joint. Prothorax with disc not punctate. Male, with cardo of maxillæ triangularly prominent, or gula armed; mandibles sometimes very long.

GIGADEMA MAXILLARE, n.sp.

G. grande Gestro, Ann. Mus. Civ. Genova, vii., 1875, p. 879, fig.1 (♀).

Depressed. Head large; prothorax subrotundate, widest about middle; apex lightly and widely produced; sides strongly sinuate-angustate to base; disc smooth, impunctate; elytra striate, interstices closely punctate (more than two rows of punctures on each). Black.

♂. Head large (6·8 mm. across eyes), depressed, finely sparsely punctate towards base and sides; eyes prominent, very lightly enclosed behind; clypeus smooth, a few fine punctures towards sides. Mandibles long, falcate, decussate. Labrum large, depressed, rounded at apex; a setigerous puncture at each anterior angle; surface lævigate with a few fine punctures. Maxilla with cardo projecting downward in a strong, bent, obtuse, horn-like process. Ligula transversely depressed; apex wide, truncate. Mentum with a short, wide, excised, median tooth; lobes triangular; submentum unarmed. Prothorax broader than long (7·1 × 9 mm.), wide at apex (6·8 mm.); rounded on sides, roundly ampliate at middle, strongly angustate posteriorly, strongly sinuate a little before base; apex with middle widely and shortly advanced, rounded and less prominent at anterior angles; base narrow (4·1 mm.), strongly bisinuate (rounded in middle), angles marked, obtuse at summit; median line well marked; margins lightly punctate. Elytra parallel (21 × 12 mm.), punctate-striate; punctures in striæ very small, a little distant from one another; interstices closely and finely setigero-punctate. Posterior trochanters conical, obtuse at apex.

♀. Differs from ♂, by cardo of maxilla unarmed; prothorax with apex less prominent in middle.

Length 27-35, breadth 9-12 mm.

Hab.—Tropical Queensland: Townsville and Kuranda (Dodd), Cooktown (Olive), Princess Charlotte Bay.

Allied to *G. grande* Macl., with which it has been confused by Gestro and Bates, but differing by the male with submentum without a prominent horn, and cardo of maxilla prominent (in *G. grande* ♂, the cardo of the maxilla is merely slightly obtusely prominent); prothorax with widest part situated further back; sides less rotundate, far more strongly angustate posteriorly, and with a strong antebasal sinuosity; elytra with second and third interstices not biseriately punctate. The female shows the same difference from the male in shape of prothorax, and puncturation of the second and third interstices of the elytra as in *G. grande;* but does not show differences in the form of the cardo of the maxilla nor of the submentum, these being secondary sexual differences of the male.

It is evident that Gestro confused this species with *G. grande;* the figure he gives as that of the prothorax of *G. grande* ♀, is that of the prothorax of *G. maxillare* ♀. A numerously represented series of specimens has been examined, and no male specimen has had the bifid horn of the submentum as in *G. grande*, nor has been without the prominent horned cardo of the maxilla.

Gigadema gulare, n.sp.

♂. Depressed. Prothorax ampliate, strongly angustate to base, anterior margin truncate, median part a little more advanced than anterior angles, disc not punctate; elytra striate, interstices closely punctate; second, third, and fifth biseriately punctate towards base; submentum armed; mentum strongly toothed; ligula wide, roundly oblique on each side to the obtuse apex, rather convex, subdepressed in middle. Piceous-brown.

Head large (6 mm. across eyes): front lightly and widely bi-impressed; impressions subrugulose, space between them transversely rugulose; eyes very prominent. Labrum depressed, closely punctate, except near base; a well marked setigerous puncture on each side. Prothorax broader than long (5·1

× 7 mm.), widest and ampliate about middle, wider across apex (4·2 mm.) than base (3 mm.); sides evenly rounded anteriorly, obliquely narrowed posteriorly, subsinuate before base: anterior margin truncate in middle, a light sinuosity between median part and anterior angles, these near neck, not quite as prominent as median part; base lightly bisinuate; lateral margins punctate; border reflexed, subrotundate posteriorly: basal angles sharply marked; disc a little raised, with some scattered, rather large punctures towards apex and base, finely transversely striolate, especially towards sides. Elytra parallel; striæ finely punctate; interstices closely punctate, especially towards apex. Length 32 mm.

Hab.—Central Australia: Tennant's Creek. (Unique in my collection; received from Mr. C. French).

Closely allied to *G. rugaticolle* Blkb., but differing by prothorax smaller, less strongly rugose, anterior margin more prominent than anterior angles, lateral margins more concave and so forming a wide channel, base less strongly bisinuate, basal angles more sharply marked; elytra more closely punctate, the punctures a little finer, particularly on the odd interstices; ligula more narrowed to apex, with the flattened discal area much smaller, the surface less punctate; tooth of mentum more prominent; gular pominence quite different, shorter and out-turned on each side in a conical process. From *G. grande* Macl., it differs greatly by prothorax smaller, the anterior margin in ♂ not nearly as prominent as in *G. grande* ♀: punctures of elytra closer, the second, third, fourth, and fifth interstices not biseriately punctate in the greater part of their course; gular horn of different shape, etc.

GIGADEMA RUGATICOLLE Blackburn.

Piceous-black. Head punctate; front striolate, longitudinally on each side, transversely in middle. Prothorax in ♂ transverse (5·3 × 7·5 mm.), widest about middle, ampliate on sides, wider across apex (4·5 mm.) than base (3·2 mm.), angustate to base; sides hardly subsinuate just before base; anterior margin truncate in middle; anterior angles widely rounded and more prominent than median part; base bisinuate; basal angles obtuse, but marked; disc not punctate, transversely striolate; margins wide; border reflexed, crenulate posteriorly. Elytra parallel (19·5 × 10 mm.); interstices depressed (especially in ♀); third, fifth, and seventh subcostate towards base, even interstices biseriately punctate towards base, triseriate posteriorly, eighth irregularly 5-seriate. Ligula wide, depressed; anterior margin rotundate. Gula with a wide short bifid prominence, the two points short, erect, obtuse. Maxillæ prominent at base, cardo not projecting beyond stipes. Length 32, breadth 10 mm.

Hab.—Western Australia: Condon (H. M. Giles). Two specimens (♂ ♀) have been examined.

I have identified *G. rugaticolle* Blkb., from the description (founded on ♀). It is allied to *G. grande* Macl., but differs by elytra with interstices more closely punctate, second 3-seriately punctate, except just near base; mentum with median tooth shorter, wider, rounded at apex; ♂, with prothorax not strongly prominent above head, but actually less prominent at middle than at anterior angles; gular horn much shorter and more deeply divided into two parts. Comparing the anterior margin of the prothorax with that of *G. grande* for both sexes, we find—♂, not strongly and roundly advanced in the middle, but less prominent in middle than the anterior angles, though these are very little advanced: ♀, middle part truncate, and decidedly less prominent than anterior angles (in *G. grande*, middle part truncate, but a little more prominent than anterior angles).

Gigadema grande Macleay.

Trans. Ent. Soc. N.S.Wales, i., 1864, 108; ♂, Chaudoir, Rev. & Mag. Zool., 1872, 215; Gestro, Ann. Mus. Civ. Genova, vii., 1875, 879.

Depressed, carbonarious. Prothorax strongly ampliate, strongly obliquely angustate to base without sinuosity; apex with median part prominent (in ♂ strongly, in ♀ lightly). Elytra with interstices finely punctate, odd ones biseriately, even ones more closely and irregularly. Posterior trochanters pointed at apex. Ligula depressed, wide, obtuse at tip. Submentum in ♂ armed with an erect horn, bifid at apex. Length 31-35, breadth 11-11·5 mm.

Hab.—Queensland: Townsville (Dodd), Port Denison (Masters).

Var. *prominens.* ♂. Head larger; mandibles longer and more strongly curved; submentum with a very short bituberculate prominence; prothorax wider, sides lightly arcuate to base (in *G. grande*, subsinuate), base wider, more strongly bordered. Length 35 mm.

Hab.—Queensland: Coen (Hacker). A single specimen (♂) in Coll. Carter.

The *nocte*-group.

Ligula punctate, depressed in middle of disc; paraglossæ corneous. Maxillæ with inner lobe moderately setose on upper side, triangularly prominent at middle of inner side. Palpi long; penultimate joint of labial long, bowed, apical joint very short; penultimate joint of maxillary longer than apical. Prothorax with disc nitid, and more or less without punctures in middle. Mandibles in ♂ long, sometimes right mandible notched near apex (e.g., *G. bostocki*).

Gigadema obscurum. n.sp.

Head with postocular part of orbits swollen beneath eyes; ligula depressed; labial palpi with penultimate joint bowed, more than twice the length of apical joint, this short; prothorax cordate, anterior margin a little more prominent above head than at anterior angles; elytra with interstices biseriately punctate near base, closely and more confusedly punctate towards apex.

♂. Head not large (5·5 mm. across eyes), punctate on vertex; eyes prominent; orbits swollen behind and below eyes; submentum not armed; maxilla with cardo not prominent.

Prothorax broader than long (5 × 7 mm.); anterior margin with a sinuosity on each side near neck, median part subemarginate, slightly more advanced than anterior angles, sides strongly rounded anteriorly, obliquely narrowed posteriorly; disc nitid, strongly raised above margins, sparsely punctate (the punctures very scattered in middle). Elytra ordinary (17 × 10 mm.); interstices closely punctate, more or less biseriately punctate towards base; punctures becoming 3-seriate towards apex on odd interstices, 4-seriate on even interstices.

♀. Differs from ♂, by head with postocular prominences less developed; prothorax narrower (4·6 × 6·3 mm.).

Length 29, breadth 10 mm.

Hab.—Queensland: Cunnamulla (Hardcastle). Two specimens (♂ ♀) received from Mr. A. M. Lea(Colls. Lea and Sloane).

Allied to *G. nocte* Newm., but differing from all the forms of that species, which I have seen, by postocular prominences more strongly developed (especially in ♂); prothorax with median part of the anterior margin more prominent in comparison with the anterior angles; elytra with interstices more finely and closely punctate. It cannot be *G. longius* Blkb., or *G longicolle* Blkb., (both unknown to me in nature) on account of the different puncturation of the elytra, and the postocular prominences in both sexes more prominent than in *G. bostocki* Cast., (the prominence in ♀ being more below the eye than in *G. bostocki*). Blackburn indicated his *G. eremita* (which I cannot differentiate from *G. bostocki*) as being a species with well developed postocular prominences.* These prominences also differentiate it from *G. dux* Blkb., which is said to be without them.* I look upon it as the most primitive species of the *nocte*-group, but cannot see any reason for supposing that it is descended from the *grande*-stem; it seems rather an offshoot from some ancient generalised form.

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* Trans. Roy. Soc. S. Aust., 1901, p.102, table.

GIGADEMA NOCTE Newman.

Ænigma nocte Newman, The Entomol. 1842, 413; Schaum, Berl. Ent. Zeit, 1863, 80: *Gigadema titanum* Thomson, Arc. Ent., 1859, 93: *G. nocte*, Gestro, Ann. Mus. Civ. Genova, 1875, vii., 878.

Right mandible in ♂ not notched on inner side before apex; elytra with interstices 2-7 biseriately punctate near base; punctures more confused towards apex.

Var. *typica*. Punctures of elytral interstices tending to be biseriate, slightly more confused towards apex. Length 30-38 mm.

Hab.—New South Wales: Germanton, Urana, Grenfell, and Cobar.

Var. *titana* Thomson. Punctures of elytral interstices more dense, biseriate only near base. Length 36-47 mm.

Hab.—Queensland: Rockhampton and Cooktown.

I place, under *G. nocte* Newm., all the specimens known to me (a large series) with the second, fourth, and sixth interstices of the elytra confusedly punctate towards apex; labial palpi with penultimate joint bowed; right mandible not notched near apex in ♂.

GIGADEMA BOSTOCKI Castelnau.

Trans. Roy. Soc. Victoria, viii., 1868, 106; Gestro, Ann. Mus. Civ. Genova, vii., 1875, 876: *G. eremita* Blackburn, Trans. Roy. Soc. S. Aust., xvi., 1892, 17: *G. intermedium* var. Gestro, *op. cit.*., vii., 1875, 877.

Black, shining. Prothorax cordate; anterior angles rounded, usually more prominent than middle of anterior margin; sides sinuate or subsinuate before base. Elytra with interstices biseriately punctate. Right mandible in ♂ notched before apex. Length 32-40 mm.

Hab.—Western Australia: Cunderdin, Wanneroo, Champion Bay, Cue, Onslow, Kimberley District.

G. bostocki Cast., is a species with a wide range, and is subject to some variation in the shape of the prothorax. I consider *G. intermedium* Gestro, a variety, and *G. eremita* Blkb., as conspecific. Found under logs, on the ground.

A specimen (♂) from Champion Bay is evidently, by its large head, prothorax with juxtabasal sinuosities of sides less marked than in *G. longipenne* Germ., and elytra narrowed to base, the *G. bostocki* of Gestro; this I consider the typical form. A specimen (♂) from Sandstone, near Cue, differs from the typical form by prothorax decidedly sinuate on sides near base; elytra with interstices more convex, more strongly biseriately punctate, the punctures closer together in the rows, this is *G. eremita* Blkb., the types of which species I have examined in the South Australian Museum; at present, I do not think *G. eremita* can be maintained as a variety.

Var. *intermedia* Gestro. Length 30-42 mm. I have identified a specimen (♂) from Jerilderie, N.S.W., as *G. intermedium* Gestro; it differs from the typical form of the species by head slightly smaller; prothorax far more strongly sinuate on sides posteriorly, anterior angles less prominent; elytra not narrowed to base, interstices more convex, punctures closer together in the rows. Specimens (♂) from Lake Hattah, Victoria, have the prothorax more convex than the Jerilderie specimen, but are conspecific with it. Specimens (♂) from Cunnamulla, Queensland (received from Mr. Lea), are larger (42 mm.), with the prothorax larger and more ampliate, median part of anterior margin truncate and slightly more prominent than anterior angles, but I cannot differentiate this form from var. *intermedia*.

It may be noted that, in var. *intermedia*, there is a tendency for the sixth interstice of the elytra to become triseriately punctate towards the apex, but I have never seen this character in the western forms of *G. bostocki*. We may suppose var. *intermedia* to be an older form than the western *G. bostocki*. In *G. bostocki* and its varieties, the prothorax is very free from punctures on the disc.

G. bostocki var. *intermedia* ranges from the Mallee districts of North-Western Victoria, through the western parts of New South Wales, into South-Western Queensland.

It is possible that *G. longicolle* Blkb., is a form of *G. bostocki* var. *intermedia*, but the examination of specimens from Oodnadatta (including the ♂) would be required to settle this matter.

GIGADEMA MANDIBULARE Blackburn.

Trans. Roy. Soc. S. Aust., xvi., 1892, 18; Var. (?) *G. longius* Blackburn, *op. cit.*, 1901, 101.

♂. Piceous-black. Head large; mandibles long, decussate, right notched on inner side before apex. Prothorax cordate (6·4 × 10 mm.); sides sinuate before base; disc nitid, sparsely punctate, except in centre. Elytra strongly striate; interstices biseriately punctate towards base, fourth and sixth wider than others, densely punctate on apical half. Maxillary palpi with penultimate joint longer than apical. Anterior tibiæ long; inner notch considerably nearer apex than base. Length 39 mm.

Hab.—Western Australia: Upper Ashburton River. I received my specimen from Mr. C. French, and have compared it with the type in the South Australian Museum.

A specimen (♀) in my collection agrees with the description given above, but has the prothorax narrower (6 × 8·6 mm.), more convex; margins narrower; disc nitid but more generally covered with punctures; intermediate tibiæ wider at apex, and with external apical angles more strongly dentiform. Length 37 mm.

Hab.—Northern Territory: Tennant's Creek (Field).

This specimen from Tennant's Creek, I compared with a specimen (♀) in the South Australian Museum (from Central Australia, which is ticketed "*Gigadema longius*" in the handwriting of the late Rev. Thos. Blackburn, and I considered it identical. It is, in my opinion, conspecific with *G. mandibulare* (perhaps a variety); but the examination of male specimens from the MacDonnell Ranges would be necessary to deal with it satisfactorily.

The *longipenne*-group.

Ligula convex, smooth; paraglossæ corneous. Maxillæ with inner lobe densely setose on upper side and apex, not triangularly prominent at middle of inner side. Palpi not long and bowed; apical joint of labial three-fourths length of penultimate; two apical joints of maxillary subequal. Mentum with lobes very long and sharply pointed. Prothorax with anterior angles more prominent than median part of apex; disc nitid and impunctate in middle. Elytra with interstices biseriately punctate, sometimes tending to become triseriately punctate towards apex. Middle trochanters with a triangular prominence on lower side.

GIGADEMA LONGIPENNE Germar.

Helluo longipennis Germar, Linn. Ent., 1848, iii., 162 · *Gigadema longipenne* Gestro, Ann. Mus. Civ. Genova, 1875, vii., 876 : *G. politulum* Macleay, Trans. Ent. Soc. N. S. Wales, 1871, ii., 83.

G. longipenne Germ., is found in South Australia, New South Wales, Queensland, and North-West Australia. It is well known, and is differentiated from all the other species of *Gigadema* by the group-characters given above. *G. politulum* Macl., is conspecific with *G. longipenne*; I have examined Macleay's type in the Australian Museum, Sydney.

NEOHELLUO, n.gen.

Depressed, winged. Head wide across neck; eyes hemispherical, prominent, lightly enclosed behind in small truncate orbits; one supraorbital sensitive hair on each side. Antennæ narrow, lightly compressed; four basal joints cylindrical. Clypeus wide, truncate, one sensitive hair at each side. Labrum truncate, one sensitive hair near each anterior angle. Mentum deeply emarginate; sinus edentate, oblique on sides; lobes triangular, pointed. Ligula wide, fringed with long setæ; apex prominent in middle; outer surface with four setæ distant from apex; inner surface plurisetose; paraglossæ rudimentary, cartilaginous. Labial palpi long; penultimate joint long, narrow; apical joint three-fourths length of penultimate, lightly incrassate. Maxillary palpi long; apical joint a little longer than penultimate; in form like a narrow compressed club. Maxillæ with external angle of cardo forming a short triangular process; inner lobe wide, apex wide, rounded, plurisetose, projecting beyond the spiniform hook. Prothorax hexagonal, widest and obtusely angulate at middle, strongly obliquely angustate to base; apex truncate; anterior angles marked and raised in ♂, rounded in ♀. Elytra striate; striæ minutely punctate; interstices depressed, 2-7 with three rows, eighth with four rows of punctures, third with four widely placed dorsal punctures; humeral angles rounded in ♂. Prosternum strongly declivous to apex; a strong transverse sulcus near anterior margin. Tarsi setose; fourth joint narrow, entire; anterior in ♂ with second and third joints dilatate and biseriately squamose beneath.

Neohelluo is nearer to *Ænigma* than to any other genus; it also shows some affinity, though remote, to *Gigadema maxillare* Sl. It differs from *Ænigma* by labrum shorter; mentum triangularly pointed, not with epilobes developed into strong curved mucrones; ligula with apex more prominent in middle; fringe of setæ longer; inner surface plurisetose towards base; maxillæ with inner lobe more setose, especially at tip, apex projecting far more beyond hook; prothorax differently shaped, basal angle near peduncle, elytra in ♂ without humeral tooth, etc.

Neohelluo angulicollis, n.sp.

♂. Black. Head large (3·9 mm. across eyes); mandibles very long, curved, bent downward to apex from middle. Prothorax broader than long (4 × 4·6 mm.), wider across apex (2·7 mm.) than base (2·3 mm.), ampliate and roundly subangulate at middle of sides; disc convex; sides obliquely narrowed to apex and base; anterior margin truncate; angles prominent, obtuse, reflexed; lateral margins punctate, wide, strongly reflexed; basal angles near peduncle. Elytra much wider than prothorax (11 × 6·7 mm), striate; striæ minutely punctate;

interstices depressed, 2-7 with three rows of fine punctures, eighth with four rows of punctures, third with four widely spaced dorsal punctures. Length 19·5, breadth 6·7 mm.

Hab.—Tropical Queensland (Dodd). Mr. F. P. Dodd sent me one specimen without exact locality; but I believe it is from somewhere near Cairns. I have seen a second specimen in the South Australian Museum, as from near Cairns.

♀. Differs from ♂ by prothorax narrower (3·5 × 4 mm.), anterior angles rounded off, anterior margin truncate, a little more prominent than anterior angles.

Hab.—Townsville (Coll. Ferguson). One specimen (♀) was sent to me for examination by Dr. E. W. Ferguson, of Sydney.

Genus ÆNIGMA.

Newman, Ent. Mag., iii., 1836, 499.

Depressed, winged; upper surface violaceous or cyaneous. Head wide; eyes semiglobose, lightly enclosed behind; one sensitive supraorbital hair on each side. Antennæ long, slender. Clypeus depressed, widely subemarginate. Labrum large, depressed; apex prominent, widely rounded; one prominent setigerous puncture at each anterior angle, four other less conspicuous setigerous punctures in an irregular row between the two lateral punctures; sides sparsely setose. Mentum edentate; lobes with apex elongate, pointed. Ligula convex, wide, cordate; inner surface with a few long setæ on basal half. Palpi: labial with two apical joints subequal, apical rather narrow, truncate; maxillary with apical joint wide, securiform. Maxillæ with inner lobe not prominent at middle of inner side; apex slightly prominent, tufted with hair; hook placed at right angles, long, slender. Prothorax transverse, wide at base; sides not ampliate, not strongly angustate to base; basal angles distant from peduncle. Elytra with interstices wide, lightly convex, 1-6 biseriately punctate, third with four or five distantly placed dorsal punctures, eighth wide, pluripunctate; humeral angles in ♂ strongly dentate, in ♀ rounded; setæ pale. Prosternum strongly declivous before coxæ. Tarsi with penultimate joint narrow, simple. Type, *Æ. iris* Newm. Length 17-21 mm.

Habits: on tree-trunks, under bark.

This is a terminal genus of ancient origin, more allied to *Neohelluo* than to any other genus.

ÆNIGMA IRIS Newman.

Ent. Mag., iii., 1836, 499; Castelnau, Trans. Roy. Soc. Victoria, viii., 1868, 108; Gestro, Ann. Mus. Civ. Genova, vii., 1875, 874; Chaudoir, Rev. & Mag. Zool., 1872, 213. Variety —*Æ. newmani* Castelnau, *l.c.*, 108; Gestro, *l.c.*, 872; *Æ. splendens* Castelnau, *l.c.*, 109; Gestro, *l.c.*, 873.

Castelnau recognised three species of *Ænigma*, *Æ. iris*, *Æ. newmani*, and *Æ. splendens;* but, Gestro, when reviewing the Australian Helluonini, reduced these to two by uniting *Æ. splendens* to *Æ. newmani.* It is my belief, after examination of thirteen specimens, four of which were females, that only one species should be recognised, namely, *Æ. iris* Newm.; and that the narrower, more cordiform shape of the prothorax, on which Castelnau and Gestro relied for the separation of *Æ. newmani*, should not be considered as of full specific value. The considerations which induce me to come to this opinion are—(*a*) The form with the narrow prothorax is reported by Castelnau from Sydney (*Æ. newmani*) and Port Denison (*Æ. splendens*)—that is, from the southern and northern districts of the range of *Æ. iris.* (*b*) A specimen(♀) is in my collection (most likely from the Rockhampton District) which, by its unusually narrow prothorax, with the sides more angustate to the base, and basal angles more obtuse than in the typical form, evidently represents *Æ. newmani*; but, I cannot think it more than a variety. (*c*) Mr. H W. Brown has given me a specimen(♂) which has the prothorax with the sides more sinuate behind than usual, so that they meet the base at right angles, the basal angles being marked and rectangular; usually the sides of the prothorax are hardly subsinuate, and the basal angles are obtuse at the summit My conclusion is that the shape of the prothorax varies in *Æ. iris*, and that the varietal name *Æ. newmani*(=*Æ. splendens*), may be used for the race with the prothorax narrow.

AMETROGLOSSUS, n.gen.

Depressed, black, winged. Head wide across eyes; neck narrow; orbits behind eyes small, oblique; eyes large, prominent; one supraorbital seta on each side. Antennæ long, narrow, lightly compressed; four basal joints cylindrical. Clypeus emarginate-truncate; one sensitive hair on each side. Labrum large, depressed; apex prominent in middle; one sensitive hair on each side. Mentum with lobes long, triangular, pointed; median tooth prominent, triangular. Ligula furcate; each side produced in a narrow curved lobe turned upwards at the apex; lateral margins with about six setæ on each side behind lobes; one sensitive hair on basal half of each lobe; inner surface with four setæ near margin of sinus. Paraglossæ rudimentary, cartilaginous; apex pointed, free. Palpi with apical joint securiform. Maxillæ strongly hooked; apex not projecting beyond hook, densely beset with hair; inner side lightly rounded in middle. Prothorax roundly ampliate at widest part, strongly sinuate-angustate to base; upper surface very sparsely punctate, transversely striolate. Elytra striate; striæ minutely punctate; interstices shagreened, subconvex, biseriately punctate (including eighth), fifth with five widely placed dorsal punctures, ninth with a double row of large punctures. Prosternum depressed; no transverse marginal sulcus. Anterior tarsi, in ♂, with second and third joints widely dilatate and biseriately squamose beneath; fourth joint small, rather transverse; in four posterior tarsi small, entire. Type, *Gigadema atrum* Macl.

Habits: on tree-trunks, under bark. A monotypic genus, with vague general affinities towards *Gigadema* and *Neohelluo*; although it has a forked ligula, it has no affinity to *Dicranoglossus*, the only other genus in which the ligula is forked.

AMETROGLOSSUS ATER Macleay.

Gigadema atrum Macl., Proc. Linn. Soc. N. S. Wales, (2), ii., 1887, 217.

Dimensions: head (across eyes) 4·1; proth. 3·75 × 5 (apex 3·5, base 2·5); elytra 14 × 8 mm.

Hab.—Queensland: Kuranda (Dodd).

Geographical Distribution of the Helluonini.

The present distribution of the Helluonini is as under—Ethiopian Region (*Macrocheilus*, *Meladroma*, *Triænogenius*). Oriental Region (*Macrocheilus*, *Omphra*, *Creagris*). Neotropical Region (*Helluomorpha*, *Pleuracanthus*). Australian Region (*Creagris*, *Helluonidius*, *Dicranoglossus*, *Helluosoma*, *Helluodema*, *Epimicodema*, *Helluo*, *Helluarchus*, *Helluapterus*, *Gigadema*, *Neohelluo*, *Ænigma*, *Ametroglossus*). Of the genera found in Australia, only *Creagris* (evidently an immigrant from the north) and *Helluonidius* (*H. chrysocomes* Maind., in New Guinea) have been found beyond the limits of the continent of Australia. The Australian group of the Helluonini can be looked upon only as an autocthonous subtribe peculiar to Australia, like its autocthonous flora, and probably derived from the same ancient land, which formed the place of origin of the autocthonous flora (probably some part of Australia is a remnant of this old land); it seems altogether unlikely that the Helluonini could have reached Australia from the Antarctic source whence came the marsupials, at a later date. The distribution of the Helluonini in Australia, Africa, and South America brings to mind the similar distribution of the genus *Megacephala*; though the Helluonini should be more adaptable to widely varying conditions, owing to the free-living habits of carabideous larvæ, in comparison with the fixed burrow-inhabiting mode of life of cicindelideous larvæ, which must cause fewer situations to be suitable to the development of the latter.

With regard to the distribution of the Helluonini throughout Australia, I have little exact data. All our genera, except *Helluo*, *Helluarchus*, and *Helluapterus*, occur in the heavily wooded coastal parts of tropical Queensland. As far as I know, only *Helluo* is found in Southern Victoria, and no Helluonid has been reported yet from the moist, heavily timbered, south-western part of the continent.

Helluonidius ranges from the Hawkesbury River, N.S.W., to Port Darwin, also to New Guinea; its range inland is unknown. *Dicranoglossus* is found in tropical Australia; its range inland and westward is unknown. *Helluosoma* is found in tropical

Australia, but the area of its range is unknown. *Helluodema* extends, in the eastern coastal districts, from the Clarence River to Cooktown. *Epimicodema* has been found from the Clarence River to Rockhampton; its range inland is unknown. *Helluo* is found in Eastern Australia; *H. costatus* from Brisbane to Wilson's Promontory throughout the mountains and coastal districts; *H. insignis* on the Darling River from Walgett to Bourke; *Helluarchus* from Cue, W.A., to the MacDonnell Ranges. *Helluapterus* is from North-West Australia (Onslow and Cue). *Gigadema* may be divided into four groups. (1) The *sulcatum*-group ranges from the Murray River, N.S.W., to Onslow, W.A.; its range in Central Australia is unknown. (2) The *grande*-group is found in tropical Australia; its range inland is unknown. (3) The *nocte*-group is very widely spread in Queensland, New South Wales, Northern Territory, Western Australia, and the northern parts of South Australia, also North-Western Victoria. (4) The *longipenne*-group contains but one species, *G. longipenne* Germ., which is found over the greater part of the continent; but is not yet reported from Queensland (north of Gayndah), Victoria (south of the Dividing Range), nor the south-western part of Australia. *Neohelluo* and *Ametroglossus* are tree-dwelling genera from the forests of tropical Queensland. *Ænigma* is found in the coastal districts, from Sydney to Port Denison. *Creagris* is found in Ceylon, Java, Banghok, and tropical Queensland.

ON SOME *PAUROPODA* FROM NEW SOUTH WALES.

By Launcelot Harrison, B.Sc., John Coutts Scholar, and Junior Demonstrator in Zoology in the University of Sydney.

(Plates lxx.-lxxi.)

At the end of May of this year (1914), I first recognised two individuals of a species of Pauropus, while overhauling a day's collections of Collembola, Thysanura, etc., under the microscope. On revisiting the locality in which this material was collected, I was easily able to find the same species in very considerable numbers, as well as a second species which was much less numerous. Both were found under bark lying upon the clay soil in forest-country at Archbold's Hill, Roseville. During June, I collected many specimens, some of which were kept alive in small tubes containing a little damp soil and pieces of bark, while others were preserved. For fixation, I used Carnoy's Fluid, which I subsequently found to have been considered satisfactory by Kenyon (1895). In many specimens fixed in this fluid, however, I found that there was a tendency for the cuticle to swell up away from the muscle-layers, causing considerable distortion. Believing this to be due to the large proportion of acetic acid, I later tried a modification, adding one per cent. of acetic acid to a mixture of two parts of 95% alcohol with one of chloroform. This mixture preserved the animals without distortion, but I have not yet cut any sections, so that I cannot vouch for the histological elements. Specimens fixed in hot aqueous sublimate-acetic were also preserved without distortion, and this fixative may prove satisfactory, as the cuticle is very delicate.

Late in June, I found the same two species at Broken Bay, in company with other species described later, which included a member of the remarkable genus *Eurypauropus*. These were all found under stones on damp ferny banks, where outcrops of shale occurred among the sandstone. I was not successful in finding any on the sandstone-soil, which would not seem to retain sufficient moisture to afford a suitable habitat for these delicate little myriapods.

Pauropus is an active little creature, easily distinguished by the unaided eye from the lipurid *Collembola*, the only things with which it might otherwise be confused, by its markedly narrow anterior end, rapid movements, and rigid body, which is only rarely flexed from side to side. From observation of those which I have in captivity, I am quite confident that they are humus-feeders, as has already been surmised; for I have frequently watched them, under the microscope, browsing upon particles of soil on which I could distinguished nothing definite in the way of food. Those in captivity laid eggs rather freely, some of which I allowed to hatch out, while the majority were preserved. I hope to be able to obtain sufficient material to ascertain something of the embryology of the Order, which is unknown; but as, even if sufficient material be forthcoming, I shall not have the opportunity, for some time to come, of working at it, I have thought it advisable to publish descriptions of the forms found, of the post-embryonic stages, and some discussion of the segmentation.

The morphology of the adult forms has been well studied by Schmidt (1895), and Kenyon (1895). Of the post-embryonic stages I have very plentiful material, but I prefer to defer an account of the minute structure of these until such time as I am also able to give an account of the embryonic stages.

Pauropoda have hitherto been recorded only from Europe, the United States, Argentine, Chili, and Siam. The Australian species appear to show affinities to the South American rather than to the Asiatic forms.

Order PAUROPODA Lubbock.

Family Pauropodidæ Lubbock.

Genus Pauropus Lubbock.

Hansen (1901, p. 349) gives the following diagnosis for the genus:—"The lower antennal branch has the anterior margin at least slightly and generally somewhat shorter than the posterior, its anterior flagellum is shorter than the other, and the transverse diameter of the globulus is never shorter, and generally much longer than its stalk. The penultimate segment of the trunk with five pairs of dorsal setæ, two of which between the tactile setæ. The sternum of the anal segment has at least two pairs, and generally three pairs of setæ."

Of this genus, I have collected five species. One of these has been found in very considerable numbers; of a second, I have upwards of twenty individuals; while the remaining three are represented only by single specimens, two of which are described. The third is a form with a small anal plate bearing four short subequal processes, but is, unfortunately, not in sufficiently good condition to justify description.

I have not found any members of the second genus of the family, *Stylopauropus* Cook.

From the fact that five species have been collected in two localities only, it is reasonable to suppose that a considerable number will be forthcoming when these little creatures are looked for over a wider range.

Although it will certainly be necessary, at a later date, to divide the genus *Pauropus* into several genera, I have avoided splitting the genus in deference to Hansen's warning (1901, p. 341) that "many species must be discovered and studied before the characters of generic value can be pointed out with tolerable certainty."

PAUROPUS AMICUS, n.sp. (Plate lxx., figs.1-11).

This species, which shares with *Stylopauropus pedunculatus* Lubbock, the distinction of being the largest known pauropod, was very plentiful among fallen timber at Lindfield during June and July. I found all stages, from egg to adult. It is of a somewhat social habit, being almost invariably found in colonies, which vary from half a dozen up to upwards of a hundred individuals. I have had a number in captivity, in small tubes half-filled with damp soil and I find, like Lubbock, that they are engaging little creatures to watch. They spend a great deal of their time cleaning their appendages, commencing with the antennæ, which are hauled down by a vigorous curling of the corresponding first leg about them, and drawn rapidly across the mouth; and proceeding on to each pair of legs in turn, the limbs being systematically washed from coxa to tarsus. The attitude assumed, in cleaning the extended hinder limbs, is amusingly reminiscent of the same process in the domestic cat.

The general form is robust, widest and highest at the fifth dorsal shield, and tapering gradually forwards and abruptly backwards. The whole cuticle is minutely pilose, the pubescence being a little stronger on the head, dorsal shields, and posterior legs. The anterior has the two basal joints short and subequal, the third about twice the length, the fourth longest, and swollen distally. The lower ramus is about two-thirds as long as the upper, and but little wider. Its anterior flagellum is less than half the posterior, and is borne on the truncated anterior corner. The basal unringed portion of the flagella is short. The globulus is small, and almost sessile. The upper ramus has its flagellum about one-fifth longer than the posterior flagellum. On the dorsal surface of the head, the "eyes" are widely separate, their inner margins being on a level with the bases of the fourth antennal segments. There are three cylindrical hairs on either side, behind "eye"; a fourth hair of similar character projecting laterally in front of these. Mid-dorsally, in front of posterior margin, a pair of slightly club-shaped hairs; in front of these a row of four, similar; in front of these, a pair, similar, with a pair curved-cylindrical, laterally; before these, a row of six, then a median hair projecting forwards between bases of antennæ, all definitely club-shaped. The first dorsal shield is hardly wider than the head, the following shields gradually widening to the fifth; sixth narrower, with the rounded anal segment projecting beneath it. The shields are almost straight along the anterior border, but broadly rounded behind. The first bears a row of four hairs along the anterior border, the outer pair being cylindrical, not clavate; and a row of four clavate hairs along the posterior border. The second has a row of four clavate hairs in front of the middle, and a similar row close to the posterior border; with a pair lateral and longer, midway between these two rows; and a second pair, cylindrical and twice as long, in front of and inside the tactile setæ, which are in the antero-lateral corners. The third and fourth shields have six hairs along hind border, all of the same character; and six hairs across the middle, the outer pair slightly longer. The second pair of tactile setæ is just in front of, the third pair just behind, the anterior row. The fifth shield has four hairs on the posterior border between and behind the tactile setæ; a pair lateral in front of these; and a row of six across the middle, the outer pair almost twice as long as the others. The sixth shield has a pair of hairs in the middle; a pair lateral behind these; and a pair close to the posterior border, between the tactile setæ, which are at the postero-lateral angles. The tactile setæ are delicately plumose almost to their bases, the last pair being longest. The rounded anal segment ends posteriorly in a button-like process, in front of which is a row of four clavate hairs, with a longer curved pair laterally. Below, it bears a pair of cylindrical plumose hairs, slightly swollen at the distal extremities, about the middle of its length; the styli long, with the distal half thinner than the proximal; and a pair of short, curved, club-shaped hairs, one outside each stylus. The anal plate is deeply cleft medianly, with four processes in one plane, the outer pair short, cylindrical, and reaching to the suture of the inner pair; the latter with sutures running diagonally inwards and backwards, the part behind the suture being precisely like the ordinary clavate hairs, with the inner face flat, the outer curving outwards distally. On the ventral surface, the twelve segments are completely marked off by transverse sutures less distinct laterally, cutting off a series of dicebox-shaped sternal areas. The copulatory appendages of the male are conical, extending without setæ to the hind border of the somite. The genital opening of the female is unpaired, and situated to the right of the midline. The rudimentary limbs of the first somite each bear two biramous hairs, the inner branches being reduced, and having a cylindrical process articulated distally. The penultimate legs are longest. The first leg has a cylindrical curved hair on the anterior face of the tibia, and a similar very short one almost at the claw of the tarsus. The succeeding legs have similar hairs, and, in addition, a hair like that of the tibia upon the metatarsus. In the ninth leg, the metatarsal hair is present, and there is a distinct indication of division on the inner side of the tarsus at a little more than half its length. All the legs have biramous hairs upon coxa and trochanter. In the first eight, one branch is much reduced, with a very short cylindrical process articulated distally; the ninth having subequal branches. The anterior legs are distinctly three-clawed, the median longest; posterior legs with the anterior branch of the empodium apparently clawless, and the posterior claw almost as large as the median.

The sexes are equal in size. The length varies from 1·5 to 1·7 mm. in sexually mature individuals; the breadth averaging 0·4 mm.

Loc.—Lindfield; Broken Bay.

The form of the anal plate at once places this species in connection with three Chilian forms described by Hansen, *P. robustus*, *P. intermedius*, and *P. spectabilis;* but it shows no very close relation to any of these species.

Pauropus australis, n.sp. (Plate lxxi., figs.12-14).

Of this smaller and more slender species, I have taken about a dozen specimens at Lindfield, where it is much less in evidence than *P. amicus*, hiding between the laminæ of barksheets, and only being brought to light by careful searching. At Broken Bay, it was the commonest species; and I captured about twenty individuals under stones in moist places.

The form is slender, the sides subparallel, only slightly diverging posteriorly. The cuticle shows a fairly long pubescence on the last shield, anal segment, and posterior legs; a slight pubescence on the fifth shield; and is smooth in front of that. The antenna has the lower ramus a little more than half the upper, its flagella subequal and symmetrically placed upon truncated angles on either side of the globulus, which is large and distinctly stalked. The upper ramus is distinctly narrower, and has its flagellum longer by one-fourth than those of the lower ramus. The basal unringed portions of the flagella are short. The hair on the anterior border of the fourth antennal segment is long, extending as far as the globulus. All the hairs of the upper surface are longer and more cylindrical than in the last species. Between the bases of the antennæ, is a very short cylindrical hair, with a club-shaped hair below it. Round the front margin of the head, are six club-shaped hairs, flanked by a pair, one placed in front of each eye, a little smaller and not so plumose. Behind the front row, a submedian pair, then a row of four, then a submedian pair. Behind each eye, two longish cylindrical hairs. Sublateral hairs, behind and below head, short and perfectly cylindrical. Hairs of dorsal shields as described by Hansen for *Pauropus* in general; all long, cylindrical and slightly swollen at tip. The first pair of tactile setæ are very coarsely plumose distally; the last pair much the longest, twice the width of shield, and with a meagre coarse pubescence. The anal segment has a pair of cylindrical hairs close to the midline at half its length, which reach to the posterior border; and a very short pair lateral to these; behind this row, there are two hairs on either lateral border, the anterior pair being much longer than the posterior. The segment ends in a slight rounded prominence. On the ventral surface, there is a pair of hairs on the middle of the segment, and two pairs on the lateral border, the posterior almost twice as long as the anterior. The anal plate has four processes in the same plane. The median incision ends square, separating the bases of the inner pair of processes, which are cylindrical, stouter than the outer, and have the distal third narrower and articulated. The outer pair spring from just behind the end of the median incision, diverge outwards, and are almost as long as the inner pair. The legs are rather short. The last has a long, tapering, plumose hair at the upper end of the tarsus; and a very short, stout, cylindrical plumose hair at the claw, with a similar one, slightly longer, on the tibia. Hairs on coxa and trochanter biramous. The tarsus seems to have the middle claw absent.

The average measurements of a number of specimens are 0·93 mm. long, and 0·16 mm. wide.

Loc.—Lindfield; Broken Bay.

This species seems to be most nearly related to *P. intermedius* Hansen, from Chili. The form of the antenna is very similar, and the anal plate, though differing considerably in detail, has the same general form.

PAUROPUS NOVÆ-HOLLANDIÆ, n.sp. (Plate lxxi., figs.15-16).

A single adult male of this species was taken under a stone at Broken Bay. The general form is fairly robust, the posterior end being considerably higher and wider than the anterior. The cuticle is apparently wholly without pubescence. The lower ramus of the antenna is a little more than two-thirds as long as the upper, and half as wide again. Its anterior flagellum rises from the truncated antero-lateral angle, and is but slightly shorter than the posterior, each being only a little more than twice the length of the ramus. The globulus and posterior flagellum are apical, the former fairly large, and with a stalk equal in length to its transverse diameter. Flagellum of upper branch about one-fifth longer than those of lower. Basal unringed portion of all flagella short and stout. The "eyes" are a little closer than their length. The hairs of the head have the usual disposition, and are cylindrical, slightly swollen towards apex. The hairs of the body are cylindrical and curved. The pair betwen the last tactile setæ, and those of the anal segment are all long. The tergum of the anal segment ends in a rounded prominence, below and beside which are the extremely short knob-like styli. Considerably lateral to these, on the posterior border, and outside the corresponding hairs of the sternum, are a pair of long hairs, one-third as long as the posterior tactile setæ. The sternum of the anal segment has a pair of long hairs, with swollen ends, on the posterior border, and a very short pair anterior to these, and nearer the midline. The sternum ends posteriorly in an oblong protuberance occupying one-third of the distance between the posterior hairs, its posterior border notched in the middle. The anal plate, the base of which is hidden under this projection, has two, long, triangular processes, with rather concave inner margins, not showing a transverse suture. The last pair of tactile setæ are twice as long as the third, and half as long again as the fourth. All bear a very fine, fairly long pilosity. The penes are stout and large, reaching, without setæ, to the middle of the fourth segment. The last legs are longest. The hairs of coxa and trochanter are baton-shaped, none of them biramous, and those of the coxa much larger than those of the trochanter.

This specimen measures 0·75 mm. in length, by 0·15 mm. in breadth.

Loc.—Broken Bay.

This species occupies a somewhat isolated position. In the form of the antenna, and in the short, knob-like styli and long hairs of the anal segment, it shows affinity with *P. inornatus* Hansen, from the Argentine, but the form of the anal plate and sternum of anal segment differs considerably from those of the Argentine forms.

PAUROPUS BURROWESI, n.sp. (Plate lxxi., fig.17).

Of this species, a single immature individual, with eight pairs of legs, was available; but I have ventured to describe it on account of the remarkable form of the anal plate, which is only comparable with that of a Siamese form, from which, however, the present species is easily distinguished by several features. As I have only a single specimen, which, owing to its obstinate opacity, is difficult to describe in detail, I content myself with its outstanding features.

The antenna has both rami short, the lower extremely so, and only one-half the length of the upper. The former has its antero-lateral angle obliquely truncated, bearing the anterior flagellum, which is not quite one-half the length of the posterior. The upper ramus is short, its flagellum thrice its length, and one-fifth longer than the posterior flagellum of the lower ramus. The globulus is conspicuously large, as wide as the distal end of the upper ramus, with a stalk about one-half its diameter. All the flagella are much swollen distally, the last four or five rings being distinguished from the rest by a clearly defined central axis running through them, of the same diameter as the little terminal bulb, with which it connects. The anal segment and plate have very much the same general features as in *P. mortensenii* Hansen, but differ in details. The dorsal setæ have the same peculiar arrangement and proportions, except that the submedian pair is at least as long as the lateral. The styli differ in being more curved in over the anal plate, and in having broadly spatulate ends. The posterior ventral setæ are situated upon protuberances, which are rather more oblong in shape than those of *P. mortensenii,* and the setæ themselves are not much more than one-half the length of the submedian dorsal setæ, and are a little swollen, not tapering, distally. The anal plate is generally like that of *P. mortensenii,* but the two processes are deeply incised on their inner margins a little behind the apices; and, behind these clefts, are a pair of rounded, rudimentary processes, a little dorsal to the plane of the plate.

The specimen measures 0·52 by 0·15 mm.

Loc.—Broken Bay, under a stone.

This species shows undoubted affinity to *P. mortensenii* Hansen, from the Gulf of Siam. This is a little remarkable in view of the fact that the other three species described, all show a closer relation ship to South American forms. But the number of described species is too small to allow of any profitable discussion of inter-relations.

Family Eurypauropodidæ Ryder.

Genus Eurypauropus Ryder.

The single genus of the Family is characterised by the large development of the dorsal shields, the first of which projects forward beyond the anterior margin of the head, while the last similarly overlaps the anal segment. They are, in addition, so wide that the legs do not project beyond them, and are heavily sculptured, or ornamented with tubercles and spines, the usual hairs being absent. The tactile setæ are not inserted upon them, but either below or in lateral clefts.

Eurypauropus speciosus, n.sp. (Plate lxxi., figs.18-21).

Four specimens of this species were collected under a small stone on a mossy bank at Broken Bay, two adult males, and two immature individuals with five and six pairs of legs respectively.

The species has about the same proportions as other members of the genus. The dorsal surface is wholly covered by six dorsal shields. The first of these is strongly rounded in front, not so much so behind, and covers the legless and first leg-bearing segments. The head hangs free below it. Its border is entire. The second presents a narrower anterior portion, not so strongly chitinised, and passing insensibly into the articular membrane. At one-quarter of its length, it broadens out rectangularly, the first pair of tactile hairs projecting through notches in the angles. The third, fourth, and fifth plates are deeply cleft at about one-half their length, the clefts of the third being a little in front, of the fifth a little behind, that point. The sixth shield has the clefts far back towards the posterior border, and the portion behind the clefts very much narrower than that in front. The tactile setæ arise from the "pleuræ" just within the angles of these clefts, and are of the usual type, but much shorter than in *Pauropus*.

The dorsal shields are devoid of spines, but have a beautifully sculptured pattern. This is formed by a series of broad, raised ridges, which enclose sunken areas, usually triangular, but many of them irregularly quadrilateral. Where these ridges meet, there is formed a rosette-like structure, consisting of a central boss, separated by a circular groove from a broad raised ring in which are from twelve to sixteen radially elongated depressions. The enclosed depressed areas have a central irregular prominence, from which run six or more, radially directed, secondary ridges, which meet the primary ridges. The secondary ridges are never more than one-third as wide as the primary. Posteriorly, the shields are terminated by a row of rosettes; but this passes inside the lateral borders, which are formed by a thin, scalloped plate, divided into a series of platelets by raised ridges.

The antenna is a little remarkable. The lower ramus is a little more than twice as long as its width at the base, and its flagella seem to be rather upper and lower, than anterior and posterior. Of these, the lower, which would correspond with the anterior in *Pauropus,* rises from an extremely short, cylindrical process at two-thirds of the length of the ramus. Beyond this point, the ramus is narrower by the width of this process, and the upper flagellum and globulus are borne apically upon the flat top of this narrower portion. The lower flagellum is about half the length of the upper; and the latter is, in turn, about three-quarters of the flagellum of the upper ramus. The upper ramus is thrice and one-half as long as broad, and its breadth is about equal to that of the distal portion of the lower. The two longer flagella have a basal unringed portion at least as long as the rami to which they are attached. The stalk of the globules, which is large, is about once and one-half as long as its transverse diameter.

I have found it extremely difficult to make satisfactory observations of the ventral surface, as I could not afford to injure my specimens; but I have finally been able to compare this species with Hansen's figures on all points except the anal plate, about the distal portions of which I cannot be certain. The tergum of the anal segment has the lateral hairs the same shape as, and longer than, the submedian; otherwise, it agrees with Hansen's figure. The sternum has a row of four hairs, the outer pair being stout, and slightly plumose distally; the inner pair delicate, shorter, and sharply ringed. The posterior ventral setæ are more than twice the length of the outer pair, and are only shortly plumose distally. The anal plate is rounded basally, its sides narrowing slightly backwards, and passing into two long processes, which are separated from one another by a deeply incised cleft. A second pair of wing-like processes seem to lie dorsal to the main body of the plate. The distal ends of the main processes, I was unable to observe satisfactorily. As far as I can judge, they end as in the figure (Fig. 18), but it is quite possible that they may show some such structure as that observed by Hansen.

The legs are very short, and none of them have a metatarsus. The hairs of coxa and trochanter are both like that of the trochanter in Hansen's figure. The tarsus bears a single large claw, with a very fine, hair-like, second claw anteriorly. The second tarsal hair mentioned by Hansen, is not present.

The larger male measures 1·2 in length.

Loc.—Lobster Beach, Broken Bay.

Until the existing descriptions of European and American *Eurypauropodidæ* are verified and amplified, it is little use attempting to discuss the affinities of the species here described. As Hansen has pointed out, if Ryder's and Latzel's descriptions are correct, this species, together with that which he describes without naming, will have to be transferred to a new genus.

Types of the five species, described as new, have been deposited in the Australian Museum, Sydney.

Development of *Pauropus amicus.*

The first eggs seen were laid by females captive in tubes, but I was later able to find them in the field. In both cases, the eggs were laid in groups of from twelve to twenty-four, loosely attached to pieces of bark, apparently by some sticky secretion of the oviducal walls.

The egg is perfectly spherical, pearly white, and 0·17 mm. in diameter. Under low power, the outer membrane, which is opaque, appears covered with minute pustulations. These, under a higher magnification, show as short, flat-topped, cylindrical processes. No sections have been cut, but observations made while the eggs were passing through fixing fluids, would appear to indicate that the embryonic development resembles that of the Diplopoda. The egg proper, which has, after fixation, only two-thirds of the diameter of the outer membrane, shows, in iodised alcohol, an appearance of total segmentation, but no nuclei are visible at the surface, so the areas probably represent yolk-pyramids. At a later stage, a distinct ventral flexure is observable. At the twelfth day, the outer membrane breaks, and the embryo bursts out in part, its anterior end being free, while the posterior end is still enclosed in the membrane. The embryo is covered by an embryonic membrane, which bears outgrowths covering the antennæ only; the three pairs of legs, though visible inside, making no impression on this second cuticle. The cuticle is covered with long, tapering, cylindrical, hair-like outgrowths; and is definitely segmented, the segments being more numerous than the apparent somites of the hexapod larva, and showing no trace of fusion. The embryo remains motion-less, in this condition, for three further days; and then, by the splitting of the second cuticle through the whole of its length dorsally, issues out as an actively moving, hexapod larva. Up to this stage, the eggs have been constantly guarded by the female; but, from this on, the young are left to themselves, and move about actively.

The six-legged larva has an antenna with two basal joints only, the distal telescoped into the proximal, so that a line, looking like a division of the latter into two, is visible. The lower ramus of the antenna is a little more than one half as long as the upper, and bears subequal flagella, the anterior slightly longer. Both are less than one-half the length of the upper flagellum. The hairs of the head are arranged much as in the adult, but are all of the same baton-shaped character. There are two behind each eye, and a pair on either side of the midline close to the hind margin; in front of these, a row of four, the outer pair slightly behind the inner; in front, a pair, with a pair marginal at the same level; in front of these, a row of six, and two in the midline, one above (behind) the other, between the bases of the antennæ. Three dorsal shields are present. The first covers the legless and first leg-bearing segments, and is without tactile hairs; the second covers the remaining leg-bearing segments, and bears a pair of tactile setæ, plumose through their distal three-fourths, projecting outwards and forwards from about one-fourth the length from the anterior end; the third covers the pre-anal and part of the anal segment, and bears a pair of similarly plumose tactile setæ projecting backwards from the postero-lateral corners. The first shield has a row of four hairs in front of the hind margin, and a hair in each antero-lateral angle, well on the shield; the second has a row of four along front and hind margins, the tactile setæ being just behind the antero-lateral pair; the third has a pair towards the middle, a little behind the anterior margin, a pair a similar distance in front of the posterior margin, a pair lateral, longer, midway between them, behind which are the tactile setæ. The anal segment ends in a button-like process, similar to that of the adult, overhanging the anal plate. Its three pairs of hairs are situated close together, and are proportionately long, the submedian being very long. The styli are fairly long, and incurved. The anal plate (Fig. 8) differs from that of the adult in that the clavate hairs, which terminate its inner processes, have inner rudimentary branches. The first and third legs are five-jointed, the second having a metatarsus marked off. The hairs and claws are as in the adult, except those of coxa and trochanter, which, with the two pairs on the leg-rudiments, are all biramous, with subequal cylindrical branches, slightly swollen distally, the inner distinctly articulating with the outer (Fig. 6). These hairs are all proportionately longer than in the adult. There are two pairs of hairs on the sternum of the anal segment. Six segments are completely differentiated ventrally. The whole cuticle is minutely pilose. The wall of the midgut is, even at this stage, already full of lime-crystals. In the hexapod condition, the larva grows in length from 0'33 mm. at hatching, to upwards of 0·5 mm.

The ten-legged larva ranges in length from a little over 0·5 up to 0·7 mm. It has four dorsal shields, the fourth being interpolated between the second and third of the previous stage, and bearing an additional pair of tactile setæ at the middle of its length, projecting laterally. This shield covers the two added pairs of legs. The antenna has three basal segments. Eight segments are well marked ventrally.

The twelve-legged larva ranges in length from upwards of 0·7 to over 0·9 mm. The antenna has three basal segments. The anterior flagellum is less than one-half the length of the posterior, which is about four-fifths as long as the flagellum of the upper ramus. There are five dorsal shields, the first four with the usual two rows of clavate hairs, the fifth with both rows very far back. There are four pairs of tactile setæ; the first, second, and fourth as in the last stage, the third projecting backwards from a little behind the middle of the fourth shield. The biramous hairs of the limb-rudiments and basal joints of the legs have assumed the adult clavate form, but all still have two subequal branches. Ventrally, the segmentation is normal as far back as the third shield (fifth legs); behind which, there is no suture until that of the anal segment is reached. This undivided area certainly includes two segments, the pre-anal and that of the sixth legs. Possibly another segment is represented between these, but, provisionally, the number of body-segments may be set down as nine.

One individual, observed alive within a day of moulting, showed the antennæ and hairs of the next stage through the cuticle. The basal segments of the antennæ were filled with the flagella of the new antennæ. The clavate hairs of the head, for the new stage, were behind those of the old. The new hairs of the first four shields directly underlay the old. In the fifth shield, however, the new hairs of the first row were well in front of the old, and of the second row slightly in front.

I had hoped, by means of this individual, to prove definitely that no stage with fourteen legs occurred. But, although it moulted successfully a day after the above observations were made, it was, unfortunately, so badly crushed between two pieces of bark in removing it from the tube, that the number of legs could not be made out. From observation on very plentiful material, in which all the other stages are represented by many individuals, I am quite satisfied that no such stage does occur; and a careful examination, under a strong lens, of many more specimens in the field, has failed to produce it.

The sixteen-legged larva ranges in length from a little under 1 mm. up to 1·3 mm. The antenna has four basal joints, and its rami and flagella have assumed the adult proportions. The genital aperture is present in the female; and the penes in the male. There are five dorsal shields, and four pairs of tactile setæ, as in the previous stage; but the tergite of the anal segment is much larger and more prominent. Ventrally, there are eleven distinct segments plainly visible. Of these, the first eight are covered by the first four dorsal shields; the ninth and part of the tenth underlie the fifth; while part of the tenth seems definitely to underlie the tergite of the anal segment. In other respects, this stage does not differ from the adult.

Segmentation.—The relation of the dorsal shields to the segments of the body has been variously interpreted; and hardly any two current textbooks of zoology will be found in agreement on the point. Schmidt (1895) and Kenyon (1895) have, however, definitely established the existence of a head and twelve segments; the first of which, Schmidt, following Latzel (1880), calls the hind-head segment; while Kenyon considers it to be the first trunk-segment. *P. amicus,* owing to its large size, and the complete demarcation of its segments ventrally, is a favourable form for the study of the segmentation. I have, therefore, added a brief note on this subject.

I agree with Kenyon in dividing *Pauropus* into a head and twelve trunk-segments. On the segmentation of the head, Kenyon writes (1895, p. 82)—"In the triangular head, so far as one may be able to judge from the number of appendages, there are three segments, corresponding to the antennæ, the mandibles, and the maxillæ. . . . But . . . there is other evidence of cephalic segmentation and possibly there are more segments in the Chilognath head and in that of the Pauropoda than the number of appendages would indicate." Kenyon claims, for the Pauropoda, a close affinity with *Polyxenus,* in which Carpenter (1905, p. 478) has shown maxillulæ to be present. It is a matter of some doubt, therefore, whether the mouth-parts of *Pauropus* consist of only two pairs of appendages. From an examination of the dorsal surface of the head of *P. amicus,* I would suggest that at least five segments are present. Behind the antennary segment, are four rows of clavate hairs. On the trunk, each such row indicates a segment. In addition, there is, in the young stages and in some adult specimens, a distinct indication of a suture between the antennæ and the anterior row of hairs; and of a second between the second and third rows of hairs; which would give two dorsal plates, each bearing two rows of hairs, strongly suggesting a comparison with the dorsal shields of the trunk.

In connection with the trunk, the statement is usually made, that eight segments fuse to form four double segments. It seems to me, however, that all six dorsal shields have an equal value, each bearing two rows of hairs, and each being in relation to two underlying segments. The first covers the first and second segments, *i.e.*, that with only limb-rudiments, and that bearing the first legs. The next four each cover two leg-bearing segments. In the case of the last, though the anal segment projects freely behind, its anterior border usually passes under the shield; and, in a lateral view of *P. amicus* (Pl. lxx., fig. 10) this insertion is very obvious. This interpretation would have the advantage of giving a uniform series of double tergites, and may possibly, as has been indicated above, also apply to the head.

The contention, that the sixth shield is of a double nature, is supported, to some extent, by the condition of that shield in *Eurypauropus,* the posterior part being marked off from the anterior by two lateral clefts. Ryder(1879, *a*) claimed these clefts as evidence of the double nature of the shields; but Kenyon (1895, p. 91) doubts the segmental significance, and suggests that the clefts are formed "merely because the tactile hairs would otherwise be prevented from projecting upwards in a position to be of greatest use to the animal." I am inclined, however, to agree with Ryder. The clefts are not necessary for the tactile setæ, as these might just as easily be situated on the shields, as they are in *Pauropus.*

The supposed diplopod condition of the Pauropoda does not seem to me to be in any way comparable with that of the millipedes. The double segments are certainly formed in a totally different way, and, in the case of the Pauropoda, fusion is confined to the dorsal shields. This fusion, I consider to be purely secondary, and to have been brought about by a series of thickenings of the dorsal cuticle, which were, at first, segmental, as we can see in *Brachypauropus;* and which, later, without segmental significance, fused in pairs. *Pauropus* is an animal with twelve, distinct trunk-somites, the value of which is wholly independent of the dorsal shields.

Nevertheless, the affinities of the Pauropoda are pretty certainly with the Diplopoda, and they are possibly best regarded as an equivalent Order. It seems unnecessary to raise them to Class-rank(Pocock, 1911); and not yet justifiable, in the light of present knowledge, to reduce them to the rank of a Suborder, sharing, with *Polyxenus,* an Order, Protodiplopoda (Kenyon, 1895).

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EXPLANATION OF PLATES LXX.-LXXI.

Plate lxx.

Pauropus amicus.

Fig. 1.—♂, from below.

Fig. 2.—♂, from above.

Fig 3.—Biramous hair from leg-rudiment.

Fig. 4.—Biramous hair from trochanter of first leg.

Fig. 5.—Biramous hair from trochanter of ninth leg.

Fig, 6.—Biramous hair of hexapod larva.

Fig. 7.—Anal plate.
Fig. 8.—Anal plate of hexapod larva.
Fig. 9.—Anal segment, from above.
Fig. 10.—Posterior end, from the side.
Fig. 11.—Antenna.

Plate lxxi.

P. australis.

Fig. 12.—Anal segment, from below.
Fig. 13.—Anal segment, from above.
Fig. 14.—Part of antenna.

P. novæ-hollandiæ.

Fig. 15.—Anal segment, from below.
Fig. 16.—Antenna.

P. burrowesi.

Fig. 17.—Anal segment, from above.

E. speciosus.

Fig. 18.—Anal plate.
Fig. 19.—Antenna.
Fig. 20.—Penes from the side.
Fig. 21.—Detail of sculpture.

AUSTRALIAN NEUROPTERA. Part i.

By Esben Petersen, Silkeborg.

(Plates lxxii.-lxxv.)

(Communicated by W. W. Froggatt, F.L.S.)

In the following pages, I give some descriptions of new species of Neuropterous insects from Australia, together with notes on other interesting species. No apology is needed for the fact that these notes are accompanied by illustrations and tables, because much of the literature relating to the Neuropterous fauna of Australia is to be found scattered in numerous papers and periodicals; and, for the student, it is, therefore, a great work to find the descriptions, which very often are insufficient, as in most cases they are based on old or mutilated specimens, and are often too short. A good and complete description of an insect is a necessity for an exact determination; but when the description is accompanied by an accurate figure, the work is facilitated to a high degree. Therefore, it is my hope that these, and the following notes, may be of some value in the study of the Australian Neuroptera.

The greater part of the material, here recorded, belongs to Mr. W. W. Froggatt, Government Entomologist of N.S.Wales, to whom my best thanks are due for his kindness in allowing me to examine it. Also my friend, Mr. R. J. Tillyard, has sent me much material for examination, and I am much obliged to him for his kind assistance.

NYMPHIDÆ.

Rambur, Hist. Nat. Ins. Névr., p.412(1842).

No ocelli. Antennæ much shorter than the wings, which are long and slender. Costa and radius united at the tip. Radial sector with several branches. Cubitus forks a little before the tip of first anal vein; its posterior branch short. bent down and running out into the hind margin. Tibiæ with two spurs at the tip. Areolum large and bifid.

1. Media in both wings unforked................................ *Austronymphes.*
Media forked in the forewing, unforked in the hindwing 2.
2. In the forewing, media forks as far out as the origin of the radial sector. Between first anal vein and the hind margin, two rows of cellules .... *Nymphes.*
In the forewing, the media forks much before origin of first branch of radial sector. Between first anal vein and the hind margin, one row of cellules........ *Nesydrion.*

In Trans. Am. Ent. Soc., xxxix., p.212 (1913), Mr. N. Banks describes a genus, *Nymphydrion*, including the species *N. delicatum* Bks., from Queensland. I do not know whether this genus belongs to the *Nymphidæ* or to the *Myiodactylidæ;* probably it belongs to the latter family.

AUSTRONYMPHES, gen.nov.

Labrum emarginate with rounded lateral margins and front margin. Maxillary palpi 5-jointed; 1st and 2nd joints short and of equal length; 3rd as long as 1st and 2nd united; 4th two-thirds as long as 3rd; 5th more slender, subcylindrical, as long as 3rd and 4th united; the tip truncate. Labial palpi 3-jointed; 1st joint short, 2nd joint twice as long as 1st; 3rd fusiform, as long as 1st and 2nd united. No ocelli. Basal joint of antennæ very stout; 2nd very short; 3rd twice as long as 2nd; 4th as long as 2nd and 3rd united; 4th and following joints longer than broad. Legs rather slender; tibiæ with two short and almost straight spurs; tarsi shorter than tibiæ. Joints 1-4 diminish successively by small gradations: 5th joint as long as 2nd, 3rd, and 4th united. Puvilli large, subtriangular. Wings long and slender, rather acute at tip; hindwings a little narrower and shorter than the forewings. Costal area narrow; its crossveins simple, but forked from the base of pterostigma. In the subcostal area one or two basal crossveins, beyond them a larger number are indicated by short streaks arising from subcosta, but not reaching radius. Subcosta and radius united at the tip of the pterostigma. Radial sector arises near base of radius; 8 branches from radial sector. Media straight, unforked. Cubitus forks nearly opposite to origin of first branch of radial sector. First anal runs parallel to cubitus. Between 1st and posterior margin of the wing, one row of cellules in the forewing, two in the hindwing. Second anal short, forked near its tip in the forewing. Third and 4th anals circumscribing a large, inconspicuous, nearly circular cellule in the forewing, and a very small one in the hindwing.

Type: *A. insularis*, sp.nov.

This genus is closely related to *Nymphes*; the most important differences are the peculiar crossveins in the subcostal area, the unforked media in forewing, and the presence of the large, circular cellule at the base of forewing.

AUSTRONYMPHES INSULARIS, sp. nov. (Pl. lxxii., fig.1).

Head and palpi reddish-yellow; above the base of antennæ a black, transverse streak; from the middle of this streak and downwards to the labrum a blackish median streak. A small blackish spot below each eye. Along the hindmargin of vertex a narrow transverse black streak at each side, and between them a blackish spot. Eyes blackish. The three basal joints of antennæ yellowish, the remainder reddish, shortly blackish-haired [tip of antennæ lost]. Thorax and legs yellowish-red without markings. Abdomen yellowish-red at the base, darker towards the tip; pleuræ with a narrow black streak. Body and legs yellowish-haired. Wings hyaline. Costa and radius reddish-yellow. Subcosta dark brown to blackish. The other nervures and crossveins reddish-brown. Nervures reddish-haired. Pterostigma conspicuous, yellowish-red, enclosing ten forked veins.

Length of body 14 mm.; of forewing 19 mm.; of hindwing 16 mm.

Prince of Wales Island (H. Elgner leg.; one specimen); Coll. Froggatt.

NESYDRION.

Gerstaecker, Mitth. naturw. Ver. Neuvorp. u. Rügen, xvi., p.47 (1884).

NESYDRION NIGRINERVE, sp.nov. (Pl. lxxii., fig.2).

Face reddish-yellow. Maxillary palpi yellowish; apical joints reddish towards the tip. Vertex reddish-yellow with trace of some indistinct darker spots along the hind margin.

Antennæ dark brown; the two basal joints reddish-brown. Thorax yellowish, with a broad dark brown longitudinal median streak. Abdomen reddish-brown above, testaceous below. Sides, venter of thorax, and legs yellowish with a faint reddish tinge. Wings hyaline along the tip and apical half part of posterior margin with a brownish tinge. Pterostigma slightly yellowish-marked. Longitudinal nervures blackish-brown except costa, radius, basal half of cubitus, and in the hindwings the anal veins, which are yellowish. All crossveins blackish, very narrowly margined with brown in the basal part of the forewing. At the tip of subcosta a brownish spot, largest in the hindwing.

Length of forewing 30 mm.; of hindwing 27 mm.

Cairns, Queensland, 20.x.1909(W. W. Froggatt leg.); one specimen; Coll. Froggatt.

This species especially differs from *N. fuscum* Gerst.,(Pl. lxxii., fig.3) by the hyaline membrane of the wings; and from *N. diaphanum* Gerst., and *N. pallidum* Bks., by the darker nervation of the wings.

APOCHRYSIDÆ.

Handlirsch, Die foss. Ins. u. Phyl. rezent. Formen, p.1251 (1908).

Apochrysa.

Schneider, Symb. Mon. Gen. Chrysopæ, p.157(1851).

Apochrysa phantoma.

Gerstaecker, Mitth. nat. Ver. Neuvorp. u. Rügen, xxv., p.153 (1893).

In Coll. Froggatt, a fine specimen from Aru Islands, 1911 (W. W. Froggatt leg.). The specimen agrees in every point with the description of Gerstaecker; his type-specimen was collected in New Guinea.

Whether *Apochr. phantoma* Gerst., is only a variety of *Apochr. aurifera* Walk., from Ceylon, as v.d. Weele supposes (Notes Leyd. Mus., xxxi., p.84, 1909), I do not propose to discuss at present; but probably the number of spots on the wing-disc is liable to variation, which, perhaps, may be due to sexual differences.

OLIGOCHRYSA, gen. nov.

One series of crossveins in the disc—the space between the radial sector and the media—parallel to media in the basal half of the wing, and then bent upwards, forming an S-shaped row, which joins the radial sector. In the disc of the forewing, two rows of cellules before the series of gradate crossveins, one row behind.

Type: *O. gracilis*, sp nov.

The genus is similar to *Apochrysa;* only the arrangement of the gradate veins in the wing-disc differs. In *Apochrysa* there are at least two series of gradate veins—the crossveins sometimes arranged somewhat irregularly—; in *Oligochrysa* only one series, ending in the radial sector, one-third of the length of the wing from tip.

OLIGOCHRYSA GRACILIS, sp.nov. (Pl. lxxiii., fig.4).

Head reddish-yellow; palpi whitish. Antennæ longer than the forewing, brownish-yellow; the two basal joints with a purplish-red stripe exteriorly in immature specimens; in the mature specimen, all the basal joints are purplish-red exteriorly. First joint very stout; second joint smaller, globular. Prothorax a little longer than broad, front angles rounded; lateral margins with a reddish stripe. Thorax and abdomen pale reddish-brown; metathorax with two indistinct reddish spots; the abdomen with indistinct reddish spots laterally. Legs yellowish-white; claws darker. Wings hyaline; iridescent. All veins testaceous except the upper end of the crossveins between radius and its sector together with the inner gradate series, which are blackish-brown. In the forewing, two brown dots, a larger oblong one enclosing the posterior crossveins in the inner gradate series, and a smaller one enclosing the last but one of the crossveins between radius and its sector. In the hind-wing, there is only the corresponding spot present, but it is smaller. The crossveins in the outer gradate series, in the forewing, greyish-brown. The tip of the upper branches of some of the marginal forks in the posterior-apical part of fore- and hindwing blackish. The forewings with rounded tip, twice and one-half as long as broad.

Length of forewing and hindwing, 19-20 mm.

Brisbane, 25.v.1912(H. Hacker leg.; one specimen, immature); Coll. Tillyard.—Middle Queensland (one specimen, mature), in Coll. Petersen.

CHRYSOPIDÆ.

Newman, Zoologist xi., App. CC.(1853).

Nothochrysa.

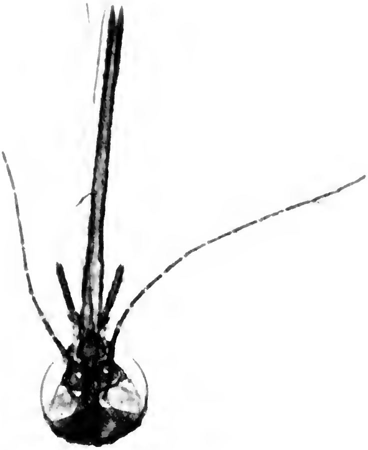
MacLachlan, Trans. Ent. Soc. Lond., p.195(1868).

NOTHOCHRYSA FROGGATTI, sp. nov. (Pl. lxxiii., fig.5).

Head reddish-yellow; palpi yellow. Antennæ at least as long as the forewing, brown with narrow yellow annulations, becoming yellowish towards the apex; basal joint reddish-yellow, very stout; 2nd and 3rd joints much smaller, reddish-yellow, the third with a small brown transverse streak dorsally at its base. Prothorax at least twice as broad as long; front angles cut off, reddish-yellow with two broad lateral purplish streaks; each of them encloses two small yellowish spots, one in the middle, the other nearer the base. Meso- and metathorax yellowish, with two narrow oblique purplish streaks at each side. Abdomen yellowish, dorsally at each side with a longitudinal, oblique, purplish streak often abrupted, on the front half of each segment and behind with a more or less distinct purplish spot. Venter of body and legs pale yellow; claws dark brown with a broad, blunt dent basally. Wings hyaline, all the nervures reddish-brown except costa, subcosta, radius and partly the cubitus. Pterostigma yellowish. Forewing 29 mm.; hindwing 26 mm.

Solomon Islands, July-August, 1909 (W. W. Froggatt leg., one female); Coll. Froggatt.

[Printed off, 17th November, 1914.]



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Figs. 1-2. *Armigeres obturbans* (Walk.).

Figs. 3-4. *Stegomyia scutellaris* (Walk.)

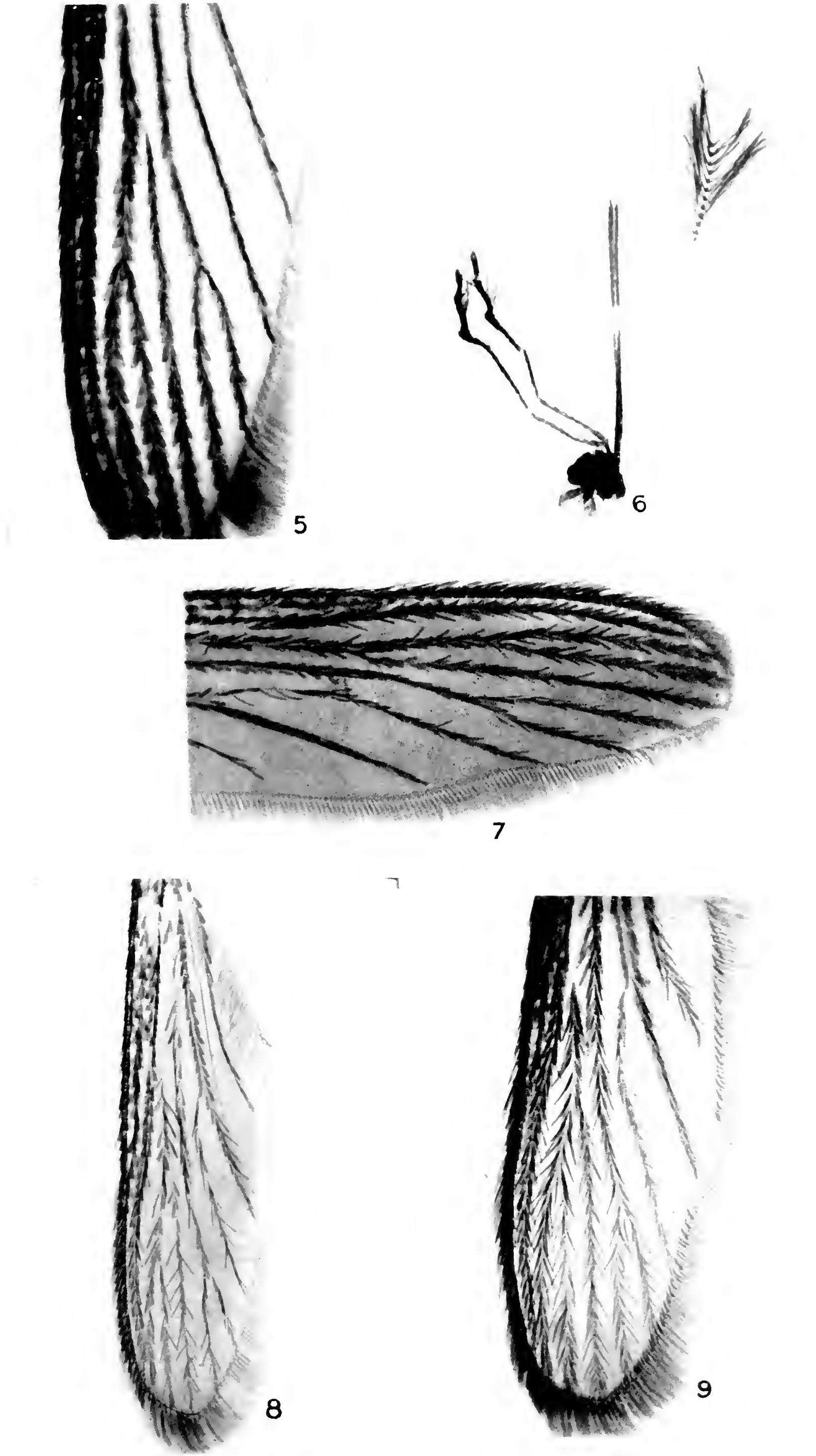
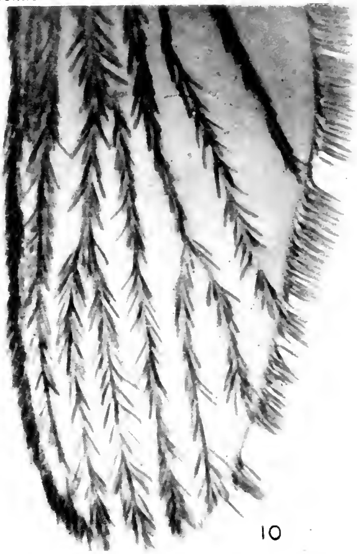


Fig. 5. *Stegomyia hilli.* Figs. 6-7. *Scutomyia notoscripta.*
Fig. 8. *Ædimorphus australis* v. *darwini.* Fig. 9. *Macleaya tremula.*



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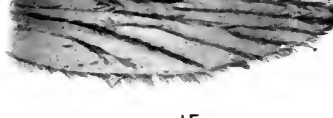

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Fig. 10. *Culicada victoriensis.* Fig. 11. *C. vandema.* Figs. 12-13. *Culicelsa alboannulata.*
Figs. 14-15. *Culex biocellatus.*


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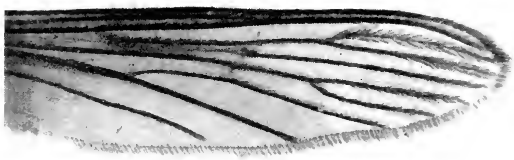
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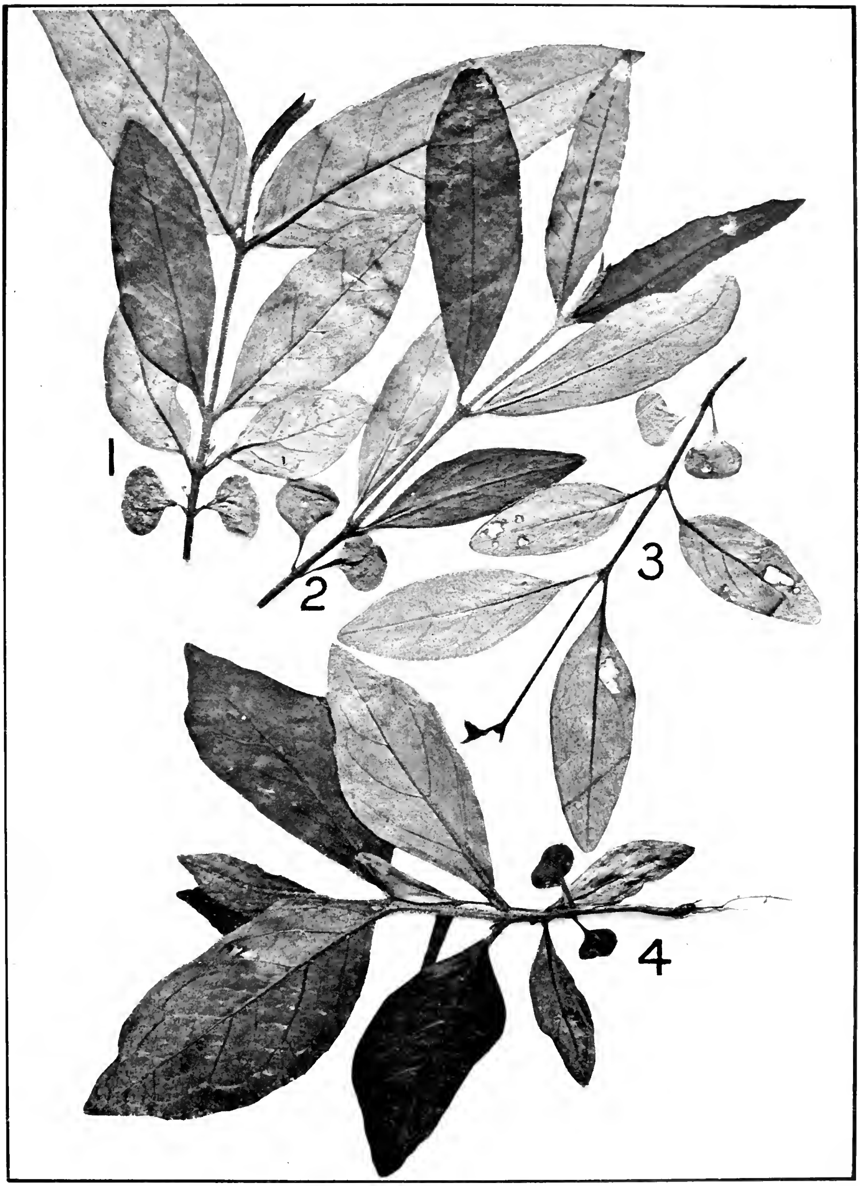
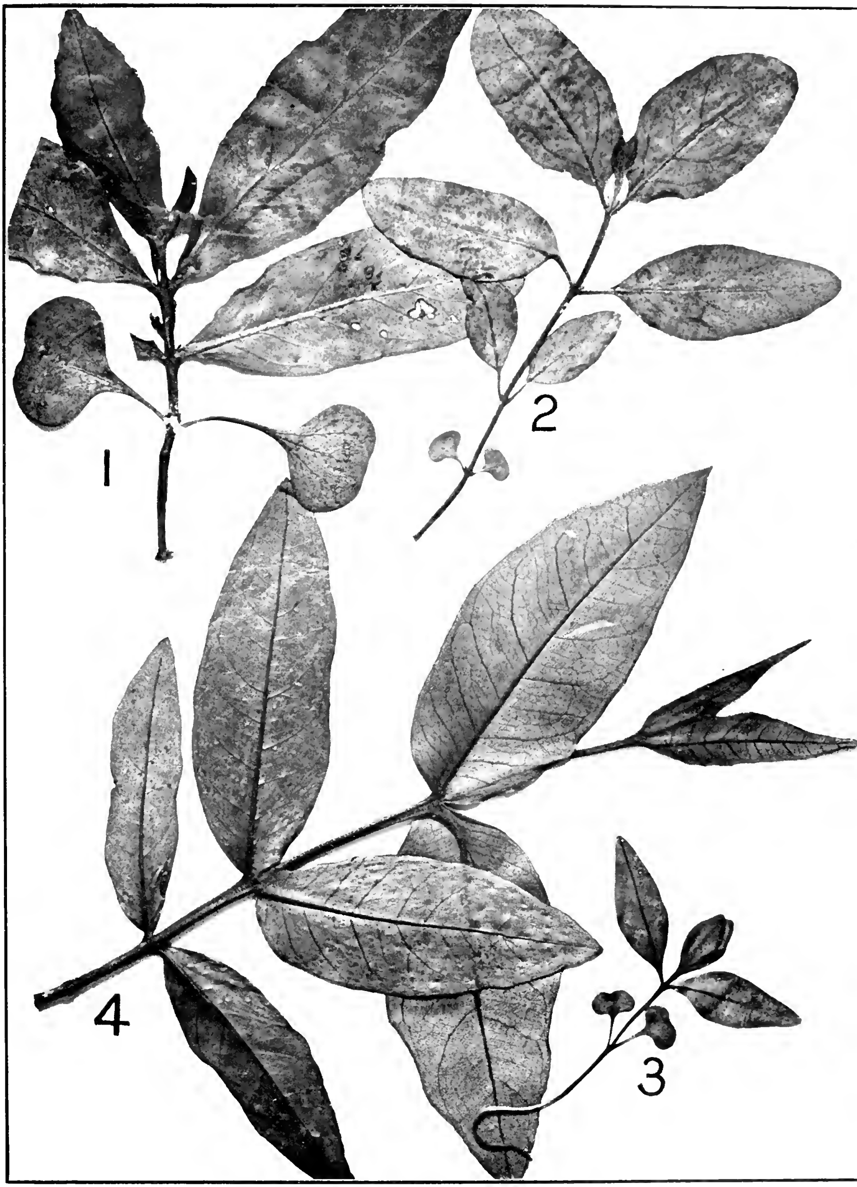
Figs. 16-17. *Culex occidentalis.* Fig. 18. *C. tigripes.* Fig. 19. *Skusea bancrofti.*
Fig. 20. *Menolepis* (?) *tasmaniensis.*

1. *E. calophylla.* 2. *E. intermedia.* 3. *E. trachyphloia.* 4. *E. corymbosa.*

1. *E. eximia.* 2-3. *E. perfoliata.* 4. *E. marginata.*



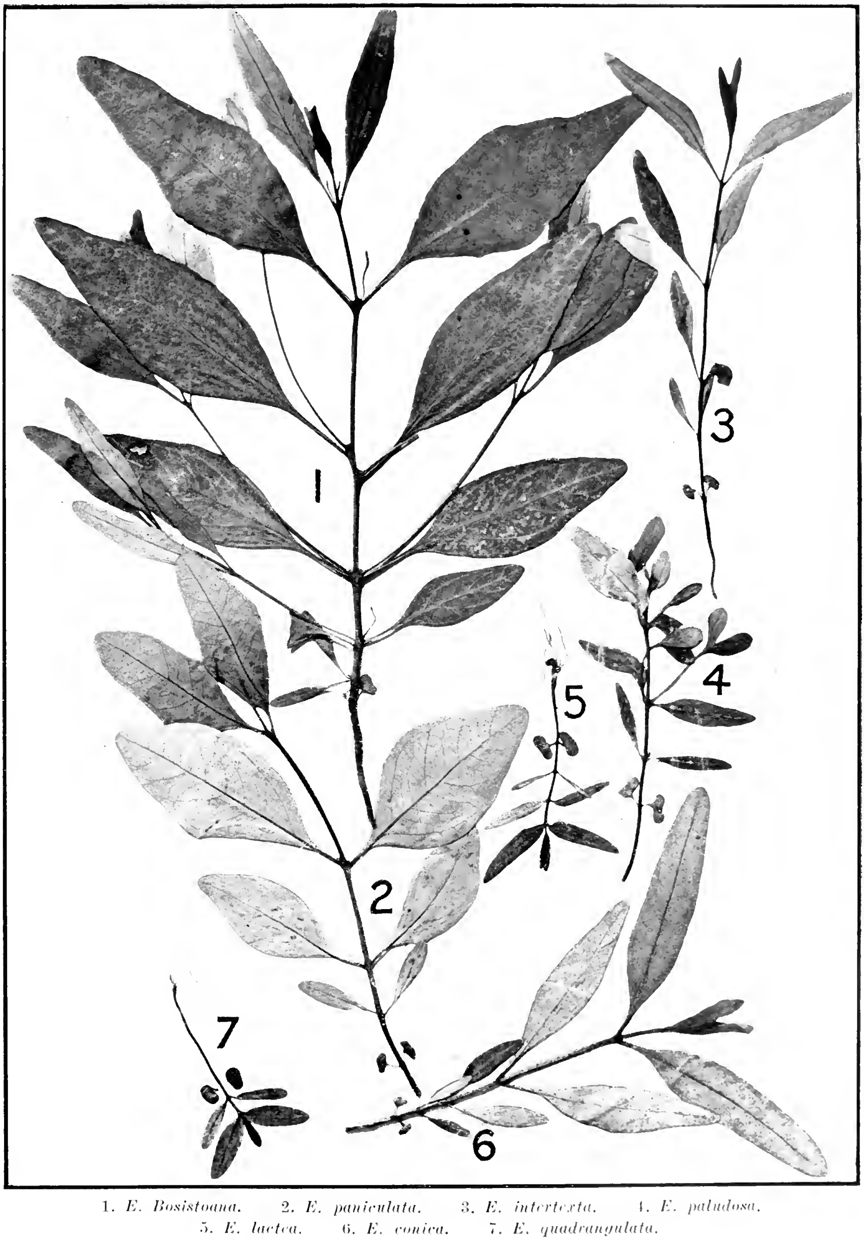
1-3. *E. lævopinea.* 4. *E. dextropinea.*



1. *E. Todtiana.* 2. *E. Wilkinsoniana.* 3-4. *E. umbra.*

1. *E. Muelleriana.* 2. *E. botryoides.* 3. *E. saligna.* 4. *E. robusta.*
5. *E. nova-anglica.* 6. *E. diversicolor.*

1. *E. maculata.* 2. *E. eugenioides.* 3. *E. microcorys.* 4. *E. propinqua.*
5. *E. affinis.* 6. *E. Baeuerleni.* 7. *E. rubida.*

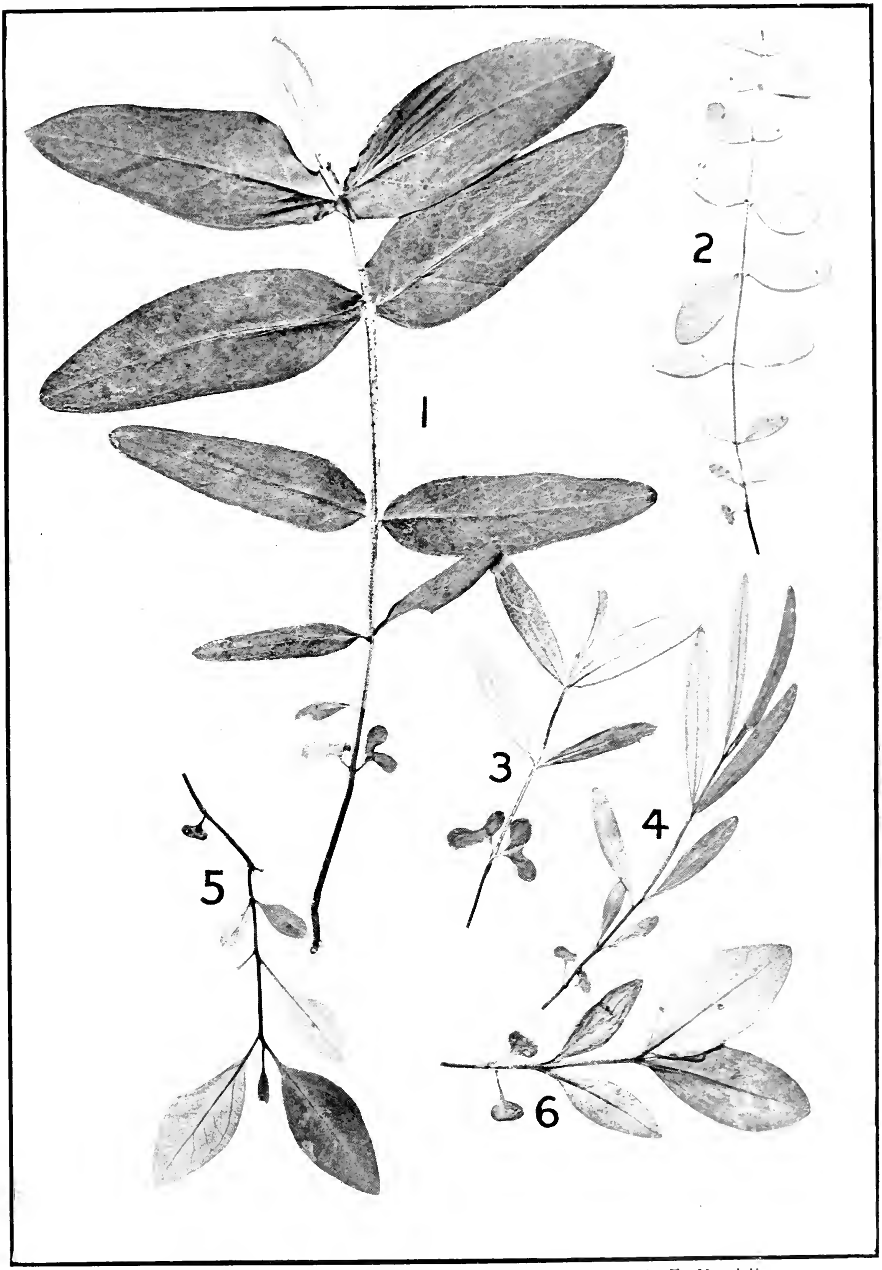


1. *E. Bosistoana.* 2. *E. paniculata.* 3. *E. intertexta.* 4. *E. paludosa.* 5. *E. lactea.* 6. *E. conica.* 7. *E. quadrangulata.*

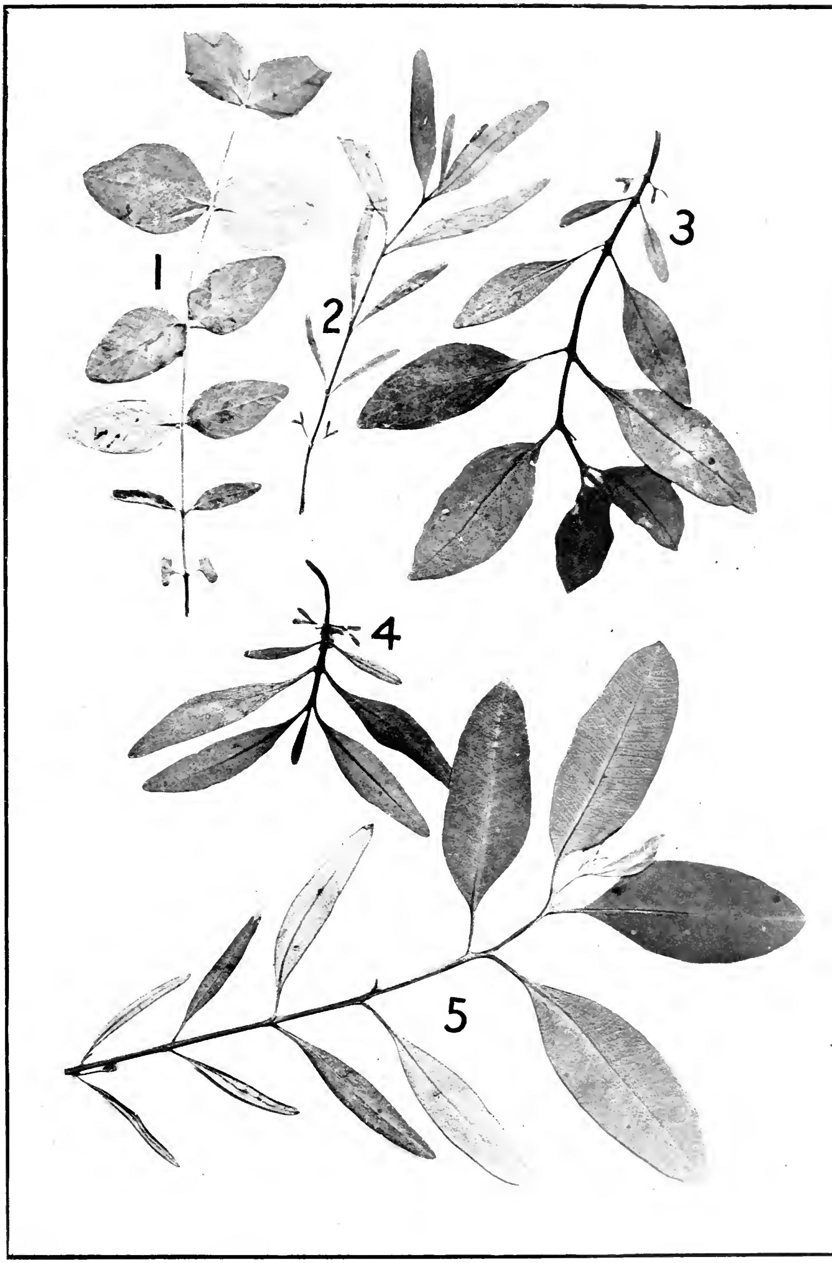
1. *E. hemilampra.* 2. *E. corynocalyx.* 3. *E. resinifera.* 4. *E. Behriana.*

1. *E. dealbata.* 2. *E. tereticornis* var. *linearis.* 3. *E. maculosa.*
4. *E. punctata.* 5. *E. Bridgesiana.* 6. *E. goniocalyx.*

1. *E. camphora.* 2. *E. populifolia.* 3. *E. cinerea.*
4. *E. longifolia.* 5. *E. Smithii.*

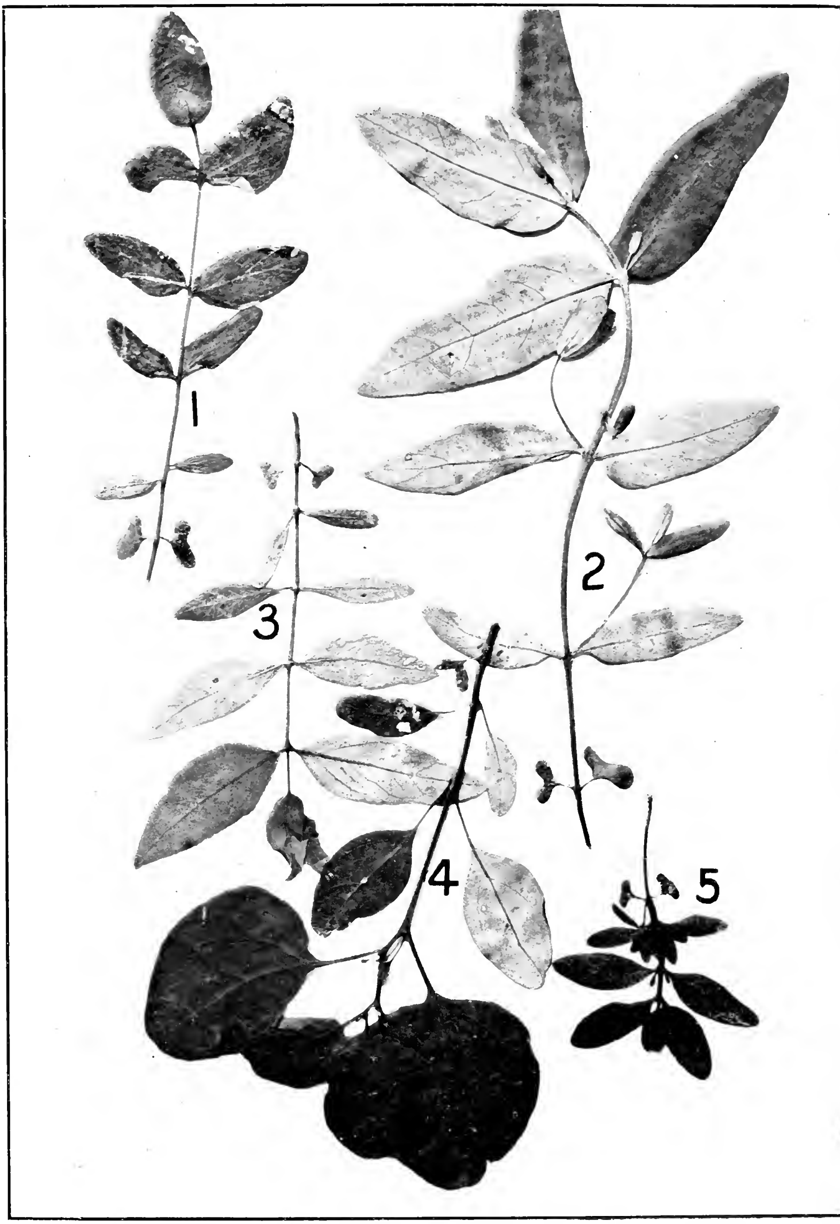


1. *E. Maideni.* 2. *E. pulverulenta.* 3. *E. globulus.* 4. *E. Morrisii.*
5. *E. sideroxylon.* 6. *E. Rossii.*



1. *E. Stuartiana.* 2. *E. pendula.* 3. *E. polyanthema.* 4. *E. salubris.*
5. *E. squamosa.*

1. *E. squamosa.* 2. *E. redunca.* 3. *E. Rodwayi.* 4. *E.* sp. nov.
5. *E. santalifolia.*



1. *E. urnigera.* 2. *E. unialata.* 3. *E. fasciculosa.* 4. *E. corynocalyx.*
5. *E. Muelleri.*

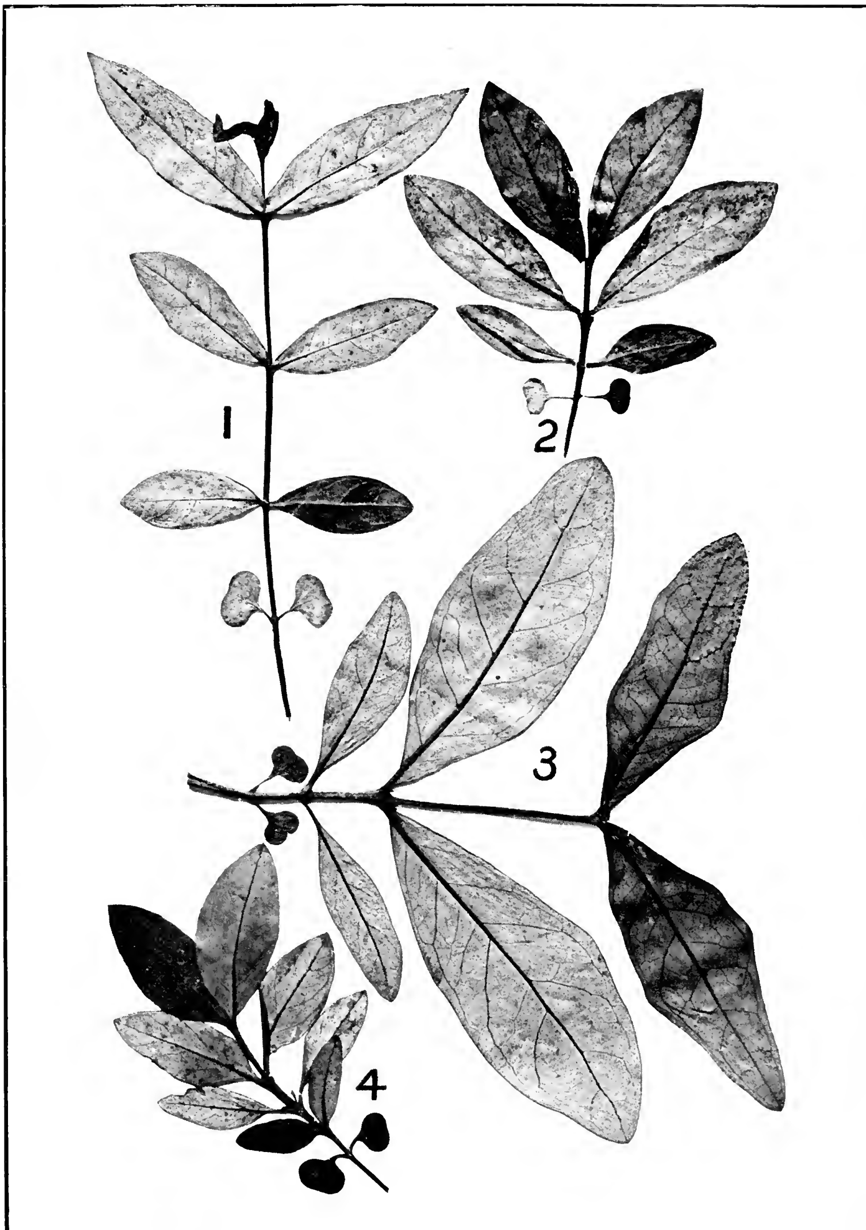
1. *E. occidentalis.* 2. *E. Perriniana.* 3. *E. megacarpa.* 4. *E. leptopoda.*

1. *E. elæophora.* 2. *E. dumosa.* 3. *E. polybractea.* 4. *E. oleosa.*
5. *E. salmonophloia.* 6. *E. cneorifolia.* 7. *E. gracilis.*

1. *E. platyphylla.* 2. *E. cornuta.* 3. *E. gomphocephala.* 4. *E.* sp. n. 5. *E. stricta.*

1. *E. cosmophylla.* 2. *E. Lehmanni.* 3. *E. striaticalyx.* 4. *E. loxophleba.* 5. *E. odorata.* 6. *E. platyphylla.* 7. *E. eudesmioides.* 8. *E. saligna* var. *pallidivalvis.*

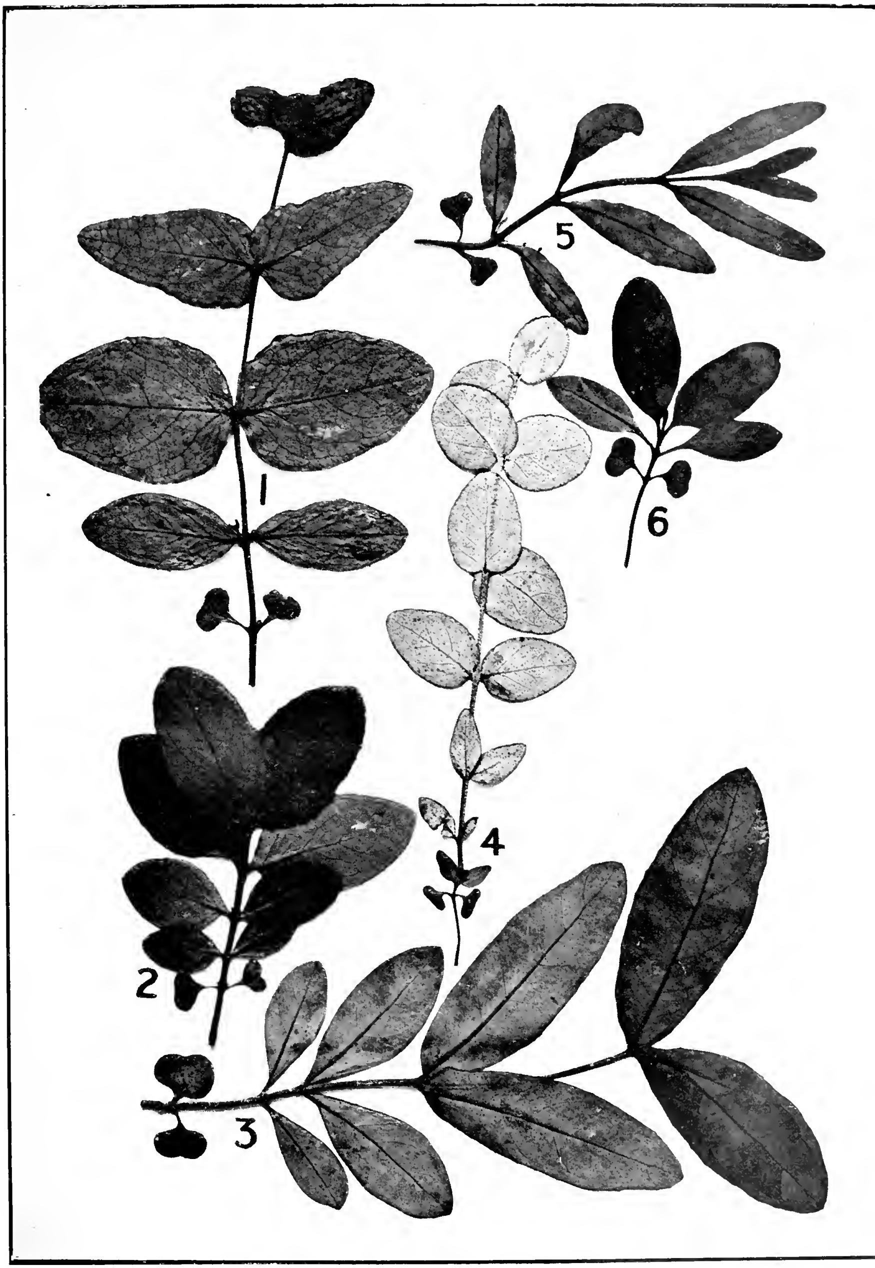
1. *E. melliodora.* 2. *E. viridis.* 3. *E. Woollsiana.* 4. *E. albens.* 5. *E.* [illegible]



1 *E. acmenioides.* 2. *E. carnea.* 3. *E. hæmastoma.* 4. *E. phlebophylla.*

1. *E. sideroxylon* var. *pallens*. 2. *E. tæniola*. 3. *E. acaciæformis*. 4. *E.* sp. n.
5. *Syncarpia laurifolia*. 6. *Angophora lanceolata*. 7. *E. melanophloia*.

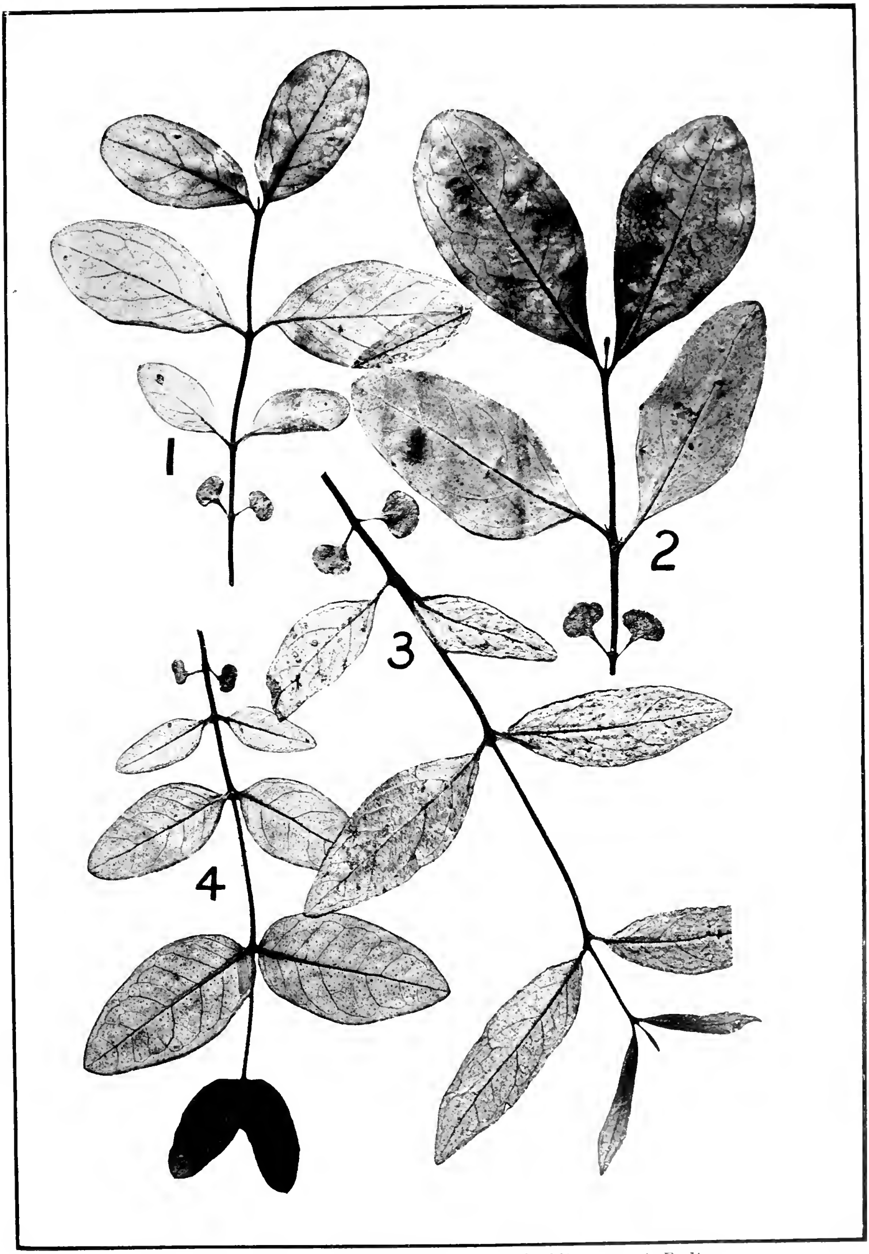
1. *E. nigra*. 2. *E. pilularis*. 3. *E. Planchoniana*. 4. *E. Fletcheri*.



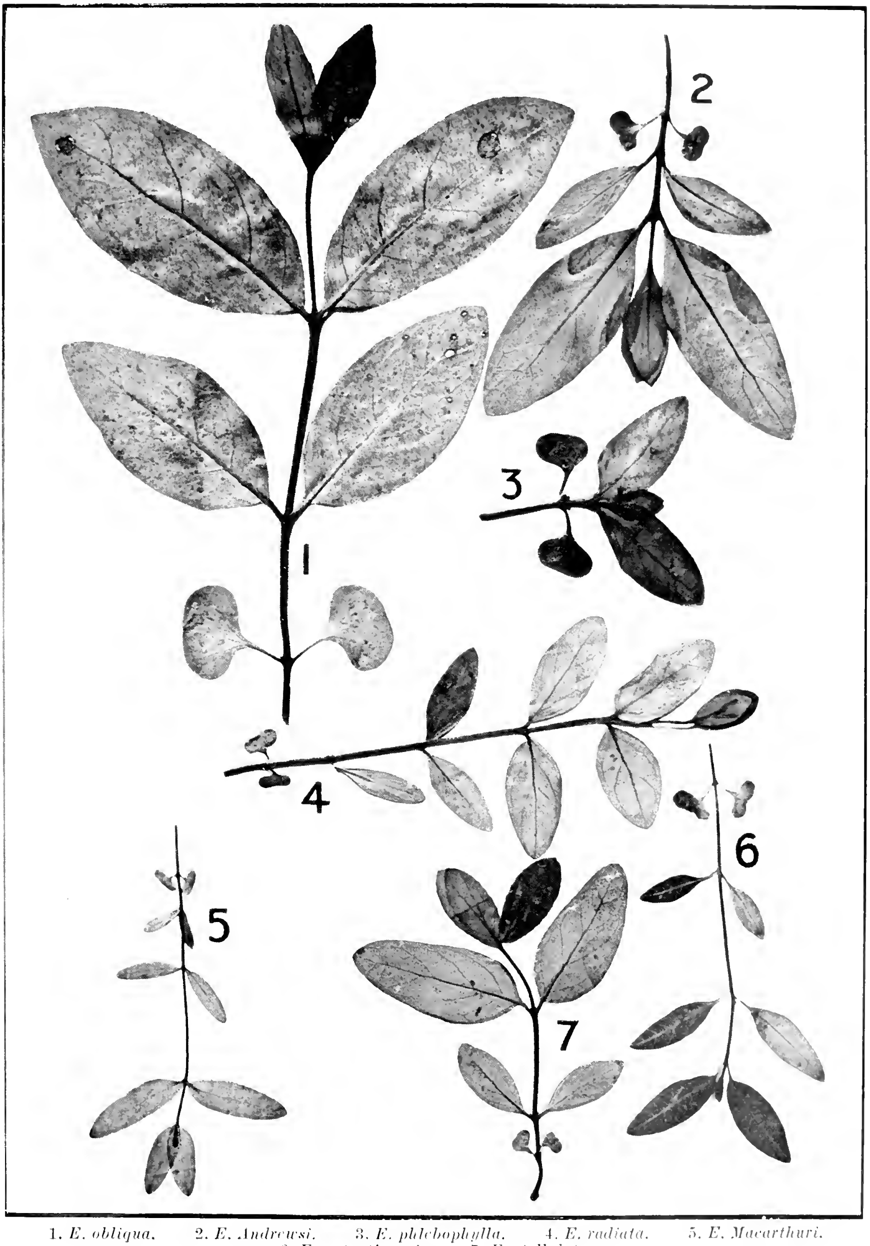
1. *E. Risdoni.* 2. *E. coccifera.* 3. *E. piperita.* 4. *E. Gunnii.*
5. *E. linearis.* 6. *E. campanulata.*

1. *E. crebra.* 2. *E. melanophloia.* 3. *E. siderophloia.* 4. *E. amygdalina.*

1-2 *E. amygdalina.* 3. *E. Luehmanniana.* 4. *E. oreades.* 5. *E. Sieberiana.*



1. *E. coriacea.* 2. *E. Delegatensis.* 3. *E. obliqua.* 4. *E. dives.*

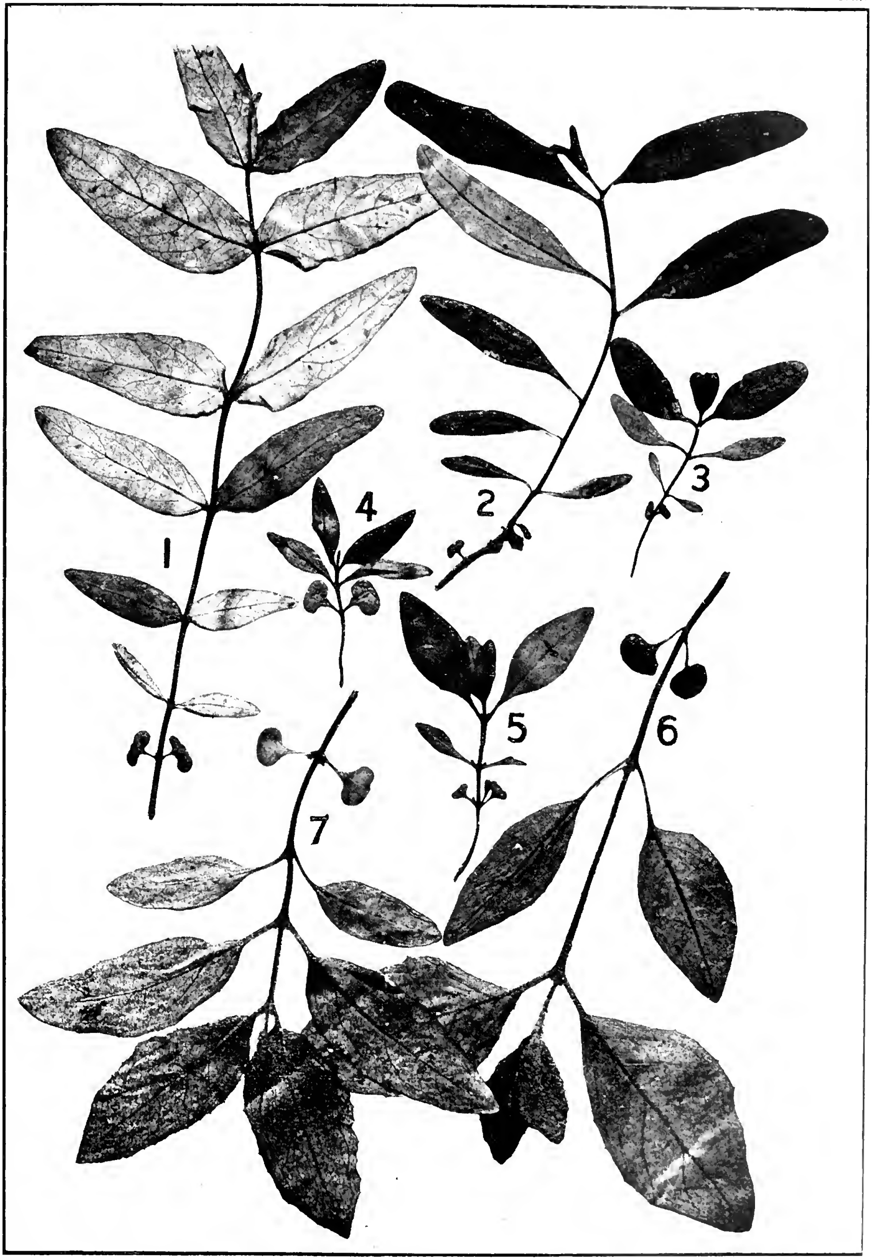


1. *E. obliqua.* 2. *E. Andrewsi.* 3. *E. phlebophylla.* 4. *E. radiata.* 5. *E. Macarthuri.* 6. *E. patentinervis.* 7. *E. stellulata.*

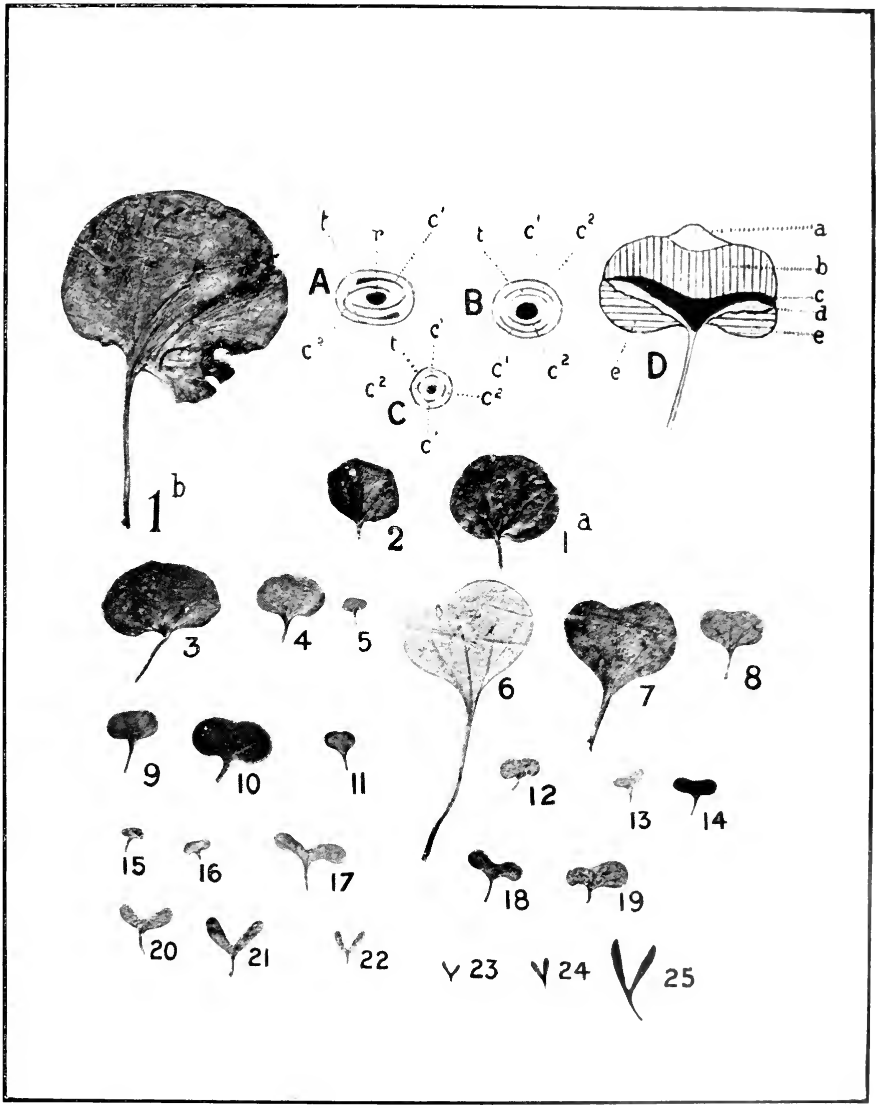
1. *E. citriodora.* 2. *E. apiculata.* 3-4. *E. virgata.* 5. *E. obtusiflora.*

1. *E. regnans.* 2. *E. Moorei.* 3. *E. incrassata.* 4. *E. acerula.* 5. *E. calycogona.* 6. *E. uncinata.* 7. *E. pulverulenta.*

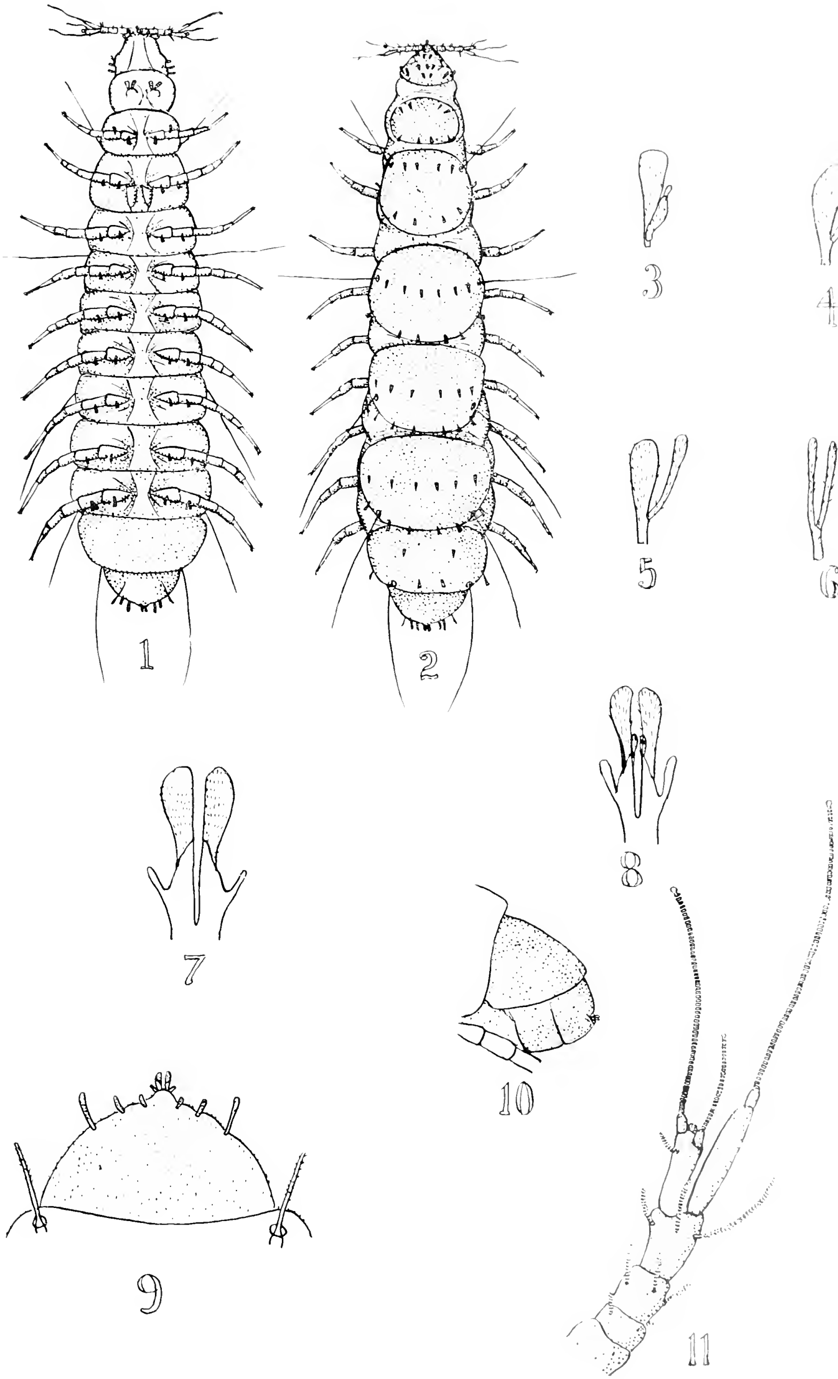
1. *E. tereticornis.* 2. *E. Bosistoana.* 3. *E. Parramattensis.* 4. *E. Marsdeni.* 5. *E. leucoxylon.* 6. *E. aggregata.* 7. *E. hæmastoma* var. *micrantha.*



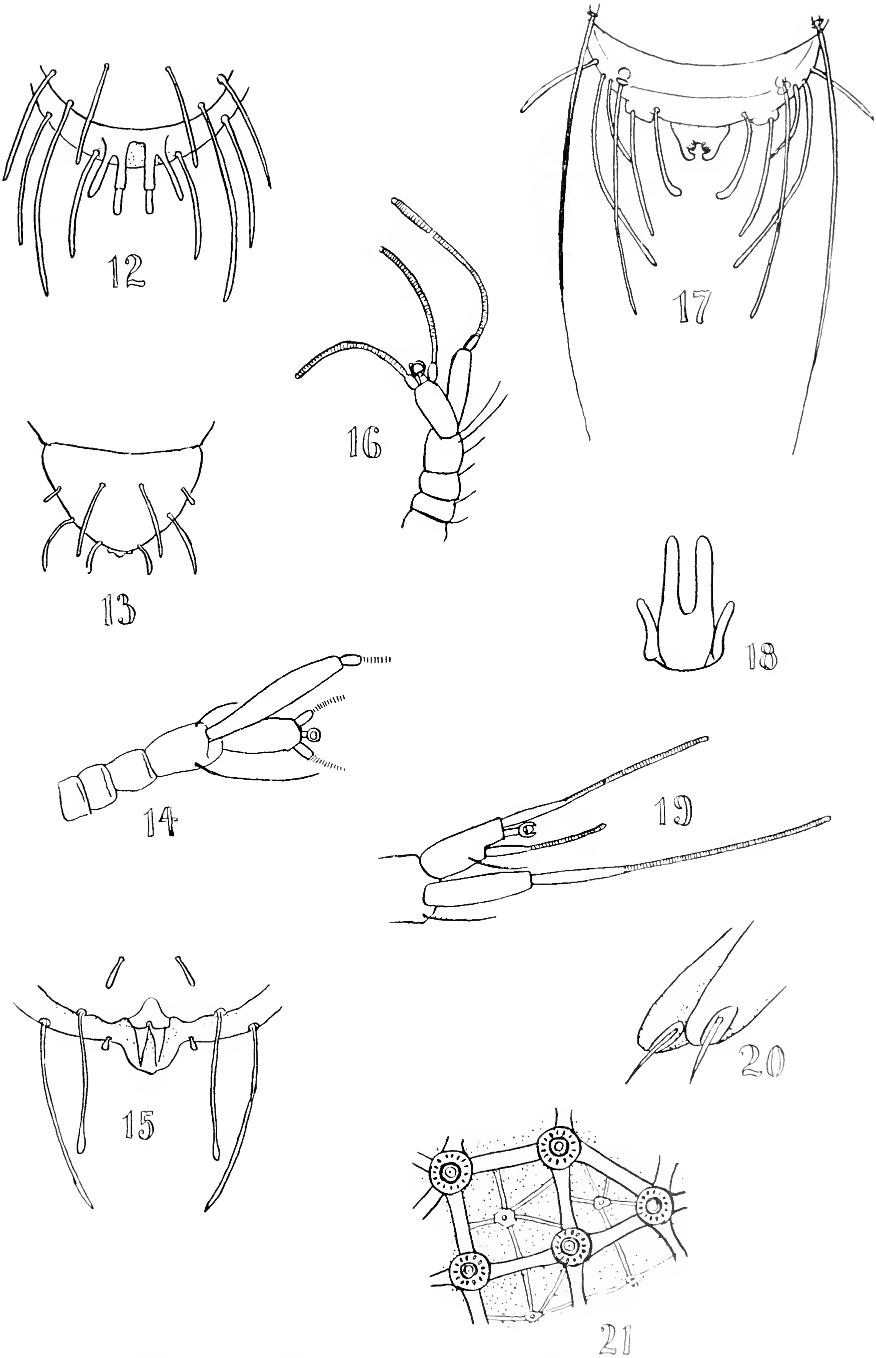
1. *E. viminalis.* 2. *E. rostrata.* 3. *E. ovalifolia.* 4. *E. Dawsoni.* 5. *E. fastigata.* 6. *E. macrorhyncha.* 7. *E. capitellata.*



Cotyledons of Angophora (1*a*) and Eucalypts.



Pauropus amicus, n. sp.



12-14. *Pauropus australis.* 15-16. *P. novæ-hollandiæ.* 17. *P. burrowsi.*
18-21. *Eurypauropus speciosus.*

It is a very large and distinct species, much resembling *N neurodes* Rbr., from South Africa.

NOTHOCHRYSA CHLOROMELAS. (Pl. lxxiii., fig.6).

Hemerobius chloromelas Girard, Ann. Soc. Ent. France, 4e série, ii., p.607(1862).

This species, described from specimens from New Caledonia, is very similar to the preceding species; it is much smaller, the colouration of the body is darker, and some of the basal cross-veins blackish-brown marginated. Length of forewing 17 mm.; of hindwing 15 mm.

Solomon Islands, July-August 1910(W. W. Froggatt leg.; two specimens); Coll. Froggatt.

OSMYLIDÆ.

Newman, Zoologist xi., App. CC.(1853).

OEDOSMYLUS.

Krüger, Ent. Zeit. Stettin, lxxiv., p.106(1913).

OEDOSMYLUS PALLIDUS. (Pl. lxxiv., fig.7).

Osmylus pallidus MacLachlan, Journ. Ent. Lond., ii., p 113, pl. vi., fig.2(1863).

Oedosmylus pallidus Krüger, Ent. Zeit. Stettin, lxxiv., p. 107(1913).

Woodford, N. S. W. (G. A. Waterhouse leg.; one female); Coll. Tillyard.

To MacLachlan's description there is only a little to add:

Vertex somewhat raised, testaceous. Prothorax about twice as long as broad, reddish-yellow with blackish lateral margins, and with reddish-yellowish hairs. In the hindwing, some of the crossveins in the gradate series and the adjoining longitudinal veins brownish-shaded. Length of forewing 20 mm., hindwing 18 mm.

HEMEROBIIDÆ.

Leach, Encycl., ix., p.138(1815).

Drepanopteryx.

Burmeister, Handb. Ent., ii., p.975(1839).

Drepanopteryx humilis. (Pl. lxxiv., fig.8).

MacLachlan, Journ. Ent. Lond., ii., p.116(1866).

Of this species, known from Australia and New Zealand, one specimen (sex indeterminable) in Coll. Froggatt; Victoria, 20.i.1905(W. W. Froggatt leg.).

In the markings of the forewing, the specimen does not exactly agree with the description of MacLachlan; the white spots along the posterior margin are very indistinct, but the number of crossveins in the gradate series is the same as stated by him.

Drep. humilis differs from the geno-type, *Drep. phalænoides* L., in having much fewer radial sectors.

Megalomina.

Banks, Proc. Ent. Soc. Wash., xi., p.78(1909).

Megalomina acuminata. (Pl. lxxv., fig.9).

Banks, loc. cit.

Queensland, 24.iv.1905(W. W. Froggatt leg.; one female); Coll. Froggatt.

In this genus, we have three rows of gradate veins in the forewings, which are acute; four radial sectors; media connected with cubitus by crossveins. Only the above-named species is known in the genus.

MANTISPIDÆ.

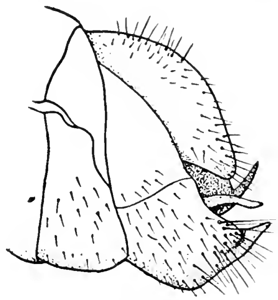
Westwood, Introduction., ii., p.58(1840).

Mantispa.

Illiger, Käf. Preuss., p.499(1798).

Mantispa tillyardi, sp.nov. (Pl. lxxv, fig.10).

Head above pitchy-black or blackish-brown with a yellowish streak along the margin of the eyes, with two small yellowish spots on the hind margin, and with a yellowish cordiform spot above the insertion of the antennæ. The central carina rather conspicuous, and the lateral impressions transversely striated. Face yellowish, with three longitudinal blackish-brown stripes, and with a transverse blackish-brown impression below each antenna. Labrum with a dark spot; tip of mandibles blackish. Antennæ 31-jointed, reddish-brown basally, becoming darker towards apex; basal joint stout, conical, yellowish on the underside, second joint globular, third joint cylindrical; the remainder broader than long. Prothorax reddish-brown, a little darker in its dilated frontal part, which is one-third of the whole length; the two basal thirds strongly sulcate and rugose transversely. Pro- and metathorax granulated; each granule provided with a short black bristle. Meso- and metathorax and the abdomen dark brown to blackish in the male, paler in the female; the abdominal segments with a whitish-yellow spot at each side. Venter of abdomen greyish-yellow, with a darker median streak. Legs and coxæ yellowish-brown: the innerside of fore-femora a little darker. Wings hyaline; nervation reddish-brown except radius, subcosta and base of the other longitudinal nervures, which are paler. Pterostigma sanguineous, very long, extending from base of second radial sector and nearly to the tip of the third.



Text-fig.1.
Mantispa tillyardi, ♂, sp.n. Lateral view of tip of abdomen.

Length of forewing 15 mm.

Cuballing, April, 1913, one male in Coll. Tillyard.—Victoria, one female, in Coll. Petersen (ex Coll. Hauschild, Copenhagen).

THERISTRIA.

Gerstaecker, Mitth. naturw. Ver. Neuvorp. u. Rügen, xvi., p.43(1884).

THERISTRIA FELINA. (Pl. lxxv., fig.11).

Gerstaecker, ibid., p.44.

Face yellowish, maxillary palpi yellowish, apical joint brown; mandibles brown; at the base of labrum and of clypeus a brown median spot; each antennal insertion circumscribed by a brown ring, above connected with a large brown spot on the vertex; this spot leaves a yellowish ring round each eye, and encloses, in its middle, three transversely placed yellowish spots, the middle one of which is the smallest. Antennæ rather long, black; the two basal joints yellowish with a brownish spot on their upper side. Eyes greenish. Prothorax greyish-brown with a broad yellowish median streak rather indistinct in front; front margin narrow yellowish; it is about twice and one-half as long as broad in front, granulated and with short black hairs or bristles; finely transversely sulcate in its apical part; prothoracic tubercles very distinct, reddish-brown and shining. Meso- and metathorax castaneous with a yellowish streak at each side, and with dark brown pleuræ; venter yellowish, with small indistinct brown spots. Femora and front coxæ testaceous, with an indistinct greyish-brown streak on their inner and outer side. Hind tibiæ yellowish, front tibiæ with a narrow brown streak on their underside; tarsi with yellowish-blackish bristles and claws. The large dents on the inner side of each of the fore-femora yellowish at the base, brown at the tip. Wings quite hyaline. In the forewings, all the nervures are brownish except costa, radius and the anal veins, which are yellowish-white. In the hindwing, all nervures in the two basal thirds yellowish except the base of subcosta, which is brown. Pterostigma yellowish-white, with an oblong yellowish-brown streak in its apical part.

Length of forewing 17 mm., hindwing 15 mm.

Cape York (H. Elgner leg.; one female), in Coll. Tillyard.

The description differs in some points from the original one of Gerstaecker, and, at first, I was inclined to take it for a new species; but after a careful examination of it, and comparison with specimens in the Godeffroy Coll. in the Museum of Hamburg—specimens undoubtedly named by Gerstaecker as *Theristria felina*—I am sure it is only a variety of that species.

CALOMANTISPA.

Banks, Trans. Am. Ent. Soc., xxxix., p.209(1913).

CALOMANTISPA SPECTABILIS. (Pl. lxv., fig.12).

Banks, ibid., pl.xxiv., fig.15.

This distinct genus is only known from Australia, and is one of the finest marked genera in the Mantispidæ.

Herberton, one specimen (Dodd leg.), in Coll. Tillyard.

Besides this species, the genus also includes *C. picta* Stitz, from New South Wales (Mitt. aus Zool. Mus. Berlin, vii., p. 45, fig.40, 1913).

EXPLANATION OF PLATES LXXII.-LXXV.

Plate lxxii.

Fig.1.—*Austronymphes insularis*, sp.n.; Coll. Froggatt.
Fig.2.—*Nesydrion nigrinerve*, sp.n.; Coll. Froggatt.
Fig.3.—*Nesydrion fuscum* Gerst.; Mus. Hamburg.

Plate lxxiii.

Fig.4.—*Oligochrysa gracilis*, sp.n.; Coll. Petersen.
Fig.5.—*Nothochrysa froggatti*, sp.n.; Coll. Froggatt.
Fig.6.—*Nothochrysa chloromelas* Girard; Coll. Froggatt.

Plate lxxiv.

Fig.7.—*Oedosmylus pallidus* MacLachl.; Coll. Tillyard.
Fig.8.—*Drepanopteryx humilis* MacLachl.; Coll. Froggatt.
Fig.9.—*Megalomina acuminata* Bks.; Coll. Froggatt.

Plate lxxv.

Fig.10.—*Mantispa tillyardi*, sp.n.; Coll. Petersen.
Fig.11.—*Theristria felina* Gerst.; Coll. Tillyard.
Fig.12.—*Calomantispa spectabilis* Bks.; Coll. Tillyard.

ORDINARY MONTHLY MEETING.

NOVEMBER 25th, 1914.

Mr. W. S. Dun, President, in the Chair.

The President reminded Candidates for Fellowships, 1915-16, that Monday, 30th inst., was the last day for submitting their applications.

The Donations and Exchanges received since the previous Monthly Meeting (28th October, 1914), amounting to 4 Vols., 34 Parts or Nos., 4 Bulletins, 3 Reports, and 3 Pamphlets, received from 29 Societies, etc., and one private donor, were laid upon the table.

NOTES AND EXHIBITS.

Mr. Fred Turner gave some additional particulars about *Fusanus acuminatus* R.Br., var. *chrysocarpus* Turner, the variety of "Quandong" with yellow fruit; and he quoted the following extract from a letter received from Archdeacon F. E. Haviland, Cobar, N.S.W., regarding this tree, and confirming his statements made at the October Meeting. "I can say this, that as I have known the existence of the yellow variety about here for several years past, I can vouch for the constancy of its type; yet, to all casual appearances, there is nothing to suggest any departure from the characteristics of the 'red'-fruited plants. I think, however, that you would be correct in regarding it only as a variety."

Mr. E. Cheel exhibited specimens of three species of Clover, and submitted notes thereon as follows:—(1) *Trifolium cernuum* Brot.; specimens of this species were collected in Victoria (without specific locality) by T. Reader in April, 1895; and at Hawkesdale, Victoria, by H. B. Williamson, in November, 1904. It has since been found naturalised in Denmark, West Australia, where, according to Mr. W. Catton Grasby, it is known as

"Gingin Clover." The specimens exhibited are from Hill Top, Southern Line, collected in October, 1914. It very closely resembles *T. glomeratum*, and can easily be mistaken for that species, but may be recognised by the drooping, pedicellate florets.—(2) *T. striatum* L., "Knotted Clover"; the specimens exhibited were raised from seed from naturalised plants at Rutherglen, Victoria, forwarded to the National Herbarium for determination by Mr. A. Hay, December, 1913. For other Victorian localities, see Vict. Nat., xxiii., 184(1907). In South Australia, it has also become naturalised on the Mount Lofty Range.—(3) *T. maritimum* Huds., "Teasel-head Trefoil"; specimens of this species were collected in the Centennial Park, in November, 1899, but it does not seem to have spread to any great extent.—Mr. Cheel exhibited also, on behalf of Mr. D. G. Stead, a drawing of *Eucalyptus* sp., on Bealby's Range, near Dandenong, Port Phillip, made by the late W. Swainson, F.R.S., on May 8th, 1853.

Mr. A. A. Hamilton showed a series of specimens from the National Herbarium, illustrative of teratology or leaf-variation:—*Gaillardia* Hort., var. (Gladesville, October, 1914; Miss M. Flockton), showing fasciation and floral displacement. In the first stage, two flower-stems cohere for part of their length, finally separating, each terminating in the usual capitula. In one of the flower-heads, several ray-florets have been displaced by the intrusion of involucral bracts. The second stage shows the two stems coherent for their full length, the laterally elongated capitula exhibiting a double facies, representing two flower-heads. In the third stage, several flower-stems are fused, the admixture of involucral bracts, ray, and tubular florets disclosing the presence of several flower-heads.—*Antirrhinum majus* Hort., (Croydon; October, 1914; Miss A. M. Jenner) showing fasciation and spiral torsion. Two stems are fused for the greater part of their length, each bearing an arrested raceme of flowers. The stems of the young shoots have, in some instances, become so contorted as to encircle the bases of the normal stem-leaves. Plants exhibiting this malformation have been noted by Miss

Jenner, coming up in the same place in the garden for four successive seasons.—The "Cup-flowered Foxglove," *Digitalis purpurea* Hort. var.,(Sydney Botanic Gardens; October, 1914; E. N. Ward) showing arrested growth accompanied by petalody of the calyx. The suppression of the internodes of the stem has forced the flowers into a circlet, the corolla-tubes are ruptured, and the segments laid open, side by side. The sepals have developed a degree of petalody in most of the flowers. This growth has been "fixed" by Sutton & Co., the well known British nurserymen, who are also responsible for the vernacular name. Plants grown from seeds in the Botanic Gardens, Sydney, yielded 90 % of "Cup"-flowers.—*Trifolium pratense* L.,[Sydney Botanic Gardens(cult.); W. M. Carne; November, 1914] showing extra-floral prolification of the inflorescence, accompanied by virescence.—*Boronia anemonifolia* A. Cunn.,(Newnes Junction; A. A. Hamilton; September, 1914), two examples illustrating the effects of environment; one taken from a bush, 4 ft. high, growing in a sheltered position, with access to a plentiful water-supply; the other from a sterile ridge, a coarse harsh plant, 6 inches high. The variation in the two forms is so marked as to create a difficulty in recognising them as the same species from dried herbarium-material.—Examples of dimorphic foliage in Acacias: *A. longifolia* Willd., *A. suaveolens* Willd., *A. myrtifolia* Willd., and *A. linifolia* Willd. In the first two, the lower leaves are much larger than the upper ones, the change occurring in each case abruptly; in *A. myrtifolia* the position is reversed, the lower leaves being the smallest; and in *A. linifolia*, the dimorphic condition occurs on two separate branches springing from the same base on the stem.—*Acacia rubida* Cunn.,(Glenbrook Lagoon; A. A. Hamilton; October, 1914), showing fructification in the juvenile (bipinnate) foliage stage. Attention was drawn to a similar occurrence on plants from Woodford, by Mr. R. H. Cambrge, in the Journ. Proc. Roy. Soc. N. S. Wales, xlviii., p.136.—Leaf-variation: *Persoonia salicina* Pers., the leaves varying in shape from rotundate to oblong-lanceolate, straight to falcate, and with acute or obtuse apices. Measurements: $8 \times 2\frac{1}{2}$, $7 \times 1\frac{1}{4}$, $6 \times 3\frac{1}{2}$, $5 \times \frac{3}{4}$, $4\frac{1}{2} \times 3$, $3\frac{1}{2} \times 2$, $2\frac{1}{2} \times 1$ inches. *Acacia myrti-*

folia Willd.: the variation found in this species is comparatively slight, resting chiefly on size and breadth.—Records: *Microcala quadrangularis* DC., Duck River, Clyde (September, 1914; A. A. Hamilton; new for New South Wales); *Lycopodium cernuum* L.,* Berowra to Peat's Ferry (A. A. Hamilton; August, 1912; previously recorded from the Northern Rivers); *Hibbertia pedunculata* R.Br, Wyong (October, 1913; A. A. Hamilton); *Hibbertia sericea* Benth., Turramurra (November, 1912; A. A. Hamilton); the last two species have not previously been recorded from the localities given.

Dr. H. G. Chapman communicated a note on the response of a Eunicid worm to a gustatory stimulus. The worms rise up out of the sand when a piece of meat is dipped in the sea-water flowing over them. The sensory organs of similar forms have been described as olfactory. As the stimulus is carried by water, it seems better to describe this sensation as gustatory.

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* First recorded for New South Wales in "Notes from the Botanic Gardens, No.7," Maiden & Betche, in These Proceedings, 1901, p.90.

DESCRIPTIONS OF NEW SPECIES OF AUSTRALIAN COLEOPTERA. Part X.

By Arthur M. Lea.

(Plate lxxvi.)

Family LUCANIDÆ.

Homolamprima crenulata Macl. (Plate lxxvi., fig.1).

A specimen of this very rare stag-beetle is in Mr. Carter's Collection from Dorrigo.

Rhyssonotus grandis, n.sp. (Plate lxxvi., figs.2, 3, and 4).

♂. Black with a bronzy gloss; parts of under surface and of legs obscurely diluted with red.

Head very wide; surface very uneven, with an obtuse median ridge culminating in a double tubercle, an obtuse tubercle near each side in front; with coarse irregular punctures. Eyes rather small, the upper one on each side separated from the lower one by a wide canthus. Mandibles moderately long, multidentate, and with coarse punctures. Mentum arched and projecting downwards, with dense punctures, lower lip rounded at base, convex and almost vertical in front, with dense punctures. Scape about as long as rest of antennæ combined, funicle three-jointed; club six-jointed, basal joint with a short stout projection, the four following ones of about even length and each with a somewhat longer projection than on the basal one. *Prothorax* large, about twice the width of head, apex emarginate in middle, on each side of which is a slight projection, sides crenulated, each side with a strong basal incurvature, surface shallowly impressed in places, with a rather strong median groove; with small punctures scattered about, but becoming coarse on sides. *Scutellum* small, strongly transverse; with a few punctures. *Elytra* narrower than prothorax and about once and one-third as long, sides rather widely flattened out and wrinkled internally, with a strong oblique ridge from each shoulder to beyond the middle, and a shorter straight one towards suture; suture itself somewhat elevated, with small punctures scattered about, and some irregular rows of large ones. *Under surface* with irregularly distributed punctures. *Legs* long; femora stout; front tibiæ with five external teeth, and in the middle of the inner edge four smaller ones; four hind tibiæ each with two small sharp teeth, slightly in advance of the middle, and with some smaller ones. Length (including mandibles) 25 mm.

Hab.—New South Wales: Comboyne (W. H. Muldoon).

The lower parts of the head are somewhat as in *R. jugularis* and *R. parallelus*, but very different from those of *R. nebulosus*. It is certainly the finest species of the genus. The extreme base of the head of the type is without punctures or gloss, and has a median fovea, but is probably usually concealed. Each mandible has a strong tooth at the apical third on the upper surface, and two somewhat smaller median ones on the outer portion of the upper surface. The right one has, internally, four large, blunt, simple teeth, and three double or semi-double ones; the left mandible has five simple and two semi-double ones. The maxillary palpi are long, the first visible joint curved, and about as long as the two others combined. [The labial palpi are missing from the type.] There are a few straggling hairs or setæ on the mandibles.

Family MALOCODERMIDÆ.

LAIUS PURPUREICEPS, n.sp.

♂. Of a rather bright flavous-red, metasternum infuscate; head and four large elytral spots deep purplish-blue, almost black. Clothed with long, straggling, upright dark hairs.

Head with dense punctures. Antennæ extending to apex of basal spot on elytra, first joint stout and curved, second slightly longer and thicker than first, with a spiniform process at apex, eleventh almost twice the length of tenth. *Prothorax* decidedly transverse, finely rugose, apex much wider than base. *Elytra* at extreme base scarcely wider than apex of prothorax, but considerably wider across middle; with dense and coarse punctures, but the thickened suture and margins almost impunctate. Front *femora* transversely excavated near apex. Length (♂ ♀), $2\frac{1}{2}$ mm.

♀. Differs in having the first joint of antennæ smaller, the second slightly longer than third but simple, and the front femora simple.

Hab.—West Australia: Mullewa (Miss J. F. May).

Of the size and with four elytral spots as in *L. pallidus*, *L. carus*, *L. sinus*, and *L. eyrensis*, but the subapical spots of different shape and the second joint of antennæ very different from that of the males of the three first-named species. Of *L. eyrensis*, only a female is before me, but the female of the present species differs in the spots being of a different shade of colour, and with punctures equally as coarse as on the rest of the surface instead of impunctate in parts. In my Table of the genus, it would be associated with the much larger *L. tarsalis* and *L. major*. One basal spot on each elytron occupies the whole of the extreme base, but its hind margin is semicircular, its length is about half that of the prothorax; the subapical spot is larger and shaped somewhat like a thick, badly formed 3, of which the concave side is obliquely placed towards the suture. The spiniform process at the apex of the second joint of antennæ is invisible from most directions, but very distinct from a few.

HYPATTALUS TRIANGULIFERUS, n.sp. (Plate lxxvi., fig.8).

♂. Black; muzzle, prothorax, parts of three basal joints of antennæ, and parts of legs, flavous. Clothed with fine greyish pubescence, and with longer hairs scattered about on sides.

Head shallowly depressed in front, with a few coarse punctures about base. Antennæ long, third joint lightly, fourth to tenth strongly serrated. *Prothorax* about once and one-half as wide as long, apex distinctly produced in middle, base and hind angles widely rounded; punctures indistinct or absent. *Elytra* slightly wider than prothorax, parallel-sided to near apex; with dense and rather coarse punctures. *Legs* rather long; hind tibiæ with a large, thick, triangular tooth at about the middle. Length, 3 mm.

♀. Differs in being larger (4 mm.), antennæ shorter and less strongly serrated, legs shorter and hind tibiæ simple.

Hab.—New South Wales: Mittagong (E. W. Ferguson).

Readily distinguished from all previously described species by the remarkable hind tibiæ of the male. The types were taken *in cop.*

Family CURCULIONIDÆ.

Subfamily Otiorhynchides.

Myllocerus bæodontomerus, n.sp.

♂. Dark reddish-castaneous. Densely clothed with white or greyish-white scales; with a silvery gloss on under-surface. Prothorax with rather numerous, stout setæ, scarcely elevated above the scales; elytra with a row of setæ on each interstice, distinct from the sides but much less so from above.

Head lightly convex, interocular fovea scarcely traceable through clothing. Eyes not very prominent. Rostrum slightly wider than long, sides gently incurved, but base wider than apex. Antennæ rather long; scape strongly curved; first joint of funicle slightly longer than second. *Prothorax* moderately transverse, sides gently curved, base rather strongly bisinuate, and the same width as apex, the latter lightly incurved at middle; with dense, concealed punctures. *Elytra* much wider than prothorax; with rows of large but almost concealed punctures. *Femora* stout, very finely dentate. Length (including rostrum), 5½ mm.

Hab.—Queensland: Cunnamulla (H. Hardcastle).

Differs from *M. amblyrhinus* in having the rostrum decidedly longer and the eyes much less prominent, with the space between them much less convex, etc. From *M. rugicollis* it is distinguished by the sides of the prothorax being less rounded, and by the more conspicuous elytral setæ, these being scarcely, or not at all, traceable on all the specimens I have seen of that species. From *M. sordidus*, to which at first it appears to belong, it differs in having the sides of the rostrum gently incurved, so that the apex is not quite its narrowest part, the antennæ are somewhat stouter, prothorax less convex, with less rounded sides and elytral setæ more conspicuous. The derm is normally entirely concealed.

A specimen, also from Cunnamulla, is probably the female; it differs in being larger ($7\frac{1}{4}$ mm.), scales greyish, setæ more numerous on elytra, rostrum with three carinæ traceable (on the type, if present, they are entirely concealed), and abdomen more convex.

MYLLOCERUS FUSCOMACULATUS, n.sp.

Black, legs of a more or less dingy red. Densely clothed with greyish-white scales, almost uniform on head, undersurface and legs, but mixed with numerous sooty spots on elytra, prothorax with a sooty stripe near each side. Prothorax and elytra with fairly numerous, feebly elevated, setæ, on the elytra usually a single row on each interstice, but some of the rows semi-double.

Head flat between eyes; interocular fovea narrow. Eyes rather large and prominent. Rostrum almost as long as wide, sides feebly incurved to middle, base as wide as apex; with three narrow carinæ. Antennæ moderately long; first joint of funicle distinctly longer than second. *Prothorax* moderately transverse, sides gently rounded, base strongly bisinuate and slightly but distinctly wider than apex, which is truncate; with dense, concealed punctures. *Elytra* much wider than prothorax; with rows of large, partially concealed punctures. *Legs* comparatively short. Length, 5 mm.

Hab.—Queensland: Cairns (E. Allen).

The prothorax is not much but quite visibly wider at the base than the apex; regarding it as distinctly wider, it would be (in my Table) associated with *M. cinerascens*, from which it differs in being smaller, rostrum of different shape, prothorax less dilated to base, elytral setæ more conspicuous, etc. Regarding the prothorax as subequal at base and apex, it would be associated with *M. trilineatus*, from which it differs in having the prothorax decidedly shorter, scape less, and differently, thickened at apex, and eyes more conspicuous. The femora appear to be edentate, although each is somewhat swollen at the position where a tooth would be.

MYLLOCERUS ANOPLUS, n.sp.

Blackish, legs and antennæ (club excepted) reddish. Densely clothed with golden and golden-green scales.

Head gently convex. Eyes not very prominent. Rostrum short, sides gently diminishing in width to apex, carinæ not traceable. Antennæ long; scape strongly curved; first joint of funicle almost twice the length of second. *Prothorax* as long as wide, sides gently rounded, base moderately bisinuate and a trifle wider than apex, which is truncate. *Elytra* much wider than prothorax; with rows of almost concealed punctures. *Femora* rather stout, edentate. Length, $3\frac{1}{2}$ mm.

Hab.—Queensland: Dalby (Mrs. F. H. Hobler).

A very small species, in some respects close to *M. gratus*, but rostrum decidely shorter, and first joint of funicle almost twice the length of second. The rostrum is much shorter than in *M. trepidus* and *M. mastersi*, the eyes are less prominent and the elytral setæ, which are not at all elevated, are much less conspicuous; in fact the elytra at first appear to be entirely without setæ, and it is only from certain directions that a feeble row may be seen on each interstice. In my Table, it would be associated with *M. elegans*, from which it differs in its much smaller size, shorter and differently formed rostrum, and longer prothorax. On the type, the green scales are nowhere conspicuously spotted, the golden and golden-green ones appearing to be irregularly mixed together, and giving the surface a peculiarly soft appearance; appearing almost greyish-green to the naked eye. On the legs, they are paler than elsewhere.

MYLLOCERUS SULCICORNIS, n.sp.

Black, legs obscurely reddish. Densely clothed with whitish green scales, variegated with black.

Head gently convex. Eyes decidedly prominent. Rostrum about as long as wide, sides gently incurved to middle; median and sublateral carinæ distinct through clothing. Antennæ rather long and thin; scape strongly curved, lower surface distinctly grooved throughout; first joint of funicle almost as long as second and third combined, second as long as third and fourth combined. *Prothorax* moderately transverse, sides feebly rounded, apex straight and scarcely narrower than base; punctures almost concealed. *Elytra* much wider than prothorax; striation distinct, but punctures almost or quite concealed. *Femora* edentate. Length, 4½ mm.

Hab.—Queensland: Dalby (Mrs. F. H. Hobler).

In some respects like a small pale specimen of *M. chrysideus*, but rostrum shorter, markings much less conspicuous, and femora edentate. *M. hilli* is smaller, thinner, with longer elytral setæ and rather strongly dentate femora. The elytral setæ are depressed and indistinct from above, but fairly distinct from the sides. Three vague dark lines may be traced on the prothorax: on the elytra the dark spots are fairly numerous, and appear to start from punctures in the striæ; although they may be fairly long they do not extend across an interstice, being confined to the vicinity of the striæ.

MYLLOCERUS CANALICORNIS, Lea.

Some specimens from North-West Australia (C. French) evidently belong to this species, but have the scales of a beautiful green, with, in places, a slight coppery gloss.

MYLLOCERUS CHRYSIDEUS, Pasc. (now HACKERIA).

There are two co-types of this species, before me, one of which has the scales more green than blue. Pascoe twice mentioned the front femora as dentate, but the co-types under examination have all the femora edentate. He also described the prothorax as "basi perparum bisinuatus," whereas the base is rather strongly bisinuate, although not so strongly as in several other species of the genus. It has quite distinct ocular lobes, and, consequently, belongs to the genus *Hackeria;*

this character, regarded as a very important one, was not even mentioned by Pascoe.

From *H. viridivaria*, it differs in having the head and rostrum narrower, elytra parallel-sided, and the setæ very much shorter and less erect.

Subfamily LEPTOPSIDES.

UROLEPTOPS, n.g.

Head fairly large. Eyes rather small, ovate, widely separated. Rostrum rather stout, shorter than prothorax. Scrobes deep (except posteriorly), commencing at apex, curved round and vanishing before lower edge of eyes. Antennæ moderately long; funicle with all joints longer than wide; club elliptic ovate, moderately long. Prothorax moderately transverse, base truncate, ocular lobes distinct but not very prominent. *Scutellum* absent. *Elytra* ovate, tuberculate. *Abdomen* with distinct and deep sutures, but the one between first and second segments curved and rather feeble in middle. *Legs* moderate.

Fairly close to *Leptops*, near which it should be placed, but the eyes are considerably less narrow than in that genus, although certainly not circular. The rostrum has a triangular glabrous space at the apex, but it is not limited by abruptly vertical walls, as in almost all other genera of the *Leptopsides*. The two species described below are from mountainous parts of New South Wales and Victoria. The first species is the type of the genus.

UROLEPTOPS IMPENDENS, n.sp.

Black, antennæ and tarsi obscurely reddish. Densely clothed with fawn-coloured or very pale brown scales, becoming still paler on undersurface, and on sides of elytra. With stout but usually depressed setæ scattered about.

Head with small, dense, concealed punctures. Rostrum slightly wider at base than at apex, sides gently incurved to middle, about base with feeble longitudinal depressions, with a narrow carina from base to between antennæ, punctures concealed except on apical triangle. *Prothorax* not much wider at base than at apex, widest at apical third, surface obtusely elevated in places; with small, dense, concealed punctures. *Elytra* much wider than prothorax; with rows of large punctures, appearing much smaller through clothing; first to third interstices with a large acute tubercle overhanging the posterior declivity, fifth with a fairly large, obtuse tubercle also at summit of declivity. Length (excluding rostrum), 8½ mm.

Hab.—Victoria: Mount Buffalo (H. J. Carter).

The large tubercle on each elytron, placed from the suture to the third interstice, appears to be almost conjoined with its fellow on the other elytron; it is considerably posterior to the one on the fifth interstice, although this also overhangs the posterior declivity. On the type they are all connected by a streak of brown scales. The two first rows of punctures on each elytron are interrupted, but not deflected, by the large tubercle, but the fourth to seventh rows are all deflected by the tubercle on the fifth interstice.

Uroleptops impar, n.sp.

Black, antennæ and tarsi reddish. Densely clothed with light-brown, or brownish-grey scales; rather thickly interspersed with setæ, stout on the upper-surface, thinner and longer on the under-surface and legs.

Head with small, dense, concealed punctures. Rostrum not much longer than wide, as wide at apex as at base, with a partially concealed median carina; punctures concealed except on apical triangle. *Prothorax* as wide at apex as at base, widest slightly in advance of the middle, obtusely elevated in places; and with dense, concealed punctures. *Elytra* at base not much wider than prothorax, but much wider across middle; with rows of large, partially concealed punctures; third interstice with a rather large conical tubercle at summit of posterior declivity, and deflecting the adjacent rows of punctures; fifth with a smaller one, not so conspicuously deflecting the rows. Length, 7-7½ mm.

Hab.—New South Wales: Mount Kosciusko (W. E. Raymond)—Victorian Alps (H. J. Carter).

With four tubercles overhanging the posterior declivity, but not as in the preceding species, as the subsutural ones are much shorter and conspicuously separated. On abrasion, the prothorax is seen to be covered with numerous obtuse granules.

MANDALOTUS LAMINATIPES, n.sp.

♂. Black, legs and antennæ reddish. Densely clothed with muddy-brown scales, interspersed with decumbent setæ.

Rostrum with carina distinct throughout. *Prothorax* with large, round, partially concealed granules; with a distinct median line. *Elytra* conjointly arcuate at base, sides dilated to beyond the middle; with rows of large, more or less concealed punctures; the third and fifth interstices with subtubercular elevations. *Mesosternum* with a moderately projecting, notched, intercoxal process. Front *coxæ* widely separated; front tibiæ subdentate near base, strongly curved at apex, with a wide, thin, terminal flange; hind tibiæ transversely multi-carinate internally. Length, 5 mm.

♀. Differs in being wider, abdomen with basal segment convex in middle, intercoxal process of mesosternum feebly produced, with its apex rounded, front tibiæ less dilated near base, the apex terminated by a thin acute spur, and hind tibiæ not carinated.

Hab.—Victoria: Nar Nar Goon (H. J. Carter, from H. M. Giles).

With the mesosternal process notched as in *M. incisus*, but front and hind tibiæ very different from those of that species. The apex of each of the front tibiæ, from some directions, appears to be terminated by an acute spine, but is really terminated by a thin, flat flange, truncated at its tip.

MANDALOTUS EMARGINATUS, n.sp.

♂. Black; antennæ and tarsi of a dingy red. Densely clothed with muddy-brown scales, interspersed with stout decumbent setæ; ciliation of tibiæ rather long and conspicuous, especially on the front pair.

Rostrum with carina partially concealed. *Prothorax* with a distinct median line. *Elytra* trisinuate at base; with rows of large, normally almost concealed punctures; third and fifth interstices subtuberculate in places. Basal segment of *abdomen* with a conspicuous median tubercle, second with a smaller one. Front *coxæ* widely separated; tibiæ rather conspicuously ciliated, hind pair with a wide, shallow, subapical emargination. Length, 5 mm.

Hab.—New South Wales: Illawarra (H. W. Cox).

Allied to *M. tuberculiventris*, but both basal segments of abdomen tuberculate. The prothorax normally appears to be without granules, and on abrasion, at any rate on the disc, they are seen to be absent. From above or below, the hind tibiæ are seen to have a conspicuous emargination from slightly beyond the middle almost to apex, the tibiæ at the middle of the emargination being only about one-half the width that they are before it, but, from the sides, the emargination cannot be seen.

MANDALOTUS ARCIFERUS, Lea.

Mr. Davey has recently taken, at Portland (Victoria), some specimens of this species, evidently in better condition than were the types. They are clothed on the upper surface with sooty scales; with two (or four) patches of white at base of elytra, some vague whitish spots near apex of prothorax, whitish rings on femora, and whitish scales on under-surface and head.

The prothorax of the male is dilated towards, but not to, apex. The elytral tubercles are fairly distinct on some specimens, and there are two (or three) on third interstice, and two on fifth, with some very feeble ones elsewhere.

Two females have the apex of elytra with scattered spots, and one has a longitudinal ochreous spot on each side of base of prothorax. Between the eyes, there is a small granule, much smaller than on the female of *M. interocularis;* from the female of that species it is also distinguished by its smaller size, comparatively wider form, and elytra with rather distinct tubercles.

Subfamily CYLINDRORHINIDES.

GASTROCIS, n.g.

Head moderately large. Eyes large, widely separated, somewhat prominent, deeper than wide, facets of medium size. *Rostrum* fairly stout, shorter than prothorax. Scrobes commencing at apex of rostrum, curved round and then directed to lower margin of eyes. Antennæ rather thin; scape shorter than funicle; funicle with all the joints longer than wide; club elongate-elliptic, distinctly three-jointed. *Prothorax* transverse, ocular lobes distinct. *Scutellum* minute. *Elytra* subovate, tuberculate. *Mesosternum* with sidepieces apparently soldered together. Metasternum very short, sidepieces very narrow, but in front triangularly dilated. *Abdomen* long. *Legs* rather long; front coxæ touching, middle lightly, the hind ones widely separated; femora moderately stout, edentate; tibiæ feebly mucronate, front pair curved at apex; tarsi moderately long, third joint wide, deeply bilobed.

I have seen but one specimen of the species described below, and its abdomen is remarkable. It appears to be composed of six segments, the first rather large (fully as long as meso- and metasternum combined), second short, third and fourth each but little shorter than the second, fifth slightly longer than three preceding combined, and at its base adorned with a conspicuous semidouble cushion of ochreous setæ,* the sixth is almost one-half the length of the fifth. But the sixth segment is probably the apical dorsal segment out of its usual position,† and, if so, the female (I presume the type to be a male) has probably the normal five segments only.

With some doubt, I refer the genus to the *Cylindrorhinides* and to the vicinity of *Perperus*; from that genus, it differs in its somewhat wider eyes, narrower metasternal episterna, shorter second segment of abdomen, and tuberculate elytra, etc.

* The front coxæ are adorned with similar setæ.

† The anal opening is visible between it and the fifth.

GASTROCIS MONTANUS, n.sp.

Black; scape, funicle and claws of a dingy red. Densely clothed with more or less ochreous or stramineous scales, in places becoming sooty. With numerous thin setæ scattered about.

Head with dense, normally concealed punctures; with a small and narrow inter-ocular fovea. Rostrum with a distinct median carina and traces of others through clothing; with dense punctures, normally visible only at apex. *Prothorax* lightly transverse, sides rather strongly rounded, widest at apical third, base very little wider than apex; punctures dense and concealed; with small granules, and a feeble median carina. *Elytra* at base no wider than base of prothorax, sides moderately dilated to beyond the middle, and then subarcuate to apex, which is very feebly notched; with rows of large, partially concealed punctures in places deflected by tubercles; these fairly numerous on the odd interstices, but mostly small, largest of all on suture crowning the posterior declivity. Length, 10½ mm.

Hab.—Tasmania: Mount Wellington, in moss (A. M. Lea).

On the elytra, the scales gradually get darker from the base to the summit of the posterior declivity, which appears to be crowned with a sooty triangle, on the outer edges of which are the largest tubercles; on the declivity itself, the scales are paler than elsewhere.

Subfamily ATERPIDES.

RHINARIA INTERRUPTA, n.sp.

Dark reddish-brown, some parts paler, some darker. Densely clothed with scales, varying from almost white to sooty; and with numerous setæ.

Head with punctures concealed; with an elevation supporting a crest. Rostrum rather short, base and sides at base notched; apical portion concave, the concave part bounded behind by an irregular, distinctly elevated ridge, at the sides by narrow ridges becoming thicker, and converging towards, but not meeting at apex. Scape rather stout, about as long as three following joints combined. *Prothorax* as long as wide, sides strongly rounded; punctures concealed: disc with numerous small granules. *Elytra* rather elongate; with regular rows of large, partially concealed punctures; interstices wide. Length, 8 mm.

Hab.—New South Wales: Clarence River (H. J. Carter).

Belongs to that section of the genus having the rostrum concave along the middle, but readily distinguished from all the previously described species by the curious, acutely elevated, transverse ridge near the base. The clothing is probably variable. On the type, it is mostly of a more or less pale fawn-colour, becoming paler on parts of the under surface and of the legs. On the prothorax, there is a pale median line. On the elytra, remnants of a pale V may be traced, and there are numerous small, sooty spots. On the prothorax, undersurface, and legs, there are numerous stramineous setæ scattered about, but, on the elytra, they form an almost regular series on each interstice. There is a conspicuous crest between the eyes and partly on the base of rostrum, entire in front, curved on each side, and impressed along the middle. On the elytra of the type, the only granules visible are a few on the suture near the base.

Subfamily Hylobiides.

Chrysophoracis, n.g.

Head not very large. Eyes of moderate size, ovate, finely faceted, widely separated, very prominent. Rostrum rather wide, shorter than prothorax, moderately curved. Scrobes deep, commencing near apex, curved round and directed to a point below the eyes, and rather abruptly terminated. Antennæ rather thin; none of the joints of funicle transverse; club elongate-elliptic-ovate. *Prothorax* about as long as wide, sides rounded, ocular lobes feeble. *Scutellum* distinct. *Elytra* much wider than base of prothorax, sides parallel, or feebly dilated to beyond the middle. *Mesosternum* with side-pieces of uneven width, the hind one the narrower, but as long as the other. *Metasternum* moderately long, side-pieces distinct, triangularly produced inwardly in front. *Abdomen* rather long, sutures distinct, that between first and second segments incurved to middle. *Legs* long; femora clavate; tibiæ denticulate on lower surface, apex feebly mucronate; tarsi elongate, third joint wide and deeply bilobed.

The type of this genus is a beautiful weevil, that occurs on Mount Wellington, and other Tasmanian mountains, at considerable elevations. It is variable in size, markings, and in the colour of its tubercles. I doubtfully associate with it another Tasmanian species, that differs in having the scrobes directed towards the lower portion of the eyes, instead of distinctly below them; this character is usually regarded as of generic and sometimes of subfamily importance, but the two species are so obviously allied, that it appears undesirable to generically separate them. The typical species has conspicuous tubercles on the prothorax and elytra, and the second species is granulate only, but in all essential generic features, except in the scrobes, they are in complete accord.

The mentum is feebly transverse, and the palpi are distinct as in other genera of *Hylobiides*, but it is not closely allied to any genus of the subfamily recorded from Australia, though, provisionally, it may be placed near *Alphitobius*; in that genus, the ocular lobes are also very feeble, but the eyes are much less prominent, the rostrum is shorter and straighter, with the scrobes narrow and terminating at the lower edge of the eyes. The Australian genera of the *Hylobiides* are not very numerous, but they are certainly very discordant in appearance.

CHRYSOPHORACIS PULCHER, n.sp.

♂. Black, parts of legs obscurely reddish. Moderately and irregularly clothed with depressed scales, varying from white to ochreous or ochreous-brown, and usually with a golden lustre. With thin setæ scattered about, sparser and shorter on elytra, and longer and denser on legs than elsewhere.

Head with dense punctures of irregular size; with a deep interocular fovea. Rostrum with a longitudinal impression filled with scales on each side of base, between same a rather narrow ridge, gradually increasing in width till it occupies the space between antennæ, where it is longitudinally impressed; with small punctures in front, becoming larger to base. *Prothorax* not much wider at base than at apex, strongly convex, with numerous shining irregularly distributed granules, with four granulated tubercles across middle, and with an abbreviated median carina. *Elytra* with rows of rather large, partially concealed punctures, and with numerous shining granules; third interstice with three tubercles, one near base, one beyond the middle, and the largest crowning the posterior declivity; fifth with four tubercles; each shoulder with a granulated tubercle. *Undersurface* with dense punctures, in many places transversely confluent. Abdomen with two basal segments large, of even length along middle, the first somewhat depressed at base, fifth slightly longer than third and fourth combined, and distinctly shorter than second. Hind *femora* extending to tip of abdomen. Length, 10-15 mm.

♀. Differs in having elytra somewhat wider, legs somewhat shorter, with hind femora just passing the base of the apical segment; and abdomen more convex, but with a depression at the apex of the first segment.

Hab.—Tasmania: Mount Wellington, including the summit, on Eucalyptus saplings (H. H. D. Griffith and A. M. Lea); Mount King William iii., 4,000 feet, Frenchman's Cap and a mountain near the Jordan River (J. E. Philp).

The white scales sometimes have a silvery lustre, and occasionally are tinged with green. Many of the ochreous scales, from some directions, appear subopaque, but from others golden; others, however, appear brilliantly golden from any direction. On old and greasy specimens, all the scales appear opaque. The scales on the scutellum are white, and there is generally a distinct white spot on the middle of each elytron, at about the basal third. Two small specimens have the derm almost entirely red, with most of the tubercles and granules appearing like red sealing-wax. One of these specimens has white scales forming three spots at the base of the elytra, four about the middle, and a patch on each side. The majority of specimens have the apex of elytra very feebly produced; on some, however, they are obtusely bimucronate, and on others quite distinctly so: but this variation appears to be individual, rather than sexual.

CHRYSOPHORACIS AMPLIPENNIS, n.sp.

♂. Black, elytra in parts obscurely diluted with red. Rather lightly clothed with white or greyish scales; and with thin setæ, shorter and sparser on elytra, and longer on legs than elsewhere.

Head with very dense and rather small punctures; a distinct fovea between eyes. Rostrum with dense and small punctures in front, becoming larger and subconfluent towards base; with a narrow carina from interocular fovea to between antennæ. Scrobes directed towards lower edge of eyes, but terminated before reaching same. *Prothorax* rather strongly convex, distinctly wider at base than at apex, with dense granules of medium and small size; with an irregular, abbreviated median carina. *Elytra* slightly dilated to beyond the middle, shoulders laterally prominent; with rows of fairly large, partially concealed punctures, and with numerous somewhat depressed granules; alternate interstices moderately but distinctly elevated. *Under-surface* with rather dense punctures, and finely shagreened. Two basal segments of abdomen somewhat depressed in middle. Length, 10 mm.

♀. Differs in being larger (12 mm.) and considerably wider, elytra much larger, two basal segments of abdomen gently convex, and legs somewhat shorter.

Hab.—Tasmania: Mount Wellington, including the summit (A. M. Lea).

The sides of the rostrum are flattened in front and quite glabrous there, so as to be reminiscent of the *Tanyrhynchides.* The type-male has a curious greyish appearance, and, in size and general appearance, is not unlike *Rhinaria granulosa*; the type-female is abraded, and, owing to the greater width of her elytra, the resemblance to the species named is not so apparent. In the male, the elytra at their widest appear to be nearly twice the width of the prothorax, but the proportions are $5\frac{1}{2} : 3\frac{1}{2}$ mm.; in the female, they appear to be considerably more than twice the width of the prothorax, but the proportions are $7\frac{1}{2} : 4\frac{1}{2}$ mm.

Subfamily ERIRHINIDES.

AOPLOCNEMIS BIFASCICULATUS, n.sp.

Dark reddish-brown, almost black; legs and antennæ reddish, rostrum and club somewhat darker. Irregularly clothed with white scales; with a distinct black fascicle on each elytron at summit of posterior declivity.

Head with dense punctures; a shallow depression with a small central pit between eyes. Rostrum slightly longer than prothorax, moderately curved, somewhat dilated at apex, with a rather feeble medio-basal carina, and some thinner lateral ones extending almost to antennæ; basal half with rather coarse punctures, apex with much smaller ones. Antennæ inserted about one-fourth from apex of rostrum; two basal joints of funicle elongate, first slightly longer than second *Prothorax* about as long as wide, base somewhat wider than apex; with numerous rather large granules, and with a short, obtuse median carina. *Elytra* much wider than prothorax, parallel-sided to beyond the middle; with rows of large, subquadrate punctures, becoming smaller posteriorly, obtusely granulate; tuberculate beneath fascicles. *Legs* long; femora subclavate. Length, $6\frac{1}{2}$-$7\frac{1}{2}$ mm.

Hab.—New South Wales: Mittagong (E. W. Ferguson), Colo Vale (W. W. Froggatt).

Allied to *A. loweri*, and with two fasciculate tubercles in the same positions as on that species, but punctures considerably larger, prothorax with a short but distinct median carina, and clothing very different. From *A. armipennis* it is still more distinct. The white scales are dense below the eyes, form three feeble lines on prothorax, and are dense just about front coxæ, clothe the scutellum, and form numerous spots on the elytra and undersurface.

Aoplocnemis maximus, n.sp.

♂. Dark reddish-brown, legs paler. Clothed with whitish scales, in places varying to stramineous.

Head with rather dense punctures; with a conspicuous interocular fovea. Rostrum slightly longer than prothorax, moderately curved, almost parallel-sided, median carina very feeble, but some distinct lateral ones extending almost to antennæ; with rather dense, irregular punctures, becoming smaller and more regular about apex. Antennæ thin, inserted one-fourth from apex of rostrum; two basal joints of funicle elongate, first slightly longer than second. *Prothorax* about as long as wide, base wider than apex, median carina feeble or absent; with numerous granules, but in places granulate-punctate. *Elytra* much wider than prothorax, parallel-sided to near apex; with rows of large, partially concealed punctures; interstices wider than punctures, with rounded or transverse granules. *Legs* long, femora subclavate. Length, 11-14 mm.

♀. Differs in being larger, legs somewhat shorter, and abdomen more convex.

Hab.—Tasmania : Mount Wellington (A. M. Lea).

The male has the undersurface and coxæ densely clothed with snowy-white scales, a few of which have an opalescent gloss. On the upper surface, the clothing (except at sides and apex of elytra) is sparser, on the elytra mostly scales (some of which are sooty), but on the prothorax (as also on the head, rostrum, and legs) mostly more or less elongated setæ. On the female, the clothing is more stramineous than white. The species is the largest of the subfamily hitherto recorded from Australia; the largest female before me measures 16½ mm., including its extended rostrum.

RHACHIODES.

In the Table of *Erirhinides* given by Mr. Blackburn, this genus, with *Olanæa*, is separated from the others by the "scrobes abruptly turned under the rostrum."

Examining the sides of the rostrum of *R. granulipes*, *R. strenuus*, and *R. bicaudatus* (which are certainly congeneric), the scape is seen to be inserted fairly close to its apex, and the scrobe to be bifid, the lower fork turning under the rostrum before the eye is reached, but the upper fork continued until it touches the eye. The lower fork is rather narrower than the upper one, and usually receives the scape. The upper fork is sometimes partially concealed by clothing, but, when looked for, is always plainly visible.

The scrobes of *Encosmia cornuta* are much the same, but that species was referred to *Encosmia* "with considerable hesitation," instead of to *Rhaciodes*, as its eyes are coarsely faceted, and claws divaricate, and Mr. Blackburn regarded the claws as of primary importance in the subfamily.

RHACIODES AURIFER, n.sp.

Dark reddish-brown, almost black, appendages paler. Somewhat irregularly clothed with more or less golden scales, but, on the elytra, condensed into distinct and usually rounded spots. Each tubercle with a fascicle of dark setæ.

Head with dense, round punctures. Eyes large and with rather coarse facets. Rostrum long, moderately curved, rather thin; punctures much as on head. *Prothorax* slightly longer than wide, sides rounded in middle, base and apex subequal; with dense, partially concealed punctures. *Elytra* distinctly wider than prothorax, base shallowly arcuate, shoulders somewhat rounded, sides feebly decreasing in width to beyond the middle, and then strongly rounded; with regular rows of large punctures, in places partially concealed; with a strong fascicle-crowned tubercle on each side near apex. *Legs* long; femora stout; four front tibiæ distinctly curved; claws divergent. Length, $3\frac{3}{4}$ mm.

Hab.—New South Wales: Tweed River (A. M. Lea).

In its divergent claws, this species agrees with *Rhaciodes*, but, in its coarsely faceted eyes and general appearance, with *Encosmia cornuta*. It is referred to *Rhaciodes*, as its scrobes are exactly as in that genus; in which the facets of the eyes are somewhat variable. In general appearance, it is fairly close to *E. cornuta*, but the spots are more numerous and differently disposed. They are of irregular size and distribution, the largest and most rounded being one on each side just before the middle, and one on the suture just beyond the middle. The type has its left scape resting in the upper fork of the scrobe, but the right one in the lower fork.

EMPOLIS ABACETUS, n.sp.

♂. Black, antennæ and claws of a dingy red. Moderately clothed with scales and stout setæ.

Head with crowded punctures. Rostrum rather long, thin, and curved; with dense punctures; with three narrow carinæ from antennæ to base. Antennæ thin, inserted about one-third from apex of rostrum. *Prothorax* somewhat wider than long, sides strongly rounded, base distinctly wider than apex; with dense, round punctures, and with a vague median carina. *Elytra* much wider than prothorax, parallel-sided to near apex; with rows of large punctures in deep striæ; interstices wider than striæ, with numerous partially concealed granules and punctures. Second segment of *abdomen* distinctly shorter than fifth, the latter with a wide shallow impression. Length, $4\frac{1}{4}$-$5\frac{1}{4}$ mm.

♀. Differs in having the second segment of abdomen slightly longer than fifth, and the latter with the shallow impression much smaller.

Hab.—New South Wales (Macleay Museum), Goulburn (T. G. Sloane).

Close to *E. granulatus*, but with the clothing condensed into spots in places. From *E. niveodispersus*, it differs in the clothing on the interstices being less setose in character, and by the total absence of snowy scales from the striæ. From a co-type of *E. angustatus*, it differs in being larger and wider, prothorax more strongly rounded in middle, and the elytral scales stouter and less setose. The two females before me have the rostrum and legs obscurely diluted with red. On the elytra, the scales are mostly stramineous or subochreous, and give the surface a somewhat spotted appearance, but there are numerous sooty scales, that, owing to their resemblance to the derm, are very easily overlooked. On the prothorax, the paler scales are condensed to form three feeble lines. On the undersurface and legs, the clothing is almost uniformly whitish.

EMPOLIS SQUAMOSUS, n.sp.

♀. Black; rostrum, antennæ, and legs of a more or less dingy red. Densely clothed with dull, pale ochreous scales, variegated with small, sooty spots; on undersurface, scales mostly of a dull bluish-white.

Head with crowded concealed punctures. Rostrum long, thin, and curved; with numerous punctures, clearly defined in front, concealed about base, and sublineate in arrangement behind antennæ; from antennæ to base with a rather feeble median carina. Antennæ thin, inserted about two-fifths from apex of rostrum. *Prothorax* moderately transverse, sides moderately rounded, base slightly wider than apex; punctures normally concealed. *Elytra* distinctly wider than prothorax, parallel-sided to beyond the middle; with rows of large, partially concealed punctures, each containing a scale; interstices wider than striæ, their sculpture concealed. Second segment of *abdomen* slightly longer than fifth. Length, 4 mm.

Hab.—Victoria: Somerville (A. M. Lea).

Readily distinguished from all others of the genus by the clothing, which consists of true scales, even on the undersurface and legs The small sooty spots are more numerous on the elytra than elsewhere.

MERIPHUS LATEROALBUS, n.sp.

Of a dingy castaneous; head, club, scutellum, parts of undersurface and of legs somewhat darker; elytra with rather numerous, feeble spots. Irregularly clothed with whitish scales, dense on sides of prothorax and of mesosternum, and moderately dense on apical half of elytra.

Head elongate; with dense, partially concealed punctures. Rostrum long, almost straight; with dense punctures, becoming linear in arrangement, and separated by feeble ridges behind antennæ. These inserted about one-third from apex of rostrum. *Prothorax* small, base much wider than apex, slightly longer than width of base; with dense punctures, in places concealed; with a feeble median carina. *Elytra* much wider than prothorax and almost thrice as long; with rows of rather large punctures, in light striæ; interstices with fine punctures, the odd ones (including suture) with rows of setiferous granules. *Undersurface* with dense more or less concealed punctures. *Femora* stout, strongly and acutely dentate. Length, $3\frac{1}{2}$-$3\frac{3}{4}$ mm.

Hab.—Tasmania: Launceston (A. M. Lea)—New South Wales: Sydney (R. Helms).

In general appearance, fairly close to *M. granulatus*, but prothorax with two longitudinal stripes instead of four, and elytra somewhat narrower and otherwise different.

MISOPHRICE SETOSA, n.sp.

Black; elytra of a dingy reddish-castaneous, with the base, suture, and margins feebly infuscated; antennæ in parts diluted with red. Densely clothed with silvery-white scales, but parts of elytra glabrous; and with numerous long, more or less erect, stiff, black setæ.

Rostrum comparatively short (shorter than prothorax), feebly curved, base grooved and punctured. *Prothorax* about as long as wide, sides evenly rounded, base scarcely wider than apex; punctures normally concealed. *Elytra* distinctly wider than prothorax, parallel-sided to beyond the middle; with rows of rather large punctures in shallow striæ. Length, 2 mm.

Hab.—New South Wales: Sydney (A. M. Lea).

With the stiff bristles of *M. hispida*, but narrower than that species, clothing very different, and elytra partly red. On the elytra, the whitish scales are dense on the suture, base, and margins, and almost or entirely absent elsewhere; but this may be due to partial abrasion. On the prothorax, the setæ are more numerous than elsewhere, but they extend to the base of the rostrum. On the legs, there are numerous distinct ones, but they are shorter than on the upper surface. There is but one specimen (whose sex is doubtful) now before me, but there is a somewhat larger one (also from Sydney) in the Australian Museum.

MISOPHRICE V-ALBA, n.sp.

Reddish-brown, appendages somewhat paler. Densely but somewhat irregularly clothed with scales, varying from white to stramineous or ochreous.

Rostrum moderately long and curved, basal half with fine ridges, and dense, partially concealed punctures; elsewhere shining, and with rows of small punctures. *Prothorax* feebly transverse, sides lightly rounded, base distinctly wider than apex; with dense, partially concealed punctures. *Elytra* elongate-subcordate, wider than prothorax, shoulders rounded, sides subparallel to beyond the middle; with rows of fairly large but usually concealed punctures. Length, $2\frac{1}{2}$-$3\frac{1}{2}$ mm.

Hab.—South Australia: Adelaide (H. H. D. Griffith)—Tasmania: Hobart (A. M. Lea).

Differs from *M. squamiventris* in being larger, the clothing of the upper surface opaque, white markings different, and leaving portions of the derm exposed, rostrum stouter, and eyes distinctly larger. From *M. variabilis*, it differs in having the prothorax larger in proportion, and the elytra not at all dilated posteriorly. *M. argentata* and *M. alternata* have setose elytra; all the other described species are very much smaller. On the elytra, most of the scales are uniformly stramineous or ochreous, with white ones forming an irregular V (the V starting on each side just beyond the shoulder, and terminating on the suture just before the middle), and rather densely clothing the apex; on the prothorax (which has thinner clothing than the elytra), two pale lines are usually distinct. On the head, sides, and undersurface, the scales usually have a golden gloss, but sometimes silvery, or even greenish. The four typical specimens present no distinct sexual differences.

MISOPHRICE AMPLIPENNIS, n.sp.

Black; elytra, parts of rostrum and of antennæ, and legs (except tarsi) of a more or less dingy reddish-brown. Densely clothed with white or whitish scales.

Rostrum long, thin, and moderately curved; basal half with fine ridges, and rows of distinct punctures, the latter continued to apex but becoming smaller beyond antennæ. *Prothorax* distinctly transverse, base somewhat wider than apex; with dense, more or less concealed punctures. *Elytra* comparatively wide, base wider than prothorax, sides gently dilated to beyond the middle, and then widely rounded to apex; with rows of fairly large punctures, close together but partially concealed. Length, 2-3 mm.

Hab.—South Australia: Adelaide (H. H. D. Griffith).

A moderately large species, allied to *M. squamiventris*, but elytra more dilated posteriorly, and upper surface with non-variegated clothing Numerous specimens were taken near Henley Beach. On the sides and undersurface, the scales usually have a greenish or golden gloss. On the elytra, they occasionally have a vague golden tinge. On the suture and fifth interstice, they are usually more closely placed than elsewhere, giving the surface (to the naked eye) a vaguely lined appearance, but, on slight abrasion, this appearance is obscured. Most of the prothoracic scales are quite as stout as those on the elytra, but they are placed transversely. The male differs from the female in being somewhat smaller and darker, two basal segments of abdomen less convex, elytra less dilated posteriorly, and rostrum somewhat shorter.

Misophrice griffithi, n.sp.

Black, part of rostrum reddish, antennæ obscurely diluted with red in parts; legs (except tarsi) reddish in female, very obscurely diluted with red in male. Densely clothed with brilliant green or golden-green scales.

Rostrum long, thin, and moderately curved; basal half with fine ridges; with rows of punctures, concealed near base, and fine in front. *Prothorax* moderately transverse, base somewhat wider than apex; with dense, normally almost concealed punctures. *Elytra* elongate, base distinctly wider than prothorax, sides almost parallel to beyond the middle; with rows of large, partially concealed punctures. Length, 2-2¼ mm.

Hab.—South Australia : Adelaide (H. H. D. Griffith).

An extremely beautiful species, to which I attach Mr. Griffith's name with great pleasure. It is allied to *M. gloriosa*, but differs in being somewhat narrower, scales more uniformly metallic, and clothing the suture to the base, etc. On the upper surface, these are occasionally almost golden, but usually golden-green, the green usually more pronounced on the elytra than on the prothorax. On the prothorax, the clothing consists of true scales, but they are somewhat smaller, and not quite so rounded as those on the elytra. The sexual differences are very slight; the male is usually smaller than the female, its rostrum is slightly shorter (but still decidedly long), and the basal segments of abdomen less convex. Mr. Griffith took numerous specimens, at the head of Coromandel Valley, on *Casuarina stricta*.

Misophrice nigriceps, n.sp.

Of a pale dingy castaneous; head, club, part of funicle, scutellum, meso- and metasternum and tarsi black or infuscated.

Moderately clothed with whitish or stramineous depressed setæ, denser, paler, and more squamose in character on sides of sterna, and sparser on abdomen, than elsewhere.

Rostrum moderately long, thin, and lightly curved; basal two-fifths with fine ridges, and rows of punctures, the latter continued to, but becoming smaller towards, apex. *Prothorax* moderately transverse, base not much wider than apex; with fairly large but partially concealed punctures. *Elytra* at base somewhat wider than prothorax, sides feebly dilated or almost parallel-sided to beyond the middle; with rows of comparatively small, partially concealed punctures. Basal segments of *abdomen* flattened across middle. Length, $1\frac{3}{4}$ mm.

Hab.—Queensland: Dalby (Mrs. F. H. Hobler).

The clothing at first appears more like pubescence than scales, and this, with the pale prothorax, render the species easy of recognition. *M. oblonga*, which in colour is very similar, is less parallel-sided, and has different clothing. In shape it approaches some of the varieties of *M. amplicollis* and *M. vicina*, but the elytra are entirely without dark markings, even the suture not being distinctly infuscated, although perhaps a trifle darker than the adjacent parts. On the two typical specimens, there are no glittering scales; on the prothorax, the clothing is transversely or obliquely placed, with, consequently, a fairly distinct median line. On the elytra, in addition to the depressed setæ, there are some curved ones, not closely applied to the derm, so that they are fairly distinct from the sides, although they are not suberect.

Misophrice evanida, n.sp.

Of a pale, dingy testaceous; head, most of antennæ, scutellum, base and suture of elytra, with a subapical spot on each side, sides of meso- and of metasternum, and the tarsi more or less deeply infuscated. Rather sparsely clothed with whitish depressed setæ.

Rostrum moderately long, thin, and curved; with rows of punctures, separated by feeble ridges on basal half, elsewhere smaller but still seriate in arrangement. *Prothorax* distinctly transverse, base somewhat wider than apex; with fairly dense and rather large punctures, usually distinct through clothing. *Elytra* slightly wider than prothorax, parallel-sided to beyond the middle; with rows of fairly large punctures. Length, 1 mm.

Hab.—New South Wales: Glenfield (A. M. Lea).

With the exception of *M. minima*, the smallest known species of the genus, but much like *M. vicina* in miniature. The difference between 1 and $1\frac{1}{4}$ mm. does not seem much on paper, but when specimens of this species and of *M. vicina* are placed side by side, the latter appear to be very considerably the larger. The subapical spot on each elytron is on the fifth interstice, and is fairly distinct on one specimen, but just traceable on the other. On neither is the clothing anywhere metallic. The two typical specimens, whose sex is doubtful, were beaten from Casuarinas growing on the banks of George's River.

Misophrice minima, n.sp.

Black, abdomen and parts of antennæ and of legs obscurely reddish. Moderately clothed with bluish-green scales; abdomen almost entirely glabrous.

Rostrum almost the length of prothorax, moderately thin and lightly curved, punctures and ridges somewhat as in preceding species. *Prothorax* feebly transverse, base slightly wider than apex, punctures partially concealed. *Elytra* very little wider than prothorax, parallel-sided to near apex; with rows of rather large, partially concealed punctures. Length, $\frac{3}{4}$ mm.

Hab.—Queensland: Cairns (E. Allen).

Somewhat like *M. parallela*, but not half the size of that species, and with legs not entirely dark. It is the smallest known species of the genus, and perhaps the smallest weevil in Australia. The derm of the elytra, at a glance, appears to be black, but, on examination, it is seen to be obscurely diluted with red, somewhat as on the darker specimens of *M. inconstans*. It is, however, very much smaller than any specimen of that species before me, and differs in other respects. The scales on the elytra appear to form quite regular lines on the interstices. The sex of the type is doubtful.

THECHIA LATIPENNIS, n.sp.

Black, rostrum and antennæ obscurely diluted with red in parts. Densely clothed with white scales, on the upper surface mottled with sooty.

Head with dense, partially concealed punctures. Rostrum fairly stout, lightly curved, about as long as prothorax; apical half with rather small but clearly defined punctures, becoming larger towards base, where they are seriate in arrangement, separated by feeble ridges and partially concealed. *Prothorax* moderately transverse, apex somewhat narrowed, but basal two-thirds parallel-sided; with a feeble median carina; with dense, partially concealed punctures. *Elytra* much wider than prothorax, parallel-sided to near apex; with rows of fairly large, almost concealed punctures. *Abdomen* moderately convex, but somewhat flattened across middle. *Legs* rather stout. Length, 3 mm.

Hab.—West Australia: Swan River (A. M. Lea).

Considerably larger and wider than, and very differently clothed from, either *T. pygmæa* or *T. cinerascens;* in general appearance, something like a large *Cydmæa.* On the sides of the elytra, the white scales are in the majority, but, towards the suture, the sooty patches cover most of the surface. On the disc of the prothorax, the sooty scales (or setæ) are also in the majority. On the undersurface, the scales frequently have a golden or greenish glitter: on the legs, they are mostly dull white, but a few have a silvery lustre.

THECHIA BIMACULATA, n.sp.

Dull red, a round postmedian spot on each elytron black, suture somewhat infuscated. Head, most of rostrum, undersurface, and legs very densely clothed with white or whitish scales, similar scales on sides and along middle of prothorax, and forming numerous irregular spots on elytra.

Head with punctures entirely concealed. Rostrum about as long as prothorax, not very thin, lightly curved, apical fourth shining and with distinct punctures, these elsewhere concealed. *Prothorax* lightly transverse; punctures dense but in places concealed. *Elytra* slightly wider than prothorax, parallel-sided to near apex; with rows of rather large, partially concealed punctures. *Legs* rather short and stout. Length, 2-2¼ mm.

Hab.—West Australia: Swan and Vasse Rivers (A. M. Lea).

Allied to *T. pygmæa*, but somewhat larger, clothing of under-surface and of legs even denser, and elytra with two conspicuous black spots.

Subfamily APIONIDES.

APION HOBLERÆ, n.sp.

♂. Black; apical half of rostrum (but not the tip), femora and tibiæ flavous, antennæ somewhat darker. Moderately densely clothed with short greyish-white pubescence, with a large sub-quadrate patch of darker pubescence on elytra.

Head with partially concealed sculpture. Rostrum about the length of prothorax, moderately stout, lightly curved; apical half narrower than basal half, and with smaller but not concealed punctures. Antennæ inserted about one-third from base of rostrum. *Prothorax* lightly transverse, sides moderately rounded; punctures almost entirely concealed. *Elytra* rather strongly striate-punctate, punctures suboblong but partially concealed; interstices with numerous concealed punctures. Length (excluding rostrum), $1\frac{1}{3}$-$1\frac{1}{2}$ mm.

♀. Differs in having the rostrum somewhat longer, thinner, and less dilated to base, with the apical half more reddish than flavous.

Hab.—Queensland: Dalby (Mrs. F. H. Hobler).

In general appearance, very close to *A. condensatum*, but slightly smaller, and with the elytral clothing somewhat different; in the present species, the darker markings are sharply defined, both laterally and posteriorly, and form an irregular square on the basal half, the pale scales at the base and towards apex nowhere being interrupted beyond the dark marking, so that the apical two-fifths are uniformly clothed with pale scales. On *A. condensatum*, the summit of the posterior declivity has conspicuous white clothing, but, immediately to the rear of this, it is darker. That on the prothorax is somewhat darker on the middle than on the sides. Mrs. Hobler has taken an abundance of specimens.

Subfamily TYCHIIDES.

EUDELA.

Pascoe, Ann. Mus. Civ. Genova, 1885, p.237.

This genus was referred to the *Tychiides*, by Pascoe, despite its simple claws. There are, before me, two specimens sent by Dr. Gestro as cotypes of *Eudela rufescens*, and with a label "Borneo, Sarawak, 1865-66. Coll. G. Doria."* They are evidently sexes of one species, as the antennæ are inserted at about one-fourth from the apex of rostrum on one specimen (presumably the male), and not much nearer apex than base on the other (presumably the female). But neither has dentate femora, whereas, in the generic diagnosis, Pascoe said "Femora compressa, dentata." As the specimens agree so well with the descriptions in other respects, however, I wrote to Mr. Arrow, of the British Museum: "I have two specimens sent by Dr. Gestro as cotypes of *Eudela rufescens;* but they differ from the description in having the femora edentate. I would be glad, therefore, if you would examine the type, and let me know if its femora are really dentate. Also how is the prothorax carinate? My specimens have the extreme outer margins acute, whereas Pascoe said 'Prothorax . . . . ad latera carinatus,' and again, 'the sharp elevated line or carina on each side of the prothorax.'"

In reply, Mr. Arrow wrote: "I have examined the type of *Eudela rufescens*. I find that Pascoe's description is quite correct. All the femora are toothed, the four posterior ones very bluntly, and the front ones acutely. Also, the prothorax is flattened, and the lateral edges are sharp or carinate as in the African genera *Antliarhinus* and *Platymerus*."

It would appear, therefore, that the specimens sent by Dr. Gestro are not *E. rufescens*, but a species closely resembling it

* The original locality, and one of the original collectors.

in size, colour, and in the curious prothoracic margins. I believe that they belong to *Eudela*, as several Queensland weevils, which I consider to be congeneric with them, differ in the femora as follows :—

E. flavipennis. All femora edentate.

E. armicollis and *E. atra.* Four hind femora dentate, the others edentate.

E. castanea. All femora strongly dentate.

Eudela armicollis, n.sp.

♂. Head, rostrum, antennæ, prothorax and legs of a more or less dingy castaneous; elsewhere black, abdomen sometimes obscurely diluted with red posteriorly. Head sometimes feebly infuscated between eyes. Moderately densely clothed with short pubescence, almost white on lower surface, darker on upper.

Head rather small; with dense and rather small clearly defined punctures. Eyes large and latero-frontal. Rostrum rather thin about the length of prothorax, lightly curved; with dense punctures, subseriately arranged behind antennæ. Antennæ moderately thin, inserted two-fifths from apex of rostrum; scape about as long as funicle; basal joint of funicle rather stout, about as long as three following combined, second somewhat longer but no wider than third; club rather briefly elliptic, subcontinuous with funicle. *Prothorax* flattened, strongly transverse, base widely rounded and twice the width of apex, each side strongly ridged from base, the ridge terminating in a distinct tooth, slightly nearer apex than base; with very dense, clearly defined punctures, somewhat larger than on head. *Scutellum* small, with distinct punctures. *Elytra* not much wider than prothorax, sides gently rounded, each strongly separately rounded at apex; with rows of distinct but not very large punctures, in narrow striæ; interstices much wider than striæ, with small and dense punctures. *Undersurface* with dense, and rather small punctures. Basal segment of abdomen flattened in middle. *Pygidium* large, sides encroached upon by apical segments. *Legs* stout; four hind femora obtusely dentate. Length, $3\frac{1}{4}$-$3\frac{1}{2}$ mm.

♀. Differs in having the rostrum somewhat longer, thinner, and with smaller punctures; prothorax with the sides less acutely ridged, and the ridges not dentate in front; abdomen evenly convex, and legs somewhat thinner.

Hab.—Queensland: Cairns (E. Allen and H. Hacker), Warrior Island (Macleay Museum).

This species differs from the specimens sent to me as *E. rufescens*, in the carina on each side of the prothorax being abruptly terminated in a tooth in the male; the tooth, however, varies in size, on some specimens being little more than a slight swelling, whilst on others it is acute. The female has the lateral ridge less acute, and not terminated in a tooth. The legs are sometimes almost flavous.

Eudela atra, n.sp.

Black, antennæ and tarsi reddish, tibiæ, tips of femora and of rostrum obscurely diluted with red. Moderately densely clothed with short pubescence, mostly white or whitish, but on the elytra darker.

Rostrum and antennæ somewhat thinner than in preceding species. *Prothorax* with sides somewhat compressed on basal half, but not acutely ridged; otherwise, and the *elytra* as in preceding species. *Undersurface* and *legs* much the same. Length, $3\frac{1}{4}$ mm.

Hab.—Queensland: Cairns (E. Allen).

The type is evidently a female of a species closely allied to the preceding one, from which it differs in its black prothorax, rostrum, and partly black legs. The prothorax has the sides near the base moderately sharp, but elsewhere rounded. On both species, the elytral pubescence from some directions appears to be ashen, and from other directions brownish.

Eudela castanea, n.sp.

Pale reddish-castaneous, legs still paler. Rather densely clothed with short, stramineous pubescence, becoming paler and finer on undersurface.

Head rather small, punctures almost concealed. Eyes large and latero-frontal. Rostrum not very thin, parallel-sided, moderately curved, about the length of prothorax; with dense punctures, clearly defined in front, subseriately arranged and partially concealed behind antennæ. Antennæ rather short; scape inserted two-fifths from apex of rostrum, and slightly longer than funicle; basal joint of funicle stout and rather long; club rather short. *Prothorax* moderately transverse, lightly convex, sides strongly rounded, base about once and one-half the width of apex; with dense, partially concealed punctures. *Scutellum* small. *Elytra* decidedly wider than prothorax, sides gently rounded, each feebly separately rounded at apex; with rows of distinct punctures, in narrow striæ; interstices much wider than striæ, with dense punctures. *Undersurface* with dense punctures, smaller along middle than on sides. Pygidium moderately large. *Legs* stout; femora strongly and acutely dentate. Length, 3-3¼ mm.

Hab.—Queensland: Wolfram Camp, near Cairns (H. Hacker).

The simple prothoracic margins and strongly dentate femora are at variance with the preceding species; but I am averse to proposing a new genus for the species, as, in many respects, it is certainly very close to them.

EUDELA FLAVIPENNIS, n.sp.

Pale castaneous, elytra (suture excepted) and legs still paler. Rather sparsely clothed with whitish pubescence; seriately arranged on elytra.

Head small; with dense, partially concealed punctures. Eyes large and latero-frontal. Rostrum rather thin and moderately curved, parallel-sided, about the length of prothorax; with dense punctures; basal two-thirds with a distinct median carina. Antennæ rather short, inserted slightly nearer apex than base of rostrum; scape about the length of funicle; club short. *Prothorax* moderately convex, strongly transverse, sides strongly rounded, base almost truncate and much wider than apex, with dense, fairly large and sharply defined punctures. *Scutellum* small. *Elytra* not much wider than prothorax, sides gently rounded, and separately rounded at apex; with regular rows of small but distinct punctures, becoming smaller posteriorly; interstices much wider than seriate punctures, with numerous small punctures. *Undersurface* with small punctures. *Legs* moderately stout; femora edentate. Length, $1\frac{3}{4}$ mm.

Hab.—Queensland : Kuranda (G. E. Bryant).

Much smaller than the other species here referred to *Eudela.* The pygidium, although not very large, is quite distinct, and is evidently not accidentally exposed, as the elytra are separately rounded. The sides of the prothorax of the type are not ridged at the base; but this may be a sexual character. The series of punctures on the elytra are distinct but apparently not in striæ. In general appearance, the species resembles a rather wide *Apion.*

Subfamily PRIONOMERIDES.

This subfamily has not been previously recorded as Australian. Two characters in combination render it easy of recognition: the femora (at any rate the front pair) strongly dentate with the teeth serrated, and the claws appendiculate. The species now referred to the subfamily has a singular resemblance to species of the genus *Meriphus.*

MERIPHERINUS, n g.

Head rather small. Eyes moderately large, widely separated, moderately faceted, oblong-elliptic. Rostrum long and thin. Antennæ thin; funicle seven-jointed; club rather loosely jointed. *Prothorax* small, without ocular lobes. *Scutellum* distinct. *Elytra* large, much wider than prothorax. Four basal segments of *abdomen* drawn backwards at sides. *Legs* long; femora stout, each with a large triangular tooth; tibiæ thin; claws strongly appendiculate.

In Pascoe's Table of the *Prionomerides,** this genus would be associated with *Themeropsis*, from the description of which it differs in the eyes being rather widely separated, front tibiæ not strongly arcuate; second segment of abdomen considerably longer than the third or fourth, etc.

MERIPHERINUS FIMBRIATUS, n.sp. (Plate lxxvi., fig.6).

Reddish-flavous, legs paler; tip of rostrum, club, serrations of femoral teeth, and claws black. Moderately clothed with de

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* Journ. Linn. Soc., Zool., xii., p.33.

pressed, stramineous setæ, becoming paler and more squamose in character on undersurface.

Head rather elongate, with small, dense punctures; a narrow interocular impression. Rostrum twice as long as head and prothorax combined, lightly curved, sides slightly dilated to apex and less noticeably so to base; with a distinct median carina, and two smaller ones on each side from base to middle; a narrow impression between antennæ, apical half with small punctures. Antennæ inserted slightly nearer apex than base of rostrum; two basal joints of funicle elongate, but none transverse. *Prothorax* small, slightly wider than long, sides rounded, base and apex truncate, shallowly transversely impressed near apex, and less distinctly so near base; with small, dense punctures *Elytra* almost twice the width of prothorax, not once and one-half as long as wide, shoulders prominent; with regular rows of fairly large deep punctures; interstices with numerous small, setiferous granules, more numerous on the odd than the even ones. Second segment of *abdomen* as long as third and fourth combined. *Legs* long; femora strongly clavate, each with a strong, serrated and fimbriated tooth; tibiæ thin, hind pair rather strongly arched at base. Length, 5½ (rostrum 3½) mm.

Hab.—New South Wales: Richmond River (A. J. Coates).

This species has many curious resemblances to several species of *Meriphus*, although the strongly appendiculate claws forbid its being placed even in the same subfamily. The appendix to each claw is large and angular, but is so placed that, from certain directions, each claw-joint appears to be terminated by four short claws of even size.

Subfamily Haplonycides.

Haplonyx multicolor, n.sp.

Dark reddish-brown, in places almost black, legs reddish. Clothing variegated.

Rostrum long, subcylindrical, rather lightly curved, with partially concealed punctures, not visibly carinate. *Prothorax* not twice as wide as long, the length equal to the width at apex; punctures partially concealed. *Elytra* distinctly wider than prothorax, slightly longer than wide; with regular rows of large, partially concealed punctures; interstices with dense punctures. *Femora* stout, acutely dentate, the front pair with a small tooth in emargination; four front tibiæ rather strongly curved. Length, 3½ mm.

Hab.—Queensland : Cairns (E. Allen).

The bases of the femora, sterna, and parts of head and of rostrum are almost black, the antennæ are distinctly darker than the legs, but the tarsi are almost as dark. The clothing varies from almost white, through ochreous, to black. Between the eyes, there is a distinct ochreous spot. On the prothorax, there is a dark, sharply limited, medio-basal triangle, with two minute black fascicles at its tip; there are also two similar fascicles at the apex. The sides are rather densely clothed with ochreous scales. On the elytra, there are some white or whitish scales on each side, close to the scutellum, and forming a rather vague median fascia (fairly wide at suture, and very narrow towards the sides). Behind the scutellum is a depressed fascicle of ochreous and sooty scales. On the fifth interstice, there are two fascicles: one just before the middle, the other just after; the latter is slightly the smaller, and, from it, a vague whitish line can be traced to the apex. On the undersurface and legs, the scales are white or whitish. I have seen but the type, evidently a female in perfect condition; but probably older specimens will have the clothing less conspicuously variegated.

Haplonyx nigrolineatus, n.sp.

Reddish-brown, rostrum and club somewhat darker. Rather densely clothed with ochreous, varied with white and sooty scales.

Rostrum long, subcylindrical, almost straight ; with dense punctures, distinct in front, but partially concealed elsewhere. *Prothorax* not much wider than long, and, at apex, distinctly narrower than long; punctures partially concealed. *Elytra* distinctly wider than prothorax, slightly longer than wide; with regular rows of rather large, partially concealed punctures; interstices with dense and almost concealed punctures. *Femora* stout, apparently unidentate; tibiæ rather wide, the four front ones bisinuate on lower surface. Length, 4 mm.

Hab.—Victoria: Flemington, from a gall on *Leptospermum* (W. W. Froggatt).

An unusually distinct species. On the head, undersurface, and legs, the clothing is ochreous, feebly variegated with whitish. On the prothorax (which is without fascicles), there are three obscure lines of dark scales, commencing at the base, and conjoined at apex (from in front, they appear to form a trident-shaped mark); towards each side are some spots of white scales. On the elytra are numerous spots of white scales, and numerous small black fascicles; on the third and fifth interstices, the fascicles are so close together that they appear to form distinct black lines, from near the base to the apical fourth. I have seen a specimen, not now before me, from Sydney, in Mr. Cox's Collection.

Subfamily Barididides.

Baris transversicollis, n.sp.

Black, somewhat shining. With whitish scales condensed into spots on each corner of prothorax, on the elytra forming an irregular median fascia, a spot on third interstice at base; and dense on side-pieces of meso- and of metasternum. Undersurface and legs with regular whitish scales; elsewhere almost or quite glabrous.

Head with minute punctures. Rostrum long, strongly curved, somewhat gibbous and thickened about base; upper surface with rather small punctures about base, becoming minute to apex, sides behind antennæ with rather coarse punctures. *Prothorax* moderately transverse, basal half parallel-sided, then strongly rounded to apex, which is about half the width of base; with dense and fairly large punctures, somewhat sparser in middle than elsewhere. *Elytra* not much wider than prothorax, base strongly trisinuate, apex of each separately rounded; with narrow, deep striæ; interstices with rather large irregular punctures, becoming smaller and regular posteriorly. *Prosternum* not longitudinally impressed. Pygidium rather large. *Femora* rather stout, edentate. Length, $3\frac{1}{2}$ mm.

Hab.—Queensland: Coen River (H. Hacker).

Allied to *B. leucospila*, but with the markings somewhat different, and prothoracic punctures much smaller. This and the following species belong to the fifth group of the genus (as defined in Trans. Roy. Soc. S. Aust., 1906, p.84).

Baris longicollis, n.sp.

Black, shining. White scales condensed to form a stripe on each side of prothorax, two interrupted fasciæ on elytra (one at base, the other beyond the middle), and a spot near each eye, and another on each side of metasternum; elsewhere sparsely clothed or glabrous.

Head and rostrum much as in preceding species. *Prothorax* slightly longer than wide, sides almost regularly diminishing in width from base to apex; with dense punctures of moderate size. *Elytra* with outlines and striæ as in preceding species; punctures of moderate size or rather small. *Prosternum*, pygidium, and *femora* as in preceding species. Length, 4 mm.

Hab.—Queensland: Cairns (J. A. Anderson).

Allied to the preceding species, but the prothorax decidedly longer, and the white scales on base of elytra not confined to the second interstice. The punctures on the first interstice are in a quite regular row to near the apex; on some of the others, they also form a single row for part of their lengths; but, on most of the interstices, they are irregular, and especially about the base and apex.

Subfamily Cossonides.

Notiosomus xanthorrhϾ, n.sp.

Black, shining; appendages of a dark dingy red, legs sometimes almost black.

Head shining, and with minute punctures at base, elsewhere with dense punctures, not very large but clearly defined; interocular fovea rather small, but deep and distinct. Rostrum rather long, feebly narrowed between antennæ and base, where the punctures are as between eyes, on apical portion somewhat smaller and denser. *Prothorax* somewhat convex, sides rounded and dilated towards, but not to, base; with rather dense, sharply defined punctures of moderate size; median impunctate line not at all, or scarcely, traceable. *Elytra* slightly wider than prothorax at its widest, parallel-sided to apical third; with rows of rather deep punctures, in narrow striæ; interstices wider than striæ, with rows of minute but fairly distinct punctures, becoming denser and larger posteriorly. Length, 5-6 mm.

Hab.—New South Wales : National Park, and Sydney (H. J. Carter, and A. M. Lea).

In general appearance, close to *N. rugosipennis*, but rather more robust and more shiny, head and rostrum with larger and more clearly defined punctures, and the punctures elsewhere generally somewhat larger; interocular fovea larger, and elytra not transversely wrinkled, except to a slight extent near apex. The rostrum is stouter in one sex than in the other. The species occurs in dry flowering-stems of *Xanthorrhœa*.

NOTIOSOMUS MAXIMUS, n.sp.

Black, shining; appendages very obscurely diluted with red.

Head almost impunctate at base; with dense and rather coarse punctures behind eyes, sparser and somewhat smaller, but clearly defined elsewhere; interocular fovea deep and distinct. Rostrum about two-thirds the length of prothorax, slightly curved, feebly dilated from base to apex; basal half with punctures as between eyes, but coarser at sides; in front, somewhat smaller and denser. *Prothorax* about once and one-half as long as greatest width, which is near the base, subapical constriction quite as distinct across middle as on sides; sides with dense and rather coarse punctures, base with very similar punctures, but somewhat smaller and sparser elsewhere; median line not traceable. *Elytra* wider than prothorax, parallel-sided to apical fourth; with rows of deep punctures in narrow striæ; interstices wider than striæ, each with a row of minute punctures, becoming larger posteriorly and crowded about apex. Length, 7 mm.

Hab.—Queensland : Cairns (E. Allen).

Considerably larger than *N. major*, with smaller punctures, rostrum longer and more dilated in front. The front of the prothorax, at first glance, appears to be part of the head, owing to the unusually deep subapical constriction.

APHANOCORYNES SEMIRUFIROSTRIS, n.sp.

Black, somewhat shining, apical half of rostrum, antennæ, and legs reddish.

Head impunctate at base, with small and not very dense, but distinct, punctures elsewhere; interocular fovea very feeble. Rostrum rather wide and somewhat flattened, somewhat narrowed from antennæ to base, almost parallel-sided in front of same; punctures much as on head between eyes, but becoming smaller and denser in front. *Prothorax* flat, sides rather strongly inflated from near apex to near base; punctures slightly stronger than those between eyes, becoming denser on sides; with a vague medio-basal impression, from which a vague impunctate line is traceable to the subapical constriction *Elytra* scarcely wider than widest part of prothorax, parallel-sided to apical fourth; with rows of not very large punctures, in narrow striæ; interstices much wider than striæ, with small punctures and fine transverse impressions. Length, $3\frac{1}{2}$-4 mm.

Hab. – West Australia: Darling Ranges.

In general appearance, close to *Notiosomus rugosipennis*, and with very similar elytral sculpture, but rostrum shorter and wider, abdomen of male more deeply impressed along middle of two basal segments, and apical segment very different. From *A. depressus*, it differs in being smaller, rostrum shorter, with the apical half nearly always paler than the basal half, prothorax less inflated near the base, etc. The elytra appear to be somewhat wrinkled, each of the fine transverse impressions connecting two punctures in adjacent striæ; and there is, usually, one between each of the minute punctures on the interstices, so that these seem to be divided into small squares, each with a central puncture; but, towards the apex, the transverse impressions and fine punctures are more crowded and irregular. The rostrum of the male is somewhat wider than that of the female, and the two basal segments of abdomen are conspicuously impressed along the middle, while the apical one has a conspicuous semidouble fovea. In the female, the basal segments are flat in middle, and the apical one is evenly convex. The species occurs in abundance in dry flowering-stems of species of *Xanthorrhœa.*

Cossonus I-nitidus, n.sp.

Piceous-brown, some parts almost black, appendages paler.

Head with dense, clearly defined punctures; a small interocular fovea, vaguely connected with a longitudinal impression on rostrum. Rostrum wide, between antennæ and base about as long as wide, in front of same suddenly dilated, and distinctly wider than long; with dense punctures, becoming smaller and denser in front. *Prothorax* moderately long, base rather lightly bisinuate, and about one-third wider than apex; with dense, round, and rather large punctures, absent from a distinct median line, but crowded into a depression on each side of middle of base. *Elytra* not much but distinctly wider than prothorax, parallel-sided to apical third: with rows of large, rounded punctures, in moderate striæ; interstices mostly wider than striæ, but towards sides somewhat narrower, with very minute punctures. Length (excluding rostrum), 4 mm.

Hab.—Tasmania: Ulverstone (A. M. Lea).

Allied to *C. coptorhinus*, but differs from the type of that species in being much smaller, narrower, more convex, and prothorax with the depression on each side of the median line (which appears as a long, thin, shining I) vanishing before the apex, and deeper posteriorly. The type is probably immature, as the two basal segments of its abdomen are somewhat castaneous; but the species is a quite distinct one, apart from colour.

Cossonus macilentus, n.sp.

Black, shining; appendages dull red.

Head with small and rather sparse, but clearly defined punctures between eyes, smaller and sparser elsewhere; interocular fovea isolated and rather feeble. Rostrum not twice as long as greatest width, sides strongly incurved behind antennæ, apical portion transverse, and with somewhat denser and stronger punctures than behind antennæ, where they are much the same as between the eyes. *Prothorax* almost twice as long as width of base, sides gently dilated from near apex to beyond the middle, and then more strongly rounded to base; with fairly numerous and rather large, non-confluent punctures, becoming smaller and more crowded on sides. *Elytra* subcylindrical, slightly narrower than greatest width of prothorax, with rows of fairly large, round punctures, becoming smaller posteriorly; interstices with sparse and very minute punctures. Length, $3\frac{1}{4}$-$3\frac{3}{4}$ mm.

Hab.—Queensland: Cairns (E. Allen and J. A. Anderson).

The smallest and narrowest species of the genus known from Australia. The largest punctures on the elytra are somewhat smaller than the median ones on the prothorax.

COSSONUS FRENCHI, n.sp.

Black, shining; appendages dark red.

Head with small but clearly defined punctures; with a small interocular fovea, vaguely connected with a shallow but distinct median line on rostrum. Rostrum about once and one-half as long as greatest width, strongly narrowed behind antennæ, punctures towards base much the same as between eyes, becoming denser on sides and in front. *Prothorax* somewhat depressed, about one-fourth longer than greatest width, base rather strongly bisinuate, and almost twice the width of apex, sides rounded and increasing in width from near apex to near base; with numerous rather large punctures, becoming dense and smaller, but still fairly large, on sides, and minute at apex. *Elytra* subcylindrical, no wider than widest portion of prothorax, with rows of large punctures, becoming much smaller before middle; interstices with minute punctures. Length, $4\frac{1}{4}$-$5\frac{1}{2}$ mm.

Hab.—Queensland.

Distinguished from *C. coptorhinus* by the absence of a distinct impression along each side of the median line; from the other black Australian species, readily distinguished by the grooved rostrum, and prothorax without a triangular basal impression. The prothoracic punctures are somewhat as on the preceding species, except that an impunctate space can usually be traced along the middle, On each side of the base, a narrow space (usually concealed by the elytra) is irregularly crowded with small punctures. On the elytra, the punctures about the basal fourth are almost, or quite, as wide as the interstices, but they rapidly become smaller. Numerous specimens were taken by Mr. C. French (Jr.) on Queensland logs in Melbourne.

COSSONUS POROSTERNUS, n.sp.

Black, shining; appendages dark red.

Head with small and not very numerous punctures between eyes, elsewhere highly polished and impunctate; with a small, narrow, isolated, interocular fovea. Rostrum more than twice as long as greatest width, rather strongly narrowed behind antennæ, where the punctures along the middle are as those between eyes, but denser and coarser on sides; in front of antennæ about as long as wide, with the sides lightly incurved, punctures more numerous but smaller than along middle. *Prothorax* not much longer than greatest width, sides rounded, base rather strongly bisinuate, and almost twice the width of apex, sides with dense and fairly large punctures, sides of disc with small and sparse punctures, along middle with some large punctures becoming crowded and irregular on a subtriangular, basal, depressed space, but middle of the triangle irregularly elevated. *Elytra* moderately convex, just perceptibly wider than widest portion of prothorax; with rows of large, round punctures, becoming smaller posteriorly; interstices with sparse and very minute punctures. *Prosternum* and mesosternum with dense and large punctures. Length, $4\frac{1}{4}$-$4\frac{3}{4}$ mm.

Hab.—Queensland : Cairns (E. Allen).

In general appearance, close to *C. excavatus* (for some cotypes of which, I am indebted to Dr. Gestro), but differs in being slightly smaller, prothorax with larger punctures about sides, and the rostrum much thinner, with much smaller punctures, and the interocular fovea without a frontal extension. *C. incisus* has the prothorax with much coarser punctures, and the median impression of very different shape. The rostrum is narrower than in most species of the genus. The legs and antennæ are sometimes so dark that they appear to be almost black.

COSSONUS COPTORHINUS, nom.nov.

I have to propose this name as a substitute for *C. impressifrons* Lea,* that name having been previously used for an American species of the genus.†

Family CHRYSOMELIDÆ.

CRYPTOCEPHALUS ALBOPICTUS, n.sp. (Plate lxxvi., fig.7).

♀. Black, elytra deep violet-blue; a spot on face, apex, and sides of prothorax, and a spot on each side of base, most of scutellum, a transverse subapical spot on each elytron, basal segment of abdomen, and sides of the others, hind femora, sixth and seventh joints of antennæ, and bases of third, fourth, fifth and eighth, white or whitish.

Head with dense punctures, in places mixed with striæ. Antennæ long; second, third, and fourth joints wide, and each longer than the others. *Prothorax* strongly convex; with distinct, irregularly distributed punctures. *Scutellum* slightly wider than long, apex rounded, base notched. *Elytra* oblong; with dense punctures, becoming crowded towards sides, and very small posteriorly. *Sterna* densely and rather coarsely punctured; middle of mesosternum with small punctures, and transversely strigose. Apical segment of abdomen with a large, round, circular fovea. Length, $6\frac{1}{4}$ mm.

Hab.—Victoria: Portland (H. W. Davey).

The intercoxal process of the prosternum is subtriangularly dilated at the apex, as in several species of *Loxopleurus*; but the species is so different, in general appearance, from the others of that genus, and so obviously allied to *C. cœlestis*, with which it would be associated in my Table, that it has been referred to the genus of the latter. It is an extremely distinct species, unlikely to be confused with any previously described one, and is one of Mr. Davey's finest captures.

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* Proc. Linn. Soc. N. S. Wales, 1896, p.318.

† Bohem., Sch. Gen. Curc., iv., p.1001.

CRYPTOCEPHALUS QUADRATIPENNIS Lea, var. (Plate lxxvi., fig.8).

Mr. Cox has taken a pair of this species at Gosford, N.S.W., that differ considerably in colour from the type. The female is almost entirely of a dingy flavous, with parts of the sterna and legs, and the elytral punctures infuscated. The male is of a shining black, with parts of the base of prothorax flavous, and a flavous sub-basal fascia on elytra, not quite touching the sides or suture.

EXPLANATION OF PLATE LXXVI.

Fig. 1.—*Homolamprima crenulata* Macl.
Fig. 2.—*Rhyssonotus grandis* Lea.
Fig. 3.—*Rhyssonotus grandis* Lea; side view of head of same.
Fig. 4.—*Rhyssonotus grandis* Lea; front tibia of same.
Fig. 5.—*Hypattalus trianguliferus* Lea.
Fig. 6 —*Meripherinus fimbriatus* Lea.
Fig. 7.—*Cryptocephalus albopictus* Lea.
Fig. 8.—*Cryptocephalus quadratipennis* Lea, var.

STUDIES ON AUSTRALIAN MOLLUSCA. Part XII.

By C. Hedley, F.L.S.

(Plates lxxvii.-lxxxv.)

(Continued from Vol. xxxviii., p.339.)

Leda dasea, sp.nov.

(Plate lxxviii., figs.7, 8, 9.)

Shell rather solid, inflated, trapezoid-ovate, rostrum short and upturned. Sculpture: the entire shell is over-run by fine spaced threads, concentric in early youth. These become oblique in later life, are generally insinuate on the median line, and more abruptly so at the base of the rostrum. Teeth, about twelve on the posterior side, and twenty anteriorly. Shell drawn, 6·2 long, 4 high; depth of single valve 2 mm. Another specimen, length 8, height 5; depth of single valve 2·5 mm.

Hab.—I found a few specimens in 1903, on the beach at Karumba, mouth of the Norman River, Gulf of Carpentaria, Queensland.

This is somewhat the size and shape of *L. verconis* Tate, from which it is readily distinguished by the oblique sculpture and blunt rostrum.

It is worth mentioning here, that the name of *Leda inopinata*, bestowed on a recent Sydney shell in the "Challenger" Report, was lately repeated for a French Tertiary fossil by Mr. Cossmann.* Also that *Leda ramsayi*, another Sydney species discovered by the "Challenger" Expedition, was reported as a Pliocene fossil from Japan by Mr. Yokoyama.†

Leda electilis, sp.nov.

(Plate lxxviii., figs. 10, 11.)

Shell rather solid, inflated, nearly equilateral, elongate with a spout-like rostrum. Colour uniform pale buff. Beak prominent.

* Cossmann, Bull. Soc. Nantes, ser.2., v., 1908, p.189.

† Yokoyama, Journ. College Science, Tokyo, xxxii., 1911, p.6.

Posterior area large, margined by a ridge radiating from the umbones to the extremity. Lunule narrow, defined by a groove. Posterior dorsal margin excavate, anterior dorsal margin convex, ventral margin gently curved, posteriorly acuminate, anteriorly rounded. Sculptured with close concentric cords, except along the rostrum where there is a smooth ray. Teeth small, about twenty on the anterior side, and sixteen on the posterior. Specimen figured is, in length, 8; height, 4; depth of single valve, 1·7 mm. Another specimen, length, 12; height, 6; depth of single valve, 1·7 mm.

Hab. —Van Dieman's Inlet, 5 fathoms(type), and off the Horsey River, 5 fathoms, mud. Both places in the Gulf of Carpentaria, self, 1903.

This species has a general resemblance to *L. novæguineensis* Smith, but is narrower, more sharply sculptured, and wants the smooth submedian ray. *L. mauritiana* Sowerby, is more inflated, and taller in proportion to length.

LEDA NARTHECIA, sp.nov.

(Plate lxxviii., figs.12, 13, 14.)

Shell rather solid, slightly inequilateral, ovate-acuminate, inflated. Dorsal margin straight, ventral margin curved, posteriorly pointed, anteriorly rounded. Colour lavender-grey dorsally, shading to cream-buff ventrally. Sculpture none, surface very smooth and glossy with an iridescent sheen. Rostrum, lunule, and posterior area not well defined. Beaks full and prominent. Teeth about eighteen on each side. Length, 10·3; height, 6; depth of single valve, 2 mm.

Hab.—In mud, 5 fathoms, off Horsey River, Gulf of Carpentaria, several specimens (self, 1903).

POROLEDA SPATHULA, sp.nov.

(Plate lxxviii., figs.17, 18.)

Leda ensicula Hedley, Mem. Aust. Mus., iv., 1902, p.293, f.41 (not of Angas).

It was kindly explained to me by Mr. Hugh Fulton, that I had fallen into error regarding *Leda ensicula* Angas. The shell which I had so identified is, as he explained, "flatter, more narrowly elongate, with the rostrum much less acute." By the study of an authentic example of *L. ensicula* with which Mr. Fulton favoured me, I am led to the conclusion that the genuine *L. ensicula* is an absolute synonym of *L. lefroyi* Beddome, as Tate and May had already declared it to be. Beddome's name is, consequently, obliterated by priority. For contrast, the authentic specimen of *L. ensicula* referred to is here illustrated (Pl. lxxviii., figs.15, 16); it is 11 mm. long, and 4·5 mm. high, and is labelled as from Port Jackson. I have also seen the species from 63-75 fathoms, off Port Kembla, N. S. Wales, and from the Derwent Estuary, Tasmania.

The species left unnamed is here introduced as *Poroleda spathula;* the type figured is 14 mm. long, and 4·5 high.

I have also taken it outside Sydney Heads, in 80, and in 300 fathoms; and in 40 and 100 fathoms, off Cape Borda, South Australia.

ARCA STRABO, sp.nov.

(Plate lxxviii., figs.19, 20.)

Shell small, solid, obliquely produced posteriorly, very inequilateral, inflated, hinge-line straight, anterior end narrow, rounded, posterior broad and obliquely truncated Epidermis dense, split into long imbricating strips, which conceal the margin Sculpture: low, broad, concentric ridges parting narrow furrows, and traversed by radiate plications. Umbos approximating, prominent, inflated, situated at about one-quarter of the length from the anterior end. Ligamental area very narrow. Hinge with a median toothless space, anteriorly four short irregular teeth, posteriorly about eight narrow, much inclined, elongate teeth. Inner margin of valve smooth, within the pallial line radially scored. Length, 11; height, 6; depth of single valve, 3 mm.

Hab.—Several specimens dredged by self, 1913, from 100 fathoms, north-east of Port Macquarie, N.S.W.(type); and again 111 fathoms, east of Cape Byron, by Mr. G. H. Halligan.

This species belongs to the section *Cucullaria* Conrad, the other recent members of which are *A. sagrinata* Dall, from the West Indies, and the Japanese *A. dalli* Smith.

CRATIS, gen.nov.

A new genus which, in youth, resembles *Philobrya* by crenulated hinge and prodissoconch cap, but, in maturity, approaches *Limarca** by cuboid form, reticulate sculpture, and massive divaricate cardinal teeth. Type *C. progressa*, n.sp. Another species is *Philobrya cuboides* Verco.

CRATIS PROGRESSA, sp.nov.

(Plate lxxix., figs.21, 22, 23.)

Shell inequilateral, rather solid, oblong, inflated, becoming less symmetrical with age. Anterior margin straight, square to the hinge-line, ventral and posterior margins rounded. Prodissoconch hat-shaped, with a broad free rim and a central raised boss. Chondrophore broad, central to the prodissoconch. Primary crenulated teeth evanescent, secondary teeth developed as two massive perpendiculars on the anterior side, and three inclined on the posterior. Medially, the inner margin of the valve is smooth, on either side are half a dozen interlocking tubercles. Height, 4; length, 3·2; depth of single valve, 1·3 mm.

Hab.—100 fathoms, north-east of Port Macquarie, N.S.W. (self, 1913).

This species has assumed a secondary dentition, while the primary or crenulated teeth are in process of disappearing. In the characters, by which it recedes from typical *Philobrya*, it is related to *P. cuboides* Verco.† That South Australian species differs by a smaller prodissoconch, less height in proportion to length, and a smaller size.

MODIOLA PULEX Lamarck.

(Plate lxxix., fig.24.)

In the previous number of this series (*antea*, xxxviii., p.265), the identity of *M. pulex* Lamarck, and *M. crassus* Tenison-Woods, was noted. When that paragraph was written, it was too late to provide an illustration of this unfigured species. The

* *Limarca* Tate, type *L. angustifrons*, a Tertiary fossil, Trans. Roy. Soc. S.A., vii., 1885, p.135, Pl. viii., f.5. There is a resemblance between this figure and that of *Limopsis antillensis* Dall, Bull. Mus. Comp. Zool., xii., 1886, Pl. viii., f.7.

† Verco, Trans. Roy. Soc. S.A., xxxi., 1907, p. 223, Pl. xxviii., f.5-9.

present drawing is of a specimen 23 mm. long, collected by Mr. W. L. May, at Fredrick Henry Bay, Tasmania, and submitted to the Geneva Museum.

In places on the Tasmanian coast, *M. pulex* encrusts the rocks so thickly that the stones appear as if painted black. Though not yet recorded, it will probably be found to reach the southern coast of New South Wales. On further consideration, I would unite *M. ater** as well as *M. crassus* to the synonymy of *M. pulex*.

CODAKIA PISIDIUM Dunker.

(Plate lxxix., figs.25, 26, 27, 28.)

Lucina pisidium Dunker, Malak. Blatt., vi., 1860, p.227; *Id.*, Moll. Jap., 1861, p.28, Pl.3, f.9.

This species was recorded from Sydney by Angas† as *Lucina parvula* Gould. Though not uncommon, the species is not well known, for the only figure published is poor, and not easily accessible. Figures of a Sydney specimen, 5 mm. long and the same high, are, therefore, here presented.

JOANNISIELLA SUBQUADRATA, sp.nov.

(Plate lxxx., figs.33, 34, 35, 36.)

Shell subquadrate, rather thin, much inflated, slightly excavate on the posterior side, which is bounded by an obscure angle, posterior margin truncate, anterior rounded, ventral straight, dorsal curved. Colour olive-buff. Sculpture fine, close, concentric threads. Umbo prominent, incurved. Two cardinal teeth in each valve. Length, 25; height, 23; depth of single valve, 9 mm.

Hab.—A few separate valves from the beach at Karumba, Gulf of Carpentaria (self, 1903). This is a deeper, squarer shell than *J. oblonga* Hanley, and is somewhat of the same proportions as *J. sphæricula* Desh., than which it is larger and more solid.

CYAMIOMACTRA BALAUSTINA Gould.

(Plate lxxvii., figs.2, 3.)

In the preceding volume (p.268), it was noted that my *C. nitida* was synonymous with Gould's species. Figures of the

* Dunker & Zelebor, Verhandl. Zool. Bot. Gesell. Wien, xvi., 1866, p.914.

† Angas, Proc. Zool. Soc., 1867, p.926.

type in the National Museum, Washington, kindly forwarded by Dr. P. Bartsch, are here presented.

Macrocallista sophiæ Angas.

Cytherea sophiæ Angas, Proc. Zool. Soc., 1877, p 176, Pl. 26, fig.23.

This species, described from the neighbourhood of Sydney by Mr. G. F. Angas, was afterwards relegated to the synonymy of *Cytherea hebræa* by Mr. E. A. Smith.*

Discussing the Oriental distribution usually assigned to *C. hebræa*, Dr. H. Lynge† notes that certain writers have remarked it "from the West Indies, but these records are due to its having been confounded with *Cytherea varians* Hanley."

The actual type of *Cytherea hebræa* with Lamarck's autograph label is still preserved in the Geneva Museum. On examination, I found this to answer fairly to *C. varians* as expressed by Römer's figs.4, 4*a*, 4*b* (but not 4*c*) of Plate xxviii., of the Venus Monograph, i., 1867, but Lamarck's shell is a little more inflated and a little higher in proportion to length. Whereas the figures given for *C. hebræa* by Sowerby, Thes. Conch., ii., 1851, Pl.cxxxiv., figs.143, 144, 148, are quite different, both in form and colour, from the type.

The conclusion seems to be that Krebs, Mörch, Simpson and Dall were correct in identifying an American species, ranging from Cape Hatteras to Barbadoes, as *C. hebræa;* that *C. varians* is a synonym of that species, and that the Australian shell may resume the name given to it by Angas.

Lepton concentricum Gould.

(Plate lxxvii., fig.1.)

Lepton concentricum Gould, Proc. Bost. Soc. Nat. Hist., viii., 1861, p.33; *Id.*, Tenison-Woods, These Proceedings, ii., 1878, p.260.

An illustration of this hitherto unfigured species, from the type in the National Museum, Washington, is here supplied by the

* Smith, Chall. Zool., xiii., 1885, p.138.

† Lynge, D., Kgl. Danske Vidensk. Selks. Skrifter, 7 ser., Vol. v., 1909, p.131.

courtesy of Dr. P. Bartsch. I have not yet recognised the species among the fauna of New South Wales; possibly it is exotic. When I saw a single valve, which constitutes the type, I was reminded of *Mysella anomala* Angas. But on comparison of actual specimens by Dr. Bartsch, it proved different.

NEOLEPTON NOVACAMBRICA, sp.nov.

(Plate lxxix., figs.29, 30, 31, 32.)

Shell small, thin, rounded, rather longer than high, glossy and smooth. Colour white. Faint concentric sculpture. Umbo tumid, prominent. In the left valve, a small posterior and a central arched cardinal with a long thickened anterior limb. In the right, a prominent bifid anterior, and a smaller, simple, posterior cardinal. Height, 2·0; length, 2·2; depth of single valve, 0·6 mm.

Hab.—80 fathoms, 22 miles east of Narrabeen, N.S.W. Numerous specimens.

This is related to *Neolepton antipodum* Filhol,* from New Zealand, which is much larger, more solid, and boldly concentrically sculptured.

ERYCINA HELMSI, sp.nov.

(Plate lxxx., figs.37, 38, 39.)

Shell small, ovate, rather solid and inflated, slightly inequivalve, inequilateral, produced anteriorly, posteriorly and ventrally rounded, umbo prominent. Hinge more developed in the right valve, a minute subumbonal cardinal, and a well developed anterior and posterior lateral in each valve The chondrophore is oblique, and is elongate interiorly and posteriorly. Muscle-scars distinct. Colour buff with irregular purple rays which may coalesce to the exclusion of the ground-colour. Length, 2·5; height, 2·1; depth of single valve, 0·8 mm.

Hab.—Specimens were taken by the veteran conchologist, to whom the species is dedicated, Mr. Richard Helms,† on the *Zostera*-beds at Deewhy Lagoon, N.S.W., in association with

* Hedley, Trans. N.Z. Inst., xxxviii., 1906, p.73, Pl. i., fig.5.

† Since this was written, Mr. Helms died, July 17th, 1914, in his 72nd year.

Potamopyrgus ruppiæ, etc. Twenty years ago, Mr. J. H. Gatliff gave me specimens of this, under another name, from Port Melbourne, Victoria.

LASÆA AUSTRALIS Lamarck.

Cyclas australis Lamarck, Anim. s. vert., v., 1818, p.560; *Pisidium australe* Smith, Journ. Linn. Soc., Zool., xvi., 1881, p.306; *Poronia purpurascens* Deshayes, Tr. elem. Conchyl., i., 1843-50, p.740, Pl. xiv. bis, figs.16-19 ; *Amphidesma nucleola* Lamarck, Anim. s. vert., v., 1818, p.493(*fide* Récluz, Rev. Zool. Soc. Cuv., vii., 1844, p.328); *Poronia rugosa* Récluz, Journ. de Conch., iv., 1853, p.50, Pl. ii., figs.4, 5; *Poronia scalaris*, *P. parreysii*, and *P. purpurata* Philippi, Zeit. für Malak., iv., 1847, p.72; Smith, Proc. Malac. Soc., iii., 1898, p.23; Gatliff & Gabriel, Vict. Nat., xxxi., 1914, p.84; *Poronia australis* Souverbie, Journ. de Conch , xi., 1863, p.287, Pl. xii., fig.8; *Id.*, Lamy, Bull. du Mus. d'Hist. nat., 1913, p.466.

An interesting review of this species has lately been published by Dr. Ed. Lamy. As his paper may not be readily accessible to Australian conchologists, a summary of it is here offered.

The types of *Cyclas australis*, labelled by Lamarck, and collected by Péron at Timor and King George's Sound, W.A., are preserved in the Natural History Museum of Paris. It is not a fluviatile form, as the name would suggest, but a *Lasæa*, closely related to the European *L. rubra*.

Amphidesma nucleola Lamarck, stated by its author to be a native of the coast of France, is, on the contrary, affirmed by Récluz to be identical with *C. australis*. As the type of that is no longer extant, and as there is some doubt as to its authenticity, and as the name has only page-precedence, not priority, over *C. australis*, it will be safest to disregard it.

Dr. Lamy recommends that the name of *australis* Lamarck, be reserved for the larger and smoother form, and that the smaller variety, with strong concentric sculpture, be named *scalaris* Philippi, 1847 (= *rugosa* Récluz, 1853).

Authorities are divided as to whether the Australian species is identical with, or distinct from, the European. Dr. Dall* has

* Dall, Trans. Wagn. Free Inst. Sci., iii., 1900, p.1163.

arranged the genus as having one member in the northern hemisphere and another in the southern.

EUMONTROUZIERA.

Eumontrouziera, nom.mut. for *Montrouziera* Souverbie, Journ. de Conch., xi., 1863, p.282, Pl xii., fig.5; *Id.*, Hedley, Rec. Austr. Mus., viii., 1912, p.135; *Id.*, Iredale, Proc. Malac. Soc., xi , 1914, p.175; not *Montrouziera* Bigot, Ann. Soc. Ent. France, (3), viii., 1860, p.224.

It was recently pointed out by Iredale, that the name of *Montrouziera* cannot be maintained for the shell, because it was previously appropriated in entomology. My friend invited me to make the necessary correction, and, in accepting this privilege, I desire to maintain a cherished link between this heroic traveller and the science he loved so well. To that end I now propose "*Eumontrouziera.*"

So little has appeared in conchological literature about this remarkable man, that I would take this opportunity to offer a few notes on his career.

Xavier Montrouzier was born at Montpellier, in France, on December 3rd, 1820, and died in his 77th year, at St. Louis, New Caledonia, on May 16th, 1897.

After a brilliant collegiate career, he commenced scientific study in Paris under the celebrated philosopher, Marcel de Serres. From this he withdrew to take up missionary work. In 1844, he was dispatched to Woodlark Island, as one of a pioneering party organised by the Marist Society for service in Melanesia. This party suffered dreadfully; their leader was killed and eaten, whilst Montrouzier himself carried the mark of a spear-thrust to his grave. After most of them had either died of fever or been massacred by cannibals, the remnant was withdrawn.

Even under these difficulties, he found means to gather and publish notes on the Entomology, Ichthyology, Conchology, and Ornithology of Woodlark Island.

In 1846, he was transferred to the healthier, but not less dangerous, post of Balade in New Caledonia, in which island he remained for the rest of his life. As a man of strong character and disinterested motives, he soon acquired an ascendency over the native tribes.

In a work, "Marins et Missionaires," it is related that it was the patriotic zeal and intelligence of Montrouzier that enabled the French Admiral Febvrier Despointes to anticipate an English annexation of the Isle of Pines. He also was the first to draw attention to the mineral wealth of the island.

In 1855, he was appointed military chaplain at Noumea, but he resumed his missionary work in 1857, at Belep, in 1858 at Lifou, in 1859 at Kanala, and in 1865 at Paita. Returning to official life, he served, from 1872 to 1875, at the penal settlement of Presqu'ile Ducos and Ile Nou, whence he was transferred to the Military Hospital at Noumea. The burden of increasing age, induced his retirement from active service in 1893. In sunshine, among flowers, he spent his declining years, peacefully and happily at the Monastery of St. Louis. His interest in conchology was a pleasure to the last, so that his end was an agreeable contrast to the dangers and hardships of his early life.

Such courage and endurance as his was not excelled by martyrs of the Colosseum. Like them, he was "in journeyings often, in perils of waters, in perils of robbers, in weariness and painfulness, in watchings often, in hunger and thirst, in fastings often, in cold and nakedness."

He wrote comparatively little for publication, but was content to supply other authors from his great store of knowledge and material. The following French Scientific Societies counted him a member, or published his works in their Proceedings:—Société Orientale; Société Linnéenne de Lyon; Académie Scientifique de Lyon; Société Linnéenne de Bordeaux; Société Impériale d'Agriculture, Histoire Naturelle, et des Arts Utiles de Lyon; Académie Scientifique de Montpellier; Société Entomologique de France; Société d'Anthropologie de Paris; and the Academy of Natural Sciences of Philadelphia. His contributions also appeared in the Revue et Magazin de Zoologie and the Journal de Conchyliologie. Either alone, or with collaborators, he wrote sixteen papers on conchology, two on botany, two on entomology, and one on carcinology, besides several on island faunulas.

PANOPÆA ANGUSTA, sp.nov.

(Plate lxxx., figs.40, 41, 42.)

Shell small, thin, oblong, inflated, gaping at each end, but most anteriorly. Colour white. Anterior side a little shorter than the posterior, rounded at each end, excised antero-ventrally. Dorsal margin rather concave. Beak prominent. Cardinal tooth large and projecting. Sculpture consisting of irregular concentric ridges and furrows. Length, 63; breadth, 35; depth of single valve, 13 mm.

Compared with *P. australis* Sowerby,* the new species is more cylindrical, smaller and thinner. Brazier has recorded† *P. australis* from the Sow and Pigs bank, Port Jackson, but that record was based on *P. angusta*. Imperfect shells from Wreck Bay, N.S.W., indicate that *P. australis* reaches north to this State. Under the name of *P. australis*, Valenciennes has described‡ a South African species, which Woodward renamed *P. natalensis*,§ and Sowerby again renamed *P. attenuata*. An extreme variety of *P. australis* is shown under that name by Sowerby, Pl. vi., fig.11, Panopæa, Conch. Icon., xix., 1873. For this, I now propose the name "*spatiosa*." Sowerby erred in ascribing *P. zelandica* Quoy and Gaimard, to Moreton Bay, Queensland. His *P cancellata*,|| described as Australian, has not been locally recognised. From external appearance, I should consider that the Table Cape fossil, *Lyonsia agnewi* Ten.-Woods,¶ was a *Lutraria* rather than a *Panopæa*, as it is classed by Tate and Pritchard.

Hab.—One right valve (type) collected at Tewantin, Queensland, by Mr. Carl Laseron. One left valve dredged near North Head, Sydney, by Mr. John Brazier.

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* Sowerby, Genera Rec. and Foss. Shells, i., pt.40, 1834, Pl.32, f.2.

† Brazier, Proc. Linn. Soc. N. S. Wales, ii., 1877, p.371.

‡ Valenciennes, Archiv. du Mus., i., 1839, p.3, Pl.3, f.1 ; *Id.*, Conch. Illustr., *Panopæa*, 1843, p.3, Pl.8, 11, 12.

§ Woodward, Proc. Zool. Soc., 1855(1856), p.220 ; Sowerby, Conch. Icon., xix., 1873, Pl. iii.

|| Sowerby, Conch. Icon., xix., 1873, Pl. iv., f.4.

¶ Proc. Roy. Soc. Tasm., 1875, p.25, Pl. iv., fig.13.

SOLECURTUS TENERIOR, sp.nov.

(Plate lxxx., figs.43, 44.)

Shell small, thin, semitransparent, subcylindrical, rounded at each end, straight on the ventral and postero-dorsal margins, compressed medially. Colour uniform pale buff. Epidermis thin, persistent, slightly wrinkled. Surface glossy. Sculpture, fine, concentric, raised threads. Umbos prominent, at one-third of the total length from the anterior end. Within, a raised rounded clavicle extends from the hinge to the antero-ventral margin. The pallial sinus is short. In the left valve are an anterior vertical and a posterior horizontal cardinal. These are clasped in the right valve by two anterior and posterior cardinals respectively. Length, 31; height, 8·5 mm.

Hab.—Plentiful, as dead shells, on the beach near Cardwell, Queensland (type), and again at Cairns (self, 1901 and 1906).

For *Solecurtus*, the value given by Dall as equivalent to *Pharus*,* is here adopted. This genus does not seem to have been previously noted as represented in Australia. Monographers have so regularly omitted to give characters from the interior of the valve, that comparisons with foreign species are difficult. Perhaps *Cultellus vitreus* Dunker,† from Singapore, is related.

MONTFORTIA SUBEMARGINATA Blainville.

Emarginula subemarginata Blainville, Dict. Sci. Nat., xiv., 1819, p.382; *Id.*, Potiez et Michaud, Galerie de Douai, i., 1838, p.519, Pl. xxxvi., figs.13, 14. *Emarginula emarginata* Blainville, Dict. Sci. Nat., xxxii., 1824, p.291, Pl.68, f.3, and Man. Malac., 1825, p.501, Pl.48 bis, f.3; *Id.*, Deshayes, Encycl. Méth., Vers, ii., 1830, p.109, and Anim. s. vert., vii., 1836, p.584; *Id.*, Rang, Man. Moll., 1829, p.247; *Id.*, Récluz, Rev. Zool., 1843, p.259; *Id.*, Tenison-Woods, Proc. Roy. Soc. Tasm., 1877, p.44. (Not *E. emarginata* Reeve, Conch. Syst., ii., 1842, p.23, Pl. cxl., f.4). *Subemarginula emarginata* Pritchard and Gatliff, Proc. Roy. Soc. Vic., xv., 1903, p.187. *Emarginula australis* Quoy and Gaimard,

* Dall, Trans. Wagner Inst., iii., 1908, p.958.

† Conch. Icon., xix, 1874, Pl. vi., f.22.

Zool. Astrolabe, iii., 1834, p.328, Pl.68, f.11-14; *Id.*, Angas, Proc. Zool. Soc., 1865, p.185. *Subemarginula australis* Shirley, Proc. Roy. Soc. Q'land, xxiii., 1911, p.96.

In 1819, De Blainville described a shell from the collection of Valenciennes, as *Emarginula subemarginata.* He noted it as an aberrant member of the genus, and, in a subsequent review, formed a section "C" to receive a species, *emarginata*, with the peculiarities of *subemarginata.* That the second name was a substitute for the first, is shown by the reference of its popular equivalent, Emarginule échancrée, in the explanation of Conchological Plates 68, both to Vol. xiv.(*subemarginata*) and Vol. xxxii. (*emarginata*).

Transferring the scheme of classification of *Emarginula* from the Dictionary to the Manual, Blainville bestowed upon section "C" a popular designation, "Les Submarginules." His arrangement was copied by Rang. This popular French term has universally, but erroneously, been accepted as the introduction of the generic name "*Subemarginula.*" Actually, Gray* seems to have been the first to give Blainville's coinage a Latin form, in 1847, while Herrmannsen† was perhaps the first to advance it acceptably.

Meanwhile, *Hemitoma* was interposed in correct form by Swainson, in 1840, with *tricostata* Sowerby, as the type.‡ But Scudder stated that *Hemitoma* was anticipated, in 1820, by Rafinesque, for a mollusc. Accepting this statement, which I cannot verify, we proceed to consider the next candidate.

Recognising "Les Subemarginules" "as a very natural group," Récluz proposed, in 1843, "to give this new genus the name of *Montfortia*, in honour of Denis de Montfort." His evident intention was to treat *subemarginata* as the type, and this, if it is necessary, it is now declared to be.

Blainville was unacquainted with the origin of his shell. Adams assigned it to Honduras, and Pilsbry to the Florida Keys

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* Gray, Proc. Zool. Soc., 1847, p.147.

† Herrmannsen, Index Gen. Malac., ii., 1849, p.520.

‡ Swainson, Treatise on Malacology, 1840, p.356.

and St. Thomas.* But Deshayes, who was in a position to know, asserted positively that Blainville's shell was identical with *E. australis*, a native of King George's Sound, W.A. Mr. A. U. Henn has sent it to me from Bunbury. The species is a characteristic Adelaidean form, and is absent from Eastern Australia. Angas recorded it from St. Vincent's and Spencer's Gulfs, under Quoy's name. While, under Blainville's second name, the species was extended to Tasmania by Tenison-Woods, and to Victoria by Pritchard and Gatliff. Dr. Shirley's record of *Subemarginula australis* Q. & G., from Cairns, Queensland, is obviously wrong. The first name has been uniformly overlooked by all writers subsequent to the unquoted notice of Potiez and Michaud.

MONTFORTIA ASPERA Gould.

(Plate lxxvii., fig.4.)

Emarginula aspera Gould, Proc. Bost. Soc. Nat. Hist., ii., 1846, p.154; *Id.*, Am. Expl. Exped., xii., 1852, p.372, Pl.32, f.493,*a*,*b*,*c*.
Emarginula radiata Gould, Proc. Bost. Soc. Nat. Hist., vii., 1859, p.163.

The types of both *E. aspera* and *E. radiata* came from Sydney Harbour, and I think that variability misled Gould into giving to his own species a second name. Angas† recorded this from Sydney as *E. rugosa* Quoy and Gaimard. I have not any West Australian material of *E. rugosa* for comparison. But if the figures of that in the Astrolabe Atlas are trustworthy, Gould was correct in saying that *E. aspera* had a groove and notch more deeply cleft than that of *E. rugosa.* So few beach-shells range unchanged from Sydney to King George's Sound, that it seems prudent to hold *E. aspera* apart from *E. rugosa* till they can be satisfactorily identified.

On this coast, *M. aspera* is a common shell between tidemarks. In colour and elevation, it is quite variable. The number of prominent ribs increases with age; these are roughened by projecting scales. The size is greater than the records in-

* Adams, Proc. Zool. Soc., 1851(1852), p.89; Pilsbry, Man. Conch., xii., 1890, p.276.

† Angas, Proc. Zool. Soc., 1867, p.219.

dicate; an example I gathered at Byron Bay, N.S.W., is 22 mm. long, 18 broad, and 12 high.

The type of *E. radiata* Gould, is here figured from an excellent drawing of the type in the Smithsonian Institution, kindly communicated by Dr. P. Bartsch. It is improbable that Pilsbry was correct in uniting the Sydney species to one from Fiji,* which might be *M. cratita* A. Adams.

Gibbula strangei A. Adams.
(Plate lxxxi., fig.45.)

Monodonta strangei A. Adams, Proc. Zool. Soc., 1851 (1853), p.177; *Gibbula strangei* Angas, Proc. Zool. Soc., 1867, p.217; *Id.*, Fischer, Coq. Viv., 1878, p.329, Pl.102, f.3; *Id.*, Shirley, Proc. Roy. Soc. Q'land, xxiii., 1911, p.96; *Gibbula dacostana* Preston, Proc. Malac. Soc., viii., 1909, p.377, text-fig.

A specimen collected at Caloundra, Queensland, by Mr. Tom Iredale, and identified by him with the type of *G. dacostana* in the British Museum, is here illustrated. I should unite this to the prior *G. strangei*, specimens of which from Queensland only differ from Sydney examples by being rather smaller.

Solariellopsis glyptus Watson.

Trochus (*Gibbula*) *glyptus* Watson, Journ. Linn. Soc., xiv., 1879, p.694; *Id.*, Chall. Rep. Zool., xv., p.75, Pl. vi., fig.6; *Astele glyptus* Hedley & Petterd, Rec. Austr. Mus., vi., 1906, p.213.

Watson's species was not happily placed in *Gibbula*, and it is now suggested that it may be properly transferred to *Solariellopsis*.† This agrees with *Turcicula* in form and sculpture, but differs from it in being umbilicate. In the South Kensington Museum are two specimens, types, obtained in 410 fathoms off Sydney by the "Challenger." Mr. Petterd and I, about thirty years afterwards, dredged two more in 300 fathoms off Sydney.

Tallorbis ampullus Tate.

Euchelus ampullus Tate, Trans. Roy. Soc. S.A., xvii., 1893, p.197, Pl. ii., f.5; *Id.*, Shirley, Proc. Roy. Soc. Q'land, xxiv., 1913, p.55.

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* Pilsbry, Man. Conch., xii., 1890, p.280.

† Schepman, Siboga Exped. Zool., xlix*a*, 1908, p.53.

This species has not been recorded from this State, but ranges as far south as Sydney. It was collected at the Redbank River by Mr. J. Brazier, and at Woolgoolga by Mr. C. Laseron. Dr. Shirley notes it from Caloundra, Queensland, whence he had previously misidentified it as *Euchelus mysticus* Pilsbry.*

By its author, the species was referred to Pilsbry's *Hybochelus*, but that seems to me synonymous with the prior *Tallorbis*,† a name so obscure as to have been omitted from all zoological indices. The type-species of *Tallorbis*, *T. roseolus* G. and H. Nevill, has been recorded by myself from Masthead Id.,(*antea*, xxxii., p.479) under the later name of *Euchelus lamberti* Souverbie.‡ This also occurs at Lord Howe Island.

A third Australian *Tallorbis* is *T. cancellatus* Krauss, recorded from Port Curtis and Torres Straits by Mr. E. A. Smith.§ This seems to me to be a synonym of the later *Euchelus fossulatus* Souverbie.||

ALCYNA EXIGUA Gould.

(Plate lxxvii., fig.5.)

Last year (xxxviii., p.278) it was explained that *Elenchus exiguus* Gould, was really an *Alcyna*, and was erroneously reported from Sydney. By the courtesy of Dr. P. Bartsch, I am now able to offer a figure of the type in the National Museum, Washington.

LIOTIA BOTANICA, sp.nov.

(Plate lxxxi., figs.46, 47, 48.)

Liotia clathrata Angas, Proc. Zool. Soc , 1871, p.96; *Id.*, Tate, Trans. Roy. Soc. S.A., xxiii., 1899, p.227; *Id.*, Kesteven, Proc. Linn. Soc. N. S. Wales, xxvi., 1902, p.714 ; (not *Delphinula clathrata* Reeve, Conch. Icon., i., 1843, Pl. v., f.21).

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* Shirley, Proc. Roy. Soc. Q'land, xxiii., 1911, p.96.

† G. and H. Nevill, Journ. Asiat. Soc. Bengal, xxxviii., 1869, Pt. ii., p. 160, Pl. xvii., f.5.

‡ Souverbie, Journ. de Conch., xxiii., 1875, p.37, Pl. iv., f.4; *op. cit.*, xxvi., 1878, p.210.

§ Smith, Zool. Coll. Alert, 1884, p.76.

|| Souverbie, Journ. de Conch., xxiii., 1875, p.39, Pl. iv., f.5 ; *op. cit.*, xxiv., 1876, p.151.

Shell solid, subdiscoidal, convex above. Colour cream. Whorls four and one-half, rather loosely coiled, rounded; the last increases rapidly, slightly ascends, and then suddenly descends to its termination. Sculpture: the whole shell is beautifully and delicately cancellated. There are seven spiral cords, two on the shoulder, three on the periphery, one at the margin of the umbilicus and one within it. The upper pair ascend the spire, the lowest peripheral is stronger than the rest. On the last whorl, there are about twenty radials; these ascend the spire, projecting like spokes over the suture. Arising in the sutural trench, they are dormant on the shoulder, are strongly expressed on the periphery, again fade on the base, but revive in the umbilicus, where they project far into the cavity. At the intersection of the spirals, they form polished knots. A secondary sculpture of fine radial laminæ overruns the whole shell. Aperture circular, oblique, guarded by a broad outstanding varix. Umbilicus broad and perspective. Height, 5; maj. diam., 7; min. diam., 4·5 mm.

Following the determination of Angas, this has been locally known as *L. clathrata* Reeve. But Mr. H. B. Preston, whom I asked to compare the Sydney shell with the type of the reputed Philippine *L. clathrata*, reported that the two are distinct, that "*L. clathrata* has not got the clathrate umbilicus" of the Australian shell. I, therefore, introduce it as a new species. The nearest relations are, perhaps, *L. tasmanica* Ten.-Woods, and *L. subquadrata* Ten.-Woods, which lack the radial sculpture of *L. botanica*.

Hab.—Common around Sydney.

CHARISMA, gen.nov.

A new genus related to *Liotia*, but without a varix to the outer lip, few-whorled, spirally sculptured, umbilicus with an internal funicle. Operculum corneous, concave, multispiral, with a spiral frilled lamella. Type, *C. compacta*.

Another member of this genus is *C. josephi* Tenison-Woods, originally described as a *Cyclostrema*, transferred, in 1901, by Tate and May to *Collonia*; in 1902, by Pritchard and Gatliff, to

Leptothyra; and, in 1908, by Hedley and May, to *Liotia*. In shell-characters, it is somewhat like *Leptothyra*, from which the operculum immediately and widely separates it. *Isanda* is perhaps related.

CHARISMA COMPACTA, sp.nov.

(Plate lxxxi., fig.49.)

Shell small, solid, turbinate. Colour pale cream. Whorls four, rather loosely coiled, separated by channelled sutures. Spire-whorls smooth, body-whorl sculptured by about twenty regularly spaced, sharp, spiral grooves. Umbilicus about one-eighth of the shell's diameter, its margin smooth and rounded, the aperture-side with an obscure funicle. Aperture descending, circular, inner lip slightly expanded, outer lip simple. Height, 1·9; maj. diam., 2; minor diam., 1·7 mm.

Hab.—100 fathoms, north-east of Port Macquarie (self).

Compared with *Cyclostrema josephi* Tenison-Woods,* the novelty is much smaller, more widely umbilicate, comparatively shorter and broader.

ACMÆA INRADIATA Reeve.

Patella inradiata Reeve, Conch. Icon., viii., 1855, Pl. xxix., figs.77*a*, *b*; *Nacella inradiata* Pilsbry, Man. Conch., xiii., 1891, p.120, Pl. 20, figs.43, 44. *Acmæa crucis* Ten.-Woods, Proc. Roy. Soc. Tasm., 1876 (1877), p.52, 1877, p.44 : May, *op. cit.*, 1902, p.113.

Mr. Tom Iredale writes to me that "*Patella inradiata* (Reeve, Conch. Icon, f.77, 1855) is identical with *Acmæa crucis* Ten.-Woods. Reeve gave no habitat, but the type-tablet in the British Museum is now marked "Tasmania."

Tate and May (*antea*, xxvii., 1901, p.411) reduced *A. crucis* to a synonym of *A. cruciata* Linn., and *A. flammea*, Quoy & Gaimard. Mr. May notes that the type of Ten.-Wood's species is in the Tasmanian Museum, but there are also, in the Australian Museum, two specimens presented by Tenison-Woods, and labelled "type *Acmæa crucis* Tenison-Woods," in his own handwriting.

* These Proceedings, xxvi., 1900, p.400, f.10.

ACMÆA MIXTA Reeve.

Patelloidea flammea Quoy & Gaimard, Zool. Astrolabe, iii., 1834, p.354, Pl. xxi., figs. 15, 16, 21, 22; *Patella jacksoniensis* Reeve, Conch. Icon., viii., 1855, Pl. xxxix., fig.127*a, b*; (not *Patella jacksoniensis* Lesson, Voy. Coquille, ii., 1830, p.418); *Patella mixta* Reeve, *op. cit.*, Pl. xxxix., fig.129, *a, b*.

Patelloidea flammea Quoy & Gaimard, is a compound of two species, one of which occurred on the beach at Hobart, and the other at the island of Guam, in the Ladrone Archipelago. Apparently figs.15, 16, 21, and 22 with a subcentral apex, represent the Tasmanian form, but the other figures, 17, 18, 19, 20, with an anterior apex, relate to the Guam species.

As the Tasmanian has other names, while the Guam species has not, it will be proper to leave the name *flammea* for the Ladrone shell, and employ one of the alternatives for the Hobart species. Apparently *Patella jacksoniensis* and *P. mixta* stand next in order, but as the former is disqualified by *P. jacksoniensis* Lesson, the adoption of *A. mixta* is recommended.

ACMÆA MUFRIA, sp.nov.

(Plate lxxxi., figs.50, 51, 52.)

Shell rather solid, variable in form, usually elevated and narrow, about as high as broad, and twice as long, the apex in advance of the centre. Colour buff, irregularly rayed with brown, usually the apex, interstices of ribs and central interior being brown. Radial ribs varying from twenty to thirty, low and broad, parted by narrow interstices; in youth, the ribs opaque and interstices translucent. Fine concentric threads overrun ribs and interstices. Muscle-scars distinct. Length, 5·5; breadth, 3; and height, 3 mm. Another specimen, length, 8; breadth, 5; and height, 4 mm.

Hab.—In the rough crust of *Galeolaria cæspitosa*, a gregarious annelid, *A. mufria* is common. I have found it dead frequently in shell-sand at Balmoral Beach, Middle Harbour, and at Wreck Bay, N.S.W.

The relatively coarse radials, narrow elevated form and forward apex, part this from the young of *A. mixta* Reeve.

HELCIONISCUS VARIEGATUS Blainville.

Patella tramoserica Chemnitz, Conch. Cab., xi., 1795, p.179, Pl.197, figs.1912, 1913; *Id.*, Tapparone-Canefri, Zool. Magenta, 1873, p.177; *Id.*, Ten.-Woods, Journ. Roy. Soc. N. S. Wales, xxii., 1888, p.140, Pl.3, f.1, 2, Pl.6, f.8; *Id.*, Pritchard & Gatliff, Proc. Roy. Soc. Vict., xv., 1903, p.191; *Helcioniscus tramosericus* Brazier, These Proceedings, xviii., 1893, p.119; *Id.*, Suter, Proc. Malac. Soc., vi., 1905, p.346; *Id.*, Verco, Trans. Roy. Soc. S.A., xxx., 1906, p.205, and xxxvi., 1912, p.181; *Id.*, Iredale, Trans. N. Z. Inst., xl., 1908, p.380; *Id.*, Shirley, Proc. Roy. Soc. Queensland, xxiii., 1911, p.97. Not *Patella tramoserica* Martyn, Univ. Conch., i., 1784, fig.16; Menke, Moll. Nov. Holland. Spm., 1843, p.33; von Martens, Malak. Blatt., xix., 1872, p.26.

Patella variegata Blainville, Dict. Sci. Nat., xxxviii., 1825, p.100 ; Reeve(?), Conch. Syst., ii., 1842, Pl.136, fig.1. Not *Patella variegata* Reeve, Conch. Icon., viii., 1854, Pl.16, fig.36*a*, *b*, *c* = *eucosmia* Pilsbry, 1891.

Patella jacksoniensis Lesson, Zool. Coquille, ii., 1830, p.418.

Patella diemenensis Philippi, Zeits. f. Malak., 1848, p.162; *Helcioniscus diemenensis* Gatliff & Gabriel, Proc. Roy. Soc. Vict., xxi., 1908, p.382.

Patella antipodum Smith, Zool. Erebus & Terror, 1874, Moll., p.4, Pl. i., f.25; *Helcioniscus antipodum* Suter, Man. N. Z. Moll., 1913, p.79, Pl.7, fig.9.

Patella sp., Maplestone, Month. Microscop. Journ., viii., 1872, p.51, Pl. xxvii., fig.3.

The nomenclature of the common Sydney limpet has been a difficulty to Australian conchologists. Under the name of *Patella tramoserica*, it was excellently figured and described by Chemnitz in 1795, and, until lately, his determination was current.

But unfortunately the original *P. tramoserica*, figured in 1784 by Thomas Martyn, differs widely from the Sydney limpet by being rounder, having the apex more central, fewer bolder ribs, scattered black dots, interior submarginal angle and interior broader, and fewer coloured radials than that of Chemnitz. A minor point is that Martyn misquoted his shell as from North-

West America, where Dr. Dall says it does not exist. Its proper habitat has not yet been recovered.

Deshayes excluded reference to Martyn from the Chemnitzian synonymy, and Menke definitely noted that the species of Martyn was different from that of Chemnitz. Gatliff, Gabriel, and Suter, realising this misuse of Martyn's name, have sought to replace it by one more appropriate. The former advanced *Patella diemenensis* Philippi, an unfigured species, described in 1848 as being common at Hobart. Although Philippi introduced *P. diemenensis*, *P. decora*, and *P. limbata* together, yet he omitted the former when he came to figure the others in the Abbildungen, and possibly doubted that it was a good species. For the New Zealand expression of the so-called *tramoserica*, Suter has accepted *P. antipodum*, proposed in 1874 by Mr. E. A. Smith. In doing so, he is on the firm ground that *antipodum* certainly represents the New Zealand shell.

But prior to Philippi, two names were apparently proposed for the Chemnitzian *tramoserica*, from its original locality, and both writers remarked on the general resemblance it has to the European *P. vulgata*, a remark not applicable to another Australian limpet, thereby fixing its identity satisfactorily. In 1825, Blainville proposed *Patella variegata* for a species from Botany Bay; and, five years later, for a Port Jackson shell, Lesson suggested the name *Patella jacksoniensis*. It is likely that the type of Blainville is preserved in the Museum at Paris, and his name is now recommended for adoption. I agree with Iredale that the New Zealand form is not separable specifically from the Australian. According to Suter, it is rare in New Zealand. Brazier traced it northwards to Moreton Bay. Dr. Verco writes that it becomes small and rare in the Great Australian Bight, and fails to reach Western Australia. Features of the radula are discussed by Tenison-Woods and Maplestone. Brazier, Pritchard and Gatliff gave some references to the literature, which are not here repeated.

It is unlikely that shells so large and conspicuous as *Helcioniscus limbatus* and *Patella neglecta* should have been overlooked by the collectors of Baudin's Expedition. Perhaps study of

Blainville's forgotten species will find among them prior names for these also.

OBTORTIO LUTOSUS, sp.nov.

(Plate lxxxi., fig.53.)

Shell small, subulate. Colour buff, spirally banded with chestnut or varying thence to uniform hazel-brown. Whorls eight, slowly increasing, rounded, parted by impressed sutures. First two whorls smooth, fourth sculptured by four narrow elevated spirals; gradually these increase to fourteen on the last whorl. Sometimes these are overridden by rather irregularly disposed, thin radial lamellæ which decrease upwards, or the radials may be absent. Aperture ovate, outer lip thin, simple. Length, 3·3; breadth, 1·2 mm.

Hab.—Beach, Middle Harbour, Sydney(type), and 5-10 fath. Hope Id., Queensland (self).

This species is close to *O. fulvus* Watson, with which, indeed, it may be found ultimately to intergrade, but the form here described seems to differ constantly and appreciably by being comparatively narrower, with feebler radials or none, and rounder whorls.

PETTERDIANA BRAZIERI Smith.

(Plate lxxxii., fig.55.)

Hydrobia brazieri Smith, Journ. Linn. Soc., Zool., xvi., 1882, p.269, Pl. vii., fig.21 ; *Id.*, Hedley & Musson, Proc. Linn. Soc. N. S. Wales, (2), vi., 1892, p.563; *Amnicola positura* Petterd, Journ. of Conch.. iv., 1884, p.159.

From Eidsvold, Queensland, a series of *P. brazieri* were forwarded by Dr. T. L. Bancroft, one of which is here figured. This is the northernmost point to which the species has yet been traced. In the south, it has been gathered by Mr. C. T. Musson at Bective, N.S.W., and its western limit, so far known, is Narrabri, where Mr. Musson also collected it. This range, from the head-waters of the Burnett to those of the Peel, and eastwards to the Clarence and Richmond, is in remarkable disregard of present watersheds. It may be that this distribution was attained when the drainage-plan was different from what it is now.

CERITHIUM TOMLINI, sp.nov.

(Plate lxxxv., fig.89.)

Since writing a note on *Cerithium novæ-hiberniæ* Adams, (*antea*, xxxviii., p.290) I have benefited by correspondence with Mr. J. R. Le B. Tomlin on the subject.

It appears that, in the first place, the name was never published by Arthur Adams, and should be cited as of Sowerby. Secondly, Sowerby, under this name, figured two species, to either of which his vague description might apply. It will be, therefore, advantageous now to declare the type of *Cerithium novæ-hiberniæ* Sowerby, to be that single shell presented to the South Kensington Museum by H. Harvey from the Hanley Collection, and ticketed with an old label on the underside, reading, "novæ-hiberniæ S., eburneus K." This type is the original of fig.84, Pl. clxxx., of the second volume of the Thesaurus. Thirdly, Mr. Tomlin says that this figure 84 is not a good one, and that the original of it is quite different from any form of *eburneum* Brug., and could not be identified with any other *Cerithium* in the Museum. Finally, that the locality "Florida," now attached to the specimen, was merely added by Mr. Smith from the Thesaurus, and that he does not now regard it as reliable.

The other half (Fig.85) of Sowerby's compound species is a shell from the Cuming Collection, and was apparently the original of fig.68, Plate x., of *Cerithium*, in the Conchological Iconica. This species now finds itself without a name, and is here called after the able conchologist who assisted me to unravel its complicated history.

Cerithium tomlini is related to its associate, *C. nodulosum* Bruguière, from which it differs by smaller size, less massive habit, and more numerous, more compressed tubercles.

Mr. G. F. Harris* and Dr. W. H. Dall† point out that Bruguière, who introduced the genus *Cerithium*, indicated no type among the 45 species assigned to it, that Lamarck exercised the privilege of first reviser in 1799, and instituted *Murex aluco*

* Harris, Cat. Tert. Moll. Austr. Brit. Mus., i., 1897, p.224.
† Dall, Proc. Nat. Sci. Philad., 1907, p.364.

Linn., as the type. Vignal* suggests that if Bruguière had indicated a type, that naturally it would have been *C. adansoni.*

Under *Cerithium*, Tryon's Manual includes the following Australian species now assigned to *Clava*—*aspera* Linn., *bituberculata* Sowerby, *fasciata* Brug., *pulchra* A. Adams, *sinensis* Gmelin, and *vertaga* Linn.; also *laevis* Q. & G., for which the genus *Ceratoptilus* was framed by Bouvier in 1886. The latter, which reaches a length of eight inches, seems the largest living member of the family. Fossil members of *Ceratoptilus* are *C. torrii* Tate, 1899, and *C. triserialis* Basedow, 1902.

The novelty may be defined as follows:—

Shell solid, elongate. Colour white with rusty irregular dots or broken lines. Apex of the spire always eroded, whorls estimated at fourteen. Suture undulating. Sculpture: prominent pointed tubercles set on the periphery at about eight to a whorl, on the base are two (rarely one) spiral rows of small tubercles, while small spiral threads overrun the whorls generally. There is an incipient varix, two-thirds of a whorl behind the mouth Last whorl slightly ascending at the aperture, which is a little oblique, externally reflected, with a gutter at the posterior corner. Inner lip well developed, canal short and broad. Length, 32; breadth, 12 mm.

Hab.—The individual figured was collected by myself at Green Island, near Cairns. Dr. A. E. Finckh took the species at Lizard Island, and a small variety only 23 mm. long, occurred to me at Murray Island, Torres Straits.

BITTIUM GRANARIUM Kiener.

(Plate lxxvii., fig.6.)

Cerithium granarium Kiener, Coq. Viv., 1842, p.72, Pl.19, fig.5; *C. lacertinum* Gould, Proc. Bost. Soc. Nat. Hist., vi., 1861, p.386; *Id.*, Sowerby, Conch. Icon., xv., 1865, Pl.18, fig.129.

Gould's species is usually accepted as identical with that of Kiener; this valuation is supported by the present figure of the type of Gould in the National Museum at Washington.

* Vignal, Journ. de Conch., lviii., 1910, p.138.

BITTIUM ELONGATUM Sowerby.

(Plate lxxxi., fig.54.)

Cerithium elongatum Sowerby, Thes. Conch., ii., 1855, p.878, Pl.184, figs.233, 234; *Id.*, Conch. Icon., xv., 1865, Pl.xix., fig.136.

In the British Museum is a series, apparently the type of this species, labelled "Sydney, under stones, F. Strange." To facilitate the identification of this, Mr. E. A. Smith kindly allowed me to bring back a specimen, 10 mm. in length, which is here figured.

Search failed to find any Australian shell at all like *B. elongatum*, and, as the Mediterranean is mentioned in the original description, I sought the help of Mr. J. R. Le B. Tomlin in this matter. He kindly replied (5/3/14) that *B. elongatum* is certainly a Mediterranean species, and that it is a shell common at Malta. In collections, it is generally known as *Bittium arenarium* Monterosato, a name which, if published, is doubtless subsequent to *B. elongatum*.

So *Cerithium elongatum* Sowerby, can now be eliminated from the list of Australian shells.

CYMATIUM AUSTRALASIÆ Perry.

Monoplex australasiæ Perry, Conchology, 1811, Pl.3., fig.3 ; *Triton olearium* Angas, Proc. Zool. Soc., 1867, p.188; *Id.*, Kesteven, These Proceedings, xxvi., 1902, p.712, Pl. xxxv., figs.4, 5; not *Murex olearium* Linné, *fide* Hanley, Ips. Linn. Conch., 1855, p.287.

Triton acclivis Hutton, Cat. N. Zealand Mar. Moll., 1873, p.13.

(?)*Murex costatus* Born, Index Mus. Cæs. Vindob., 1778, p.295; *Id.*, Brauer, Sitz. Akad. Wiss. Wien, lxxvii., 1878, p.49. Not *Murex costatus* Pennant, Brit. Zool., 1777, p.108, Pl.79.

(?)*Murex parthenopeus* von Salis, Reis Neap., 1793, p.370, Pl. vii., f.1.

(?)*Tritonium simpulum* Bolten, Mus. Bolt., 1798, p.128, for Martini, Conch. Cab., iv., 1780, p.96, Pl.131, figs.1252, 1253.

(?)*Triton succinctum* Lamk., Tabl. Encycl. Méth., 1816, Pl.416, fig.2, and Anim. s. vert., vii., 1822, p.181.

The nomenclature of this species is also in an unsettled condition. Deshayes* considered that, in *T. succinctum*, Lamarck had lumped three species; the first Mediterranean (apparently *parthenopeus* von Salis, 1793), the second Australian (apparently *australasia* Perry, 1811), the third American (apparently *americanum* D'Orbigny, 1845). On the contrary, Boog Watson,† though prejudiced in favour of division, was unable to separate the Lamarckian aggregate. For a single species, there is here a discontinuous distribution which is remarkable, as Watson notes that it is absent across the whole Indian Ocean. In Australasia, the range is singularly restricted. Suter‡ cites it from the Bay of Islands to the Hauraki Gulf. Angas found it from Brisbane to Sydney, and I can now add it from the Great Australian Bight, where the "Endeavour" trawled it in 80-120 fathoms.

I have not a series sufficient to decide whether the Sydney shell ought to be reckoned as a geographical race or as an independent species; but which ever it be, the current names cannot be employed. For Hanley has shown that *Murex olearium* Linn., referred to another species than Born's *costatum*. Again, Born's name was preoccupied by Pennant, so that if the species be held to have a world-wide range, the name of von Salis must be used, but, if restricted, that of Perry.

POLINICES EPHEBUS, sp.nov.

(Plate lxxxii., figs.62, 63.)

Shell solid, obliquely ovate. Colour ferruginous, shading on the base to buff. Whorls five, the last wound obliquely and rapidly descending, flattened on the shoulder. Suture sharply impressed. Surface in general smooth, under the lens fine growth-lines are crossed by finer dense spiral scratches which become coarser in the umbilicus. Aperture semilunate, the posterior angle filled by a thick callus. This extends to the edge of the umbilicus, continuing in a short brown lobe lightly impressed by a median sulcus. Umbilicus narrow, but deep, containing a large funicle. Height, 31; breadth, 26 mm.

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* Deshayes, Anim. s. vert., ix., 1843, p.630, footnote.

† Watson, Chall. Zool., xv., 1886, p.390.

‡ Suter, Manual N.Z. Moll., 1913, p.305, Pl.43, fig.2.

The furrow on the pad suggests a relationship with *P. aulacoglossa* Pilsbry and Vanatta. In size, shape, and general appearance, the nearest is *Natica phytelephas* Reeve,* but that differs by its white colour and unfurrowed pad. In the British Museum, four specimens, apparently part of the same lot as my type, are regarded as unnamed.

Hab.—Dredged by Mr. J. Brazier, in 4 fathoms, mud, off Peat's Ferry, Hawkesbury River, N.S.W.

SCAPHELLA Swainson.

Scaphella Swainson, Zoological Illustrations, 2nd Series, Vol. ii., Part 19, 1832, Plate 87, type, *Voluta maculata* Swainson; (not *Scaphella* of subsequent writers). *Amoria* Gray, Proc. Zool. Soc., 1855, p.64, type, *Voluta turneri* Griffiths and Pidgeon. *Terniroluta* von Martens, Archiv f. Naturg., lxiii., 1897, p.177, type, *V. studeri* von Martens.

"It is extremely probable," wrote Martin Woodward, "that we are at present incorporating in the Volutidæ several forms derived from distinct stocks."† As the type of Linné's genus *Voluta* is generally agreed to be *Voluta musica*,‡ it is apparent that *Voluta* proper does not occur in Australia, and that other names must be found for the species formerly assigned to that genus.

Searching for the foundations of *Scaphella*, error and disagreement are obvious in literature. So reliable an author as Agassiz§ cites the genus from "Swainson's Elements of Modern Conchology, 1835," and the type is variously given as *junonia* Chemnitz, *undulata* Lamarck, or *papillosa* Swainson. Actually, the type is *V. maculata*, and the genus was introduced in 1832. In the second edition of Swainson's "Exotic Conchology," and of the "Bligh Catalogue" issued by Hanley in 1841, *Scaphella* is defined and used. The first edition of these rare publications is

* Reeve, Conch. Icon., ix., 1855, Pl. xi., fig.42.

† Woodward, Proc. Malac. Soc., iv., 1900, p.124.

‡ Pace, Proc. Malac Soc., v., 1902, p.21.

§ Agassiz, Nomina Syst., 1846, Moll., p.80.

not accessible to me. But it is plain that this second edition was entirely rewritten, and does not represent the nomenclature of the first edition of 1822. For Férussac, minutely reviewing the first four parts of the "Exotic Conchology," failed to note *Scaphella* or *Cymbiola*.* Even in 1824, Swainson† had not decided on the generic subdivision of the Volutidæ.

The original reference to *Scaphella* enumerated *S. undulata*, *junonia*, *maculata*, and *zebra* as typical species, and *papillaris* (= *S. papillosa* Swainson, 1822, not *papillaris* Borson, 1820) and *elongata* (*arabica* Martyn var.) as aberrant species. Afterwards, in his "Treatise on Malacology," 1840, p.318, Swainson redefined the genus, and included in it, *fusiformis*, *undulata*, *volvacea*, *zebra*, *junonia*, and *papillosa*; "the best known type" being(p.107) *S. undulata* Lamarck. Thus compounded, the genus covered, more or less, *Amoria* Gray, *Maculopeplum* Dall,‡ and *Ericusa* H. & A. Adams. Of these, the first should apparently sink as a synonym; *Amoria* Gray, was introduced in 1855, with *Voluta turneri* as the first species generally accepted as type. It is noteworthy that *Scaphella volva* Gmelin, var *turneri* Griffiths & Pidgeon, as originally figured,§ is not the form given under that name by Reeve, Sowerby, and subsequent authors, and is perhaps *Amoria broderipi* Gray.‖ Under the name of *Voluta undulata* Lamarck, Swainson seems to have figured¶ not that, but *Scaphella volva* var. *elliotti* Sowerby.

I suggest that the following Australian shells should be ranked under *Scaphella*: *canaliculata* McCoy, *exoptanda* Sowerby, *gatliffi* Sowerby, *hedleyi* Iredale, *maculata* Swainson, *maria-emma* Gray, *moslemica* Hedley, *prætexta* Reeve, *spenceriana* Gatliff, *studeri* Martens, *translucida* Verco, *undulata* Lamarck, *volva* Gmelin, and its numerous varieties, *zebra* Leach.

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* Férussac, Bulletin des annonces nouv. scient., ii., 1823, p.66.

† Swainson, Quart. Journ. Sci., xvii., 1824, p.31.

‡ Dall, Smithson. Miscell. Coll., Vol.48, 1907, p.370.

§ Griffiths & Pidgeon, Anim. Kingdom, xii., 1834, p.601, Pl.40, f.1.

‖ Gray, Ann. Mag. Nat. Hist.,(3), xiv., 1864, p.237.

¶ Swainson, Exotic Conchology, Part iv., 1823, Pl.27.

LIVONIA Gray.

Livonia Gray, Brit. Mus. Cat. Volutidæ, 1855, p.8; *Mamillana* Crosse, Journ. de Conch., xix., 1871, p.308, type, *M. mamilla* Sowerby; Tate, Proc. Roy. Soc. N. S. Wales, xxxi., 1898, p.386: *Pterospira* Harris, Brit. Mus. Cat. Tert. Moll. Austr., 1897, p.100, type, *V. hannafordi* McCoy.

Livonia Gray, (not to be confused with *Livona** Gray, 1847) was proposed for *V. mamilla* Sowerby, and *V. dubia* Broderip. As H. & A. Adams had already created *Aurinia*† solely for *V. dubia*, the type of *Livonia* becomes *mamilla*, both by elimination and by first mention.

Mörch‡ has pointed out that, in *Cymbiola*, the specific name *mamilla* is preoccupied by Meuschen§ for the shell later renamed *V. scapha* by Gmelin.

The radula of *L. mamilla* has been shown, by Gatliff & Gabriel, and that of *L. roadnightæ* by Verco, to conform to the pattern of *Cymbiola* rather than to that of *Scaphella*.||

Livonia seems to be closely related to *Alcithoë*, and more distantly to *Ericusa*. The only recent members of *Livonia* are *L. mamilla* Sowerby, and *L. roadnightæ* McCoy.

CYMBIOLA Swainson.

Cymbiola Swainson, Zoological Illustrations, 2nd series, Vol. ii., Part xviii., 1832, Pl.83, type, *Voluta vespertilio* Linn., var.; *Scapha* Gray, Proc. Zool. Soc., 1847, p.141, type *V. vespertilio*; *Aulica* Gray, *op. cit.*, type *V. aulica* Sowerby; *Nobilia* Gray, Brit. Mus. Cat. Volutidæ, 1855, p.19; *Ausoba* H. & A. Adams, Gen. Moll., ii., 1858, p 618; *Vespertilio* Cossman, Ess. Pal. Conch., iii., 1899, p.117; *Volutoconus* Crosse, Journ. de Conch., xix., 1871, p.306; Tate, Proc. Roy. Soc. N. S. Wales, xxxi., 1898, p.386, type, *Voluta coniformis* Cox.

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* Iredale, Proc. Malac. Soc., x., 1913, p.309.

† H. & A. Adams, Gen. Rec. Moll., i., p.166, 1853.

‡ Mörch, Cat. Conch. Yoldi, 1852, p.123.

§ Meuschen, Mus. Gevers., 1787, p.328, *Murex mamilla*.

|| Gatliff & Gabriel, Victorian Naturalist, xxvi., 1909, Plate iii., fig.5; Verco, Trans. Roy. Soc. S.A., xxxvi., 1912, Pl. xvi., f.1.

The history of *Cymbiola* is parallel to that of *Scaphella*. Herrmannsen* ascribed it to the "Elements of modern Conchology," 1835, though it really dates from 1832. Subsequent authors have generally perverted it from the original intention. At first presentation, Swainson included the following Australian species, *C. marmorata, nivosa, rutila, pulchra, magnifica,* and *flavicans*. But in the "Treatise on Malacology," 1840, p.317, Swainson gave a fresh definition and list of contents, shifting the genus towards *Adelomelon*, to the misleading of his readers.

I suggest that the Australian contents of the genus be grouped thus; under *Cymbiola* restricted, *irvinæ* Smith, *nivosa* Lamarck, *nodiplicata* Cox, (= *dannevigi* Verco), *oblita* Smith, *perplicata* Hedley, *pulchra* Sowerby, and *rutila* Broderip.

Under the subgenus *Aulica*: *flavicans* Gmelin, *guntheri* Smith, *kreusleræ* Angas, *magnifica* Chemnitz, *marmorata* Swainson, *punctata* Swainson, and *verconis* Tate.

Under the subgenus *Volutoconus*: *bednalli* Brazier, and *coniformis* Cox.

Ericusa.

Ericusa H. & A. Adams, Genera Rec. Moll. ii., 1858, p.619, for *fulgetrum* Sowerby, and *papillosa* Swainson; *Scaphella* Gray, Brit. Mus. Cat., Volutidæ, 1855, p.20 (not Swainson).

Swainson was oppressed by a craze for arranging species and higher groups in quintettes and circles. Probably both *Scaphella* and *Cymbiola* had a heterogenous content on purpose that they might fill a place in the Quinary System. The group of *Ericusa*, though recognised by systematists, long lacked a name because Swainson placed its members as aberrant *Scaphella*, and Gray reconstituted *Scaphella* to receive them. The names of *Ericusa*, *Livonia*, and *Mamillana* have been uniformly omitted from Zoological Indices. A *Voluta fusiformis* was, in 1814, proposed by Brocchi,† so for the Australian shell named *Voluta fusiformis* by Swainson in 1822, it will be necessary to resume the name *Voluta sowerbyi* of Kiener, 1839.

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* Herrmannsen, Indicis Generum Malac., i., 1846, p.352.

† Brocchi, Conch. foss. sub., 1814, p.315.

To *Ericusa* are assigned : *fulgetrum* Sowerby, *papillosa* Swainson, and *sowerbyi* Kiener.

ALCITHOE H. & A. Adams.

Alcithoë H. & A. Adams, Gen. Rec. Moll., i., 1853, p.164, type *pacifica* (*arabica*) selected by Fischer, Manuel, 1883, p.607.

This genus, which is nearly related to *Adelomelon*, does not seem to occur on the Australian coast. Solander erroneously recorded *V. pacifica* from the Endeavour Reef. The same species, under the name of *V. rossiteri*, was described by Brazier* from Gippsland. Reeve, by mistake, recorded *A. gracilis* Swainson, from Australia. Species from the Australian Tertiary, which have been attributed to the genus, do not seem to be happily placed.

MARGINELLA MALINA, sp.nov.

(Plate lxxxii., fig.65.)

Shell small, rather thin, smooth and glossy, subtriangular in outline, shoulder rounded, apex slightly projecting from a rather flat summit. Colour uniform white. Whorls three, wound nearly in the same plane. Aperture straight, wide, as long as the shell. Outer lip rather broadly expanded. Plications four, narrow, erect, becoming smaller and deeper posteriorly, the last midway along the mouth. A slight glaze on the inner lip. Canal a little produced. Length, 3; breadth, 2·4 mm.

Hab.—I dredged several specimens in 100 fathoms, off Wollongong, and, again, in 80 fathoms, off Narrabeen, N.S.W. (type).

The latter were erroneously catalogued as *M. brazieri* Smith.† That species is a larger shell, with more exsert spire, and lives in deeper water.

MARGINELLA TRANSLUCIDA Sowerby.

(Plate lxxxii., fig.67.)

This species was discussed in the last part of these Studies (xxxviii., p.302). A figure of a specimen 5·5 mm. long, from Sydney, compared with the type in the British Museum, is here presented.

* Brazier, Proc. Linn. Soc. N. S. Wales, xxii., 1898, p.779.

† Hedley, Rec. Austr. Mus., vi., 1907, p.287.

Another member of this genus, hitherto unrecorded for New South Wales, is *M. victoriæ* Gatliff & Gabriel, which I have taken in Middle Harbour.*

Marginella inconspicua Sowerby.

(Plate lxxxii., fig.64.)

Marginella inconspicua Sowerby, Thes. Conch., i., 1846, p.387, Pl.75, fig.80; *Id.*, Reeve, Conch Icon., xv., 1865, Pl.25, fig.141; (not *M. inconspicua* G. & H. Nevill, Journ. Asiat. Soc. Bengal, xliii., 1874, p.23; xliv., 1875, p.95, Pl. viii., figs.10, 11).

This shell was described from an unknown locality. Mr. J. R. Le B. Tomlin informed me that it belongs to the Sydney fauna. By his kind assistance, I am now able to identify it from Ballina, Port Stephens, Port Jackson, Gerringong, N.S.W.; and Schouten Island, Tasmania. It is allied to *M. olivella* Reeve, than which it is about one-half the length, and more attenuate anteriorly. *Marginella evanida* Sowerby, is broader, with outer lip inflected, but closely resembles *M. inconspicua.* A specimen, identified by Mr. Tomlin, is here figured; it is 5·5 mm. long.

Marginella angasi Crosse.

(Plate lxxxii., fig.66.)

Marginella angasi Crosse, Journ. de Conch., xviii., 1870, p.304; xix., 1871, p.324, Pl. xii., fig.3 : *Id.*, Watson, Chall. Rep. Zool., xv., 1866, p.266.

This shell is figured as with a single columellar fold, a peculiarity to which Watson has alluded. Through the distribution, by Brazier, of authentic specimens, this species was well known in Australia as with many folds. Impressed by the discrepancy between Brazier's specimens and Crosse's figure, I took examples to Paris. Mr. Dautzenberg, who now owns the "collection du journal" which contains the type, kindly showed it to me. I found that the animal had dried in the aperture of the type-specimen and concealed all the folds but the first, hence the error of the artist. To show the proper disposition of the armature, herewith is figured a shell which I compared, in Paris, with the type of *M. angasi.*

* Gatliff & Gabriel, Proc. Roy. Soc. Vict., xxi., 1908, p.365, Pl.21, fig.5.

In the genus *Marginella*, as at present arranged, are included species with diverse radulæ and opercula.* Probably such dismemberment as has occurred in "*Voluta*" will, therefore, be repeated in *Marginella*.

MARGINELLA MAUGEANA, nom.mut.

Marginella gracilis May, Proc. Roy. Soc. Tasm., 1910 (1911), p.383, Pl. xiii., fig.4; (not *M. gracilis* C. B. Adams, Contributions to Conchology, 1852, p.130).

The name chosen by Mr. May for a shell we dredged off Cape Pillar, happens to have been selected for a Jamaican species sixty years before. In giving it a new name, I have associated it with Réné Mauge, an ardent conchologist on the scientific staff of the "Géographe," who died at Maria Island, 21st Feb., 1802.†

A pathetic story relates how his friend Péron landed on Bruni Island, and gathered treasures by the handful. There was the first recent *Trigonia* a naturalist had ever seen, which Péron at once labelled *Trigonia antarctica*; there was a *Turbo* whose beauty he expressed by the name of "*Eustomiris*," but which Martyn had already called *undulatus*; there was a superb *Venus* (*Salacia disjecta*), besides splendid *Phasianella*, *Trochus*, *Patella*, and *Fissurella*.

To interest his sick colleague, he spread these magnificent shells on his bunk. But poor dying Mauge burst into tears at the thought of his helplessness, when such wonderful shells could be gathered. He insisted on joining the shore-party next day, but he fainted on the beach, and his next journey shorewards was to his grave.

DRILLIA COMMENTICUS, sp.nov.

(Plate lxxxii., fig.59.)

Shell small, solid, narrowly fusiform. Colour uniform cream. Whorls nine. First three small and smooth, next with a dozen prominent curved radial ribs. On the following whorl, a keel arises from the base, reaches the periphery, and, as a conspicuous

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* Journ. Roy. Micros. Soc., Ser.2, ii., 1882, p.604.

† Péron, Voy. Terr. Aust., i., 1807, p.240; ii., 1816, p. xxvii.

median keel, descends to the aperture. The upper whorls have a second conspicuous spiral keel below the suture, between which and the peripheral keel lies the fasciole, a third and fainter keel runs below the median. On the body-whorl, there are about a dozen spirals below the main keel. The fasciole is sculptured by transverse crescentic threads becoming weaker on the later whorls. Radial threads also appear over the whole shell. Aperture narrow, notch deep, subsutural, outer lip simple, thin, projecting. Canal broad and short. Length, 4; breadth, 1·5 mm.

Hab.—10 fathoms, off Cape Sidmouth, type, A. U. Henn; 15 fathoms, off the Palm Islands, Queensland (self).

Mr. H. B. Preston reports that he was unable to match this small species in the collection of the British Museum. The sculpture of the fourth whorl is a good recognition-mark for this shell.

Daphnella aculeola, sp.nov.

(Plate lxxxii., fig. 58.)

Shell small, lanceolate-fusiform. Colour buff, stained with ferruginous at the extremities. Whorls eight, the first three minute, smooth, forming the protoconch, the rest sculptured, gradate and rapidly increasing in size. Sculpture: broad peripheral undulations compose radial ribs spaced at ten to a whorl, fine spiral cords continue across both ribs and interstices and extend over the base; of these, the last whorl carries sixteen and the penultimate six, those on the periphery increase in size and sharpen the projection of the ribs. Aperture ovate, outer lip thin, simple, a slight smear of callus on the columella. Canal short, straight, open. Length, 8·5; breadth, 4 mm.

Hab.—Middle Harbour, Sydney (self).

This is a narrower shell than *Daphnella aculeata* Webster, with wider radials and spirals.

Glyphostoma alliteratum, sp.nov.

(Plate lxxxii., figs.56, 57.)

Shell small, solid, acuminate-fusiform. Colour grey to orange, aperture stained with chocolate, usually an intenser patch anteriorly and posteriorly, frequently a chocolate line upon the base and ascending the suture. Whorls seven, angled at the shoulder, flattened at the periphery, and excavate at the base. Sculpture: first two whorls smooth, on the next are two spiral cords which multiply as they descend, until, on the last whorl, they amount to eighteen. Of these, three run on the fasciole and ten on the base, those on the periphery overrun the ribs unchanged, and carry minor threads in their interstices. On the peripheral belt are prominent undulating perpendicular ribs, which amount to fourteen on the last whorl. Over all are dense microscopic grains. Aperture small, ovate. Outer lip defended by a prominent varix, sculptured like the rest of the shell, with a smooth upturned and notched margin, grooved within the throat. Sinus subsutural, deep and narrow, a solid coloured callus-patch at the right insertion, on the inner lip a smear of callus. Canal short. Length of the orange specimen figured, 6·3; breadth, 2·8 mm. Another grey specimen, length, 7·5; breadth, 3 mm.

Hab.—I have collected this species at Wreck Bay, Sydney Harbour (type-locality), and Dudley, N.S.W.

Hitherto this species has been confused with *Clathurella bicolor* Angas,* with which it is associated. I am indebted to Mr. Tom Iredale for identifying *C. bicolor* for me by the British Museum type. A specimen so authenticated is here figured (Figs. 60, 61). Compared with *C. bicolor*, the novelty is rather larger, comparatively broader, with more prominent sculpture, and consequently sharper shoulder-angle. The uniform orange colour of the base of *C. bicolor* affords a ready means of recognition.

Both these should, I think, take their place in *Glyphostoma*, in which genus they approach *G. aliceæ* Melvill & Standen, and *G. callistum* Hervier, by form, sculpture, and colour-pattern.

Duplicaria ballina, sp.nov.

(Plate lxxxiv., fig.86.)

No perfect specimens of this distinct species have yet reached me. It is, therefore, provisionally described from beach-worn material. In size and general appearance, it is comparable to

* Angas, Proc. Zool. Soc., 1871, p.18, Pl. i., f.20.

D. ustulata Deshayes, from which it differs by being more slender, and by fewer, wider-spaced ribs.

Shell solid, clavate-fusiform. Colour uniform buff. Whorls about fourteen. At two-thirds of the height of the whorl, a deep groove appears on the interstices, but not on the ribs; this ascends the spire, but is inconspicuous on the earlier whorls. Below the groove, there are eight spiral threads. On the last whorl, these continue to the snout and amount to about thirty. The ribs are polished, well spaced, slightly curved, set obliquely, not continuous from whorl to whorl, vanishing on the base, about twenty to a whorl, rather less on the earlier whorls. Length, 23; breadth, 6 mm.

Hab.—Trial Bay (type), C. Laseron; Ballina, C. Hedley; Caloundra, H. L. Kesteven.

MITRA VOLUCRA, sp.nov.

(Plate lxxxiv., fig.84.)

Shell small, solid, compact, ovate-fusiform. Colour purple-slate or cinnamon, with a narrow pale peripheral band and a pale line below the suture. Five whorls remaining in the decollate specimen studied. Suture channelled. The earlier whorls are sculptured by fine close radial riblets developed on the periphery and vanishing towards the suture. These disappear on the last whorl, which is smooth; between the riblets run spiral threads. Aperture elliptical, plaits four, decreasing anteriorly, canal short. Length, 11; breadth, 5 mm.

Hab.—Woolgoolga, N.S.W.; three beach-worn specimens collected by Mr. Carl Laseron.

This species is superficially like the Tasmanian *M. vincta* A. Adams, but differs by being more solid, by having the suture canaliculate, and by the sculpture.

MITRA ACROMIALIS, sp.nov.

(Plate lxxxiv., fig.85.)

Shell ovate-fusiform, rather thin and light. Colour pale buff. Whorls six, including a smooth protoconch of a whorl and a half, spire gradate. Sculpture: perpendicular ribs widely spaced, about seventeen on the last whorl, diminishing and alternating in ascent from whorl to whorl, knotted at the shoulder and fading at the base. Spirals occur as six prominent cords on the snout, above which a dozen threads become fainter as they ascend, traverse the interstices but not the ribs; about six of these ascend the spire. Aperture pyriform, lip simple. Columella with four well developed, spaced, oblique plaits. Length, 9·5; breadth, 4 mm.

This is the form mentioned in the Thetis Report,* as a variety of *Mitra tasmanica* Ten.-Woods. On reconsidering a larger series, I now conclude that the northern shell is an independent species, readily separable by its sharp shoulder from the real *M. tasmanica*, which does not extend to New South Wales.

Hab.—Off Cabbage-Tree (type) and Broughton Islands, 35 fathoms; Port Stephens (Museum Expedition of 1880); off Port Kembla, 63-75 fathoms (Thetis); off Wollongong, 100 fathoms; off Sydney, 250 fathoms; and off Narrabeen, 80 fathoms (self).

NODOPELAGIA, gen.nov.

A new genus of the Buccinidæ. Shell very solid, fusiform, with a short canal and longitudinal ribs. Type, *Peristernia brazieri* Angas, Proc. Zool. Soc., 1877, p.171, Pl.26, fig.4.

Loc.—Mouth of the Redbank River, N.S.W.

Absence in *P. brazieri*, of the essential character, plaits on the columella, excludes it both from the family and genus of *Peristernia*, and brings it nearer to *Cominella*.

Melvill† noted *P. brazieri* as a *Peristernia* of slightly doubtful affinity, while Tryon transferred it to *Latirus*.‡

In literature, considerable confusion between the genera *Latirus* and *Peristernia* has occurred. Tryon, for instance, considered that the distinction between them was entirely arbitrary. Yet differential characters are shown by the radula.§

The type of *Latirus* is certainly *L. gibbulus* Gmelin, but the type of *Peristernia* is not so plain. The second of five species,

* Hedley, Mem. Austr. Mus., iv., 1903, p.372.
† Melvill, Mem. Manchester Lit. Phil. Soc.,(4), iv., 1891, pp.368, 385, 407.
‡ Tryon, Man. Conch., iii., 1881, p.93.
§ Cooke, in Melvill, *op. cit.*, p.376.

originally named by Mörch,* as constituting his new genus *Peristernia*, was *Turbinella nassatula* Lamarck. This was selected by H. & A. Adams† to represent the genus, a course followed by Cossmann.‡ As example of *Peristernia*, Fischer§ gave *L. wagneri* Anton, a name not in the original list, but one advanced by Tapparone-Canefri|| to replace *T. crenulata* Reeve, the first species of Mörch. For better definition, *P nassatula* is now declared the type of *Peristernia*.

From the original locality, *N. brazieri* ranges north to Ballina and Caloundra, Queensland.

Engina gannita, sp.nov.

(Plate lxxxiv., fig.87.)

Shell solid, fusiform, acuminate at either extremity. Colour uniform cinnamon-brown. Whorls eight, including a protoconch of three smooth whorls. Suture deeply channelled. Sculpture: undulating radial ribs, about ten to a whorl and set a little obliquely, extend from the suture to the base; both ribs and interstices are traversed by prominent polished spiral cords terminating at the lip; the last whorl carries fifteen of these, and the upper whorls three or four; between the major spirals, run three or four small threads. Aperture oblique, narrowly pyriform, arched posteriorly, outer lip contracted, slightly denticulated by the ends of the spiral cords; within are eight entering ridges, the posterior largest. Inner lip with a free margin for most of its length, medial with four strong plaits, posteriorly a double tooth at the angle and a few small wrinkles. Canal short and open. Length, 15; breadth, 7 mm.

In the British Museum, I failed, after some search, to find a representative of this species. *Engina costata* Pease,¶ is like it in general appearance, and has the same sculpture, but is a more

* Mörch, Cat. Yoldi Coll., 1852, p.99.
† H. & A. Adams, Gen. Rec. Moll., i., 1853, p.153.
‡ Cossmann, Essais Paléoconch. comp., iv., 1901, p.47.
§ Fischer, Man. Conch., 1884, p.617.
|| Tapparone-Canefri, Journ. de Conch., xxvii., 1879, p.322.
¶ Pease, Proc. Zool. Soc., 1860, p.142.

obese shell. A species from India, *Ricinula xuthedra* Melvill,* is also somewhat like, but has a minute scaly sculpture wanting in the Australian species, and is, besides, larger, comparatively broader and blunter at the ends. Closest of all to our species is *Tritonidea curtisiana* Smith,† but that is variegated instead of monochrome, smaller, less pointed in front, has the ribs closer and more prominent, and the denticles in the aperture are differently arranged. In the Australian Museum collection, there is a specimen of *E. curtisiana* from W. Australia.

Hab.—The specimen described was dredged by Mr. J. Brazier, in 30 fathoms, off Darnley Island, Torres Straits.

CADUCIFER DECAPITATA Reeve.

Triton decapitatus Reeve, Conch. Icon., ii., 1844, Pl. xviii., f.85; *T.* (*Epidromus*) *decapitatus* Melvill & Standen, Journ. of Conch., viii., 1895, p.110.

At the Palm Islands, Queensland, I found two specimens of this species, which is unrecorded for Australia. But in my Queensland list, these were erroneously noted as *Colubraria tessellata* Reeve.‡

To *Colubraria*, however, I would now refer both *Pisania reticulata* A. Adams, and *Pisania schoutanica* May.

MACULOTRITON GRACILIS Sowerby.

(Plate lxxxiv., fig.79.)

Phos gracilis Sowerby, Thes. Conch., iii., 1859, p.91, Pl.222, fig.33.

This rare species escaped the attention of Angas when he collected and catalogued the mollusca of Sydney Harbour. It is related to *Cantharus unicolor* Angas, and *Tritonidea australis* Pease. *M. gracilis* is 12 mm. long, more cylindrical in form, and has finer, closer ribs than its associates. Also *M. gracilis* is uniform cinnamon-brown, *M. unicolor* is straw-yellow, either monochrome or with rusty blotches below the suture, and *M. australis* is chequered buff and chocolate. It is now proposed to

* Melvill, Proc. Manchester Lit. Phil. Soc.,(4), vii., 1893, p.55, Pl. i., f.6.
† Smith, Zool. Coll. Alert, 1881, p.47, Pl. v., f.E.
‡ Hedley, Rep. Austr. Assoc. Adv. Sci., xii., 1910, p.367.

transfer all three to *Maculotriton*, as more suitable for their reception than *Cantharus*. The genus has already been reported from the State as *M. bracteatus* Hinds.*

Probably the genus *Jeannea*† is nearly allied to *Maculotriton*.

ARCULARIA CÆLATA A. Adams, var. TORRESIANA, n.var.
(Plate lxxxiii., fig.76.)

Nassa cœlata A. Adams, Proc. Zool. Soc., 1851(1852), p.97; *Id.*, Reeve, Conch. Icon., viii., 1853, Pl. xx., fig.133.

Shell small, solid, ovate. Whorls six, half of which compose the protoconch. Colour pale buff with a broad orange zone on the upper half of the whorl, and another on the base, white beneath the suture. Sculpture: radial riblets are disposed at the rate of about eighteen to a whorl and are crowded towards the aperture, each expands posteriorly to form a subsutural bead-row. Their interstices are crossed by broken spiral furrows at the rate of sixteen to a whorl. Aperture slightly ascending, varix solid and projecting, outer lip with four interior denticles, inner with a small tubercle at either end. Length, 5; breadth, 2·5 mm.

Hab.—Dredged in 12 fathoms, in Torres Straits, by Mr. J. Brazier.

Mr. G. C. Robson, of the Natural History Museum, London, to whom I referred the form here described, writes that "*N. cœlata* is three times larger, and has more transverse ribs, but is otherwise very near your species; and the latter is probably the young." *N. cœlata* has not previously been recorded from Australia.

ARCULARIA CONOIDALIS Deshayes.

Buccinum conoidale Deshayes, in Bélanger, Voy. aux Indes Orient. Zool., 1833, Pl.3, figs.6, 7; *Id.*, Kiener, Coq. Viv., Buccinum, 1834, p.92, Pl.27, fig.109; *Id.*, Deshayes, Anim. s. vert.,(2), x., 1844, pp.182, 196; *Id.*, Marrat, Proc. Liverpool Geol. Soc., 1879, p.52.

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* Hedley, These Proceedings, xxx., 1905, p.529.

† Iredale, Proc. Malac. Soc., x., 1912, p.220.

Nassa cremata Hinds, Voy. Sulphur Zool., Moll., 1844, p.35, Pl. ix., figs.8, 9; *Id.*, Reeve, Conch. Icon., viii., 1853, Pl. iv., f.26; *Id.*, Melvill & Standen, Journ. Linn. Soc. Zool., xxvii., 1899, p.159; *Id.*, Marrat, Proc. Liverpool Phil. Soc., xxxiii., 1879, p.232.

Nassa ravida (*ranida*) A. Adams, Proc. Zool. Soc., 1851(1852), p.97; *Id.*, Reeve, Conch. Icon., viii., 1853, Pl. xi., figs.68, 74; *Id.*, Brazier, Proc. Linn. Soc N. S. Wales, i., 1876(1877), p.179; *Id.*, Watson, Chall. Rep. Zool., xv., 1886, p.177.

Brazier reported this species as *N. ravida* from 20 fathoms, off Darnley Island, Torres Straits. As *N. cremata*, Melvill & Standen record the species from Albany Pass. I have dredged it off Mapoon in the Gulf of Carpentaria. In the British Museum are two *N. ravida* obtained by Prof. J. B. Jukes, in 7 fathoms, mud, in Port Essington, Northern Territory. On this tablet is a note referring the species to the prior *N. cremata* Hinds. And to a series, probably cotypes of *N. cremata* Hinds, is another note directing the student to *N. conoidalis* Deshayes. It is curious how completely this name of Deshayes has disappeared from modern literature.

Arcularia semigranosa Dunker.

(Plate lxxxiii., fig.78.)

Buccinum semigranosum Dunker, Zeitsch. Malak., 1846, p.170; *Id.*, in Philippi, Abbild. Besch., iii., **1849**, pp.**45**, 68, Buccinum, Pl. i., fig.9, Pl. ii., fig.12; *Id.*, Schmeltz, Mus. Godeff. Cat., 1874, p.124; *Id.*, Marrat, Proc. Liverpool Phil. Soc., xxxiii., 1879, p.232; *Nassa nigella* Reeve, Conch. Icon., viii., 1854, Pl. xxvi., f.173; *Nassa optata* Gould, Proc. Bost. Soc. Nat. Hist., vii., 1860, p.331; *Id.*, Report New York State Museum, xxvii., 1875, p.12; *Id.*, Ten.-Woods, Proc. Linn. Soc. N. S. Wales, ii., 1877(1878), p.257; *Nassa munieriana* Crosse, Journ. de Conch., xii., 1864, p.345, Pl.13, fig.6; *Nassa jacksoniana* Angas, Proc. Zool. Soc., 1867, p.190, and of all Australian writers, but not of Quoy & Gaimard, nor of Kiener.

In cataloguing the mollusca of Port Jackson, Angas treated a common shell as *Nassa jacksoniana*, and for half a century his guidance has been followed in Australia. The French naturalists did not themselves collect the shell thus described. It was particularly acknowledged that they owed it to the botanist, Mr. Fraser, apparently he who was the first Superintendent of the Sydney Botanic Gardens.

I am disposed to think that it was a foreign shell which Fraser gave to the zoologists of the Astrolabe. For not only does *Buccinum jacksonianum* differ widely in the external sculpture and the armature of the aperture from *Arcularia semigranosa*, with which it has been confounded, but it cannot be matched with any other Australian shell. A species differing from either that of Quoy or of Dunker was figured by Kiener under the name of *Buccinum jacksonianum*. Deshayes, who drew attention to this error, states that Kiener represented Quoy's species by his Fig.119 of *B. polygyratum* var.,* but I see no likeness between the latter and the Astrolabe figure. Marrat supposed that *B. jacksonianum* was a variety of *Nassa monile* Kiener.†

I noticed, in the British Museum, an unnamed series from Bombay, which appeared to be more like *jacksoniana* than any Australian shell. *Nassa jacksoniana* Quoy & Gaimard, is recorded from Ceylon by A. W. Langdon.‡

Dunker gave good descriptions and figures of his species, and properly compared it with its near relation *A. pauperata* Lamk. The locality was unknown to him, but it is worth noting that he had a considerable supply of unlocalised Sydney shells for description. In the same paper are, for instance, *Buccinum parvulum*, and *B. jonasi*.

Nassa nigella was ascribed by its author to New Zealand, but it has not been recovered there, and is now excluded from the New Zealand catalogue. In London, I examined three shells from the Cuming Collection, probably Reeve's types of *nigella*, but not so marked; these I found to be a chestnut monochrome of *semigranosa*, a common form of the Sydney shell.

The type of *Nassa optata* Gould, was collected at Sydney by Dr. W. Stimpson. It has never been figured. In 1863, Gould's collection was transferred to the New York State Museum. On

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* Kiener, Coq. Viv. Buccinum, 1834, p.92, Pl.29, fig.119.

† Marrat, Journ. of Conch., i., 1878, p.374.

‡ Langdon, Journ. of Conch., i., 1875, p.72.

application to that institution, Mr. W. G. van Name most kindly sent me an enlarged photograph of the type, here re-drawn (Fig.78), which suffices to establish the name as a synonym of *A. semigranosa.*

Nassa munieriana Crosse, was described from St. Vincent's Gulf, S.A. The type was presented by Mr. G. F. Angas to the British Museum, where it is now labelled as a synonym of *A. semigranosa.* The figure suggests an abnormal, distorted shell, which perhaps accounts for Watson's mistake in referring it to *N. pauperata.*

The affinities of *A. semigranosa* are, as was recognised by Dunker, Marrat, and Watson, with *A. pauperata.* Both share a smooth space behind the aperture, a subsutural bead-row, and absence of denticles in the aperture; but *A. pauperata* is proportionately broader, absolutely larger, more solid, and generally more highly coloured. For most of their range, the two co-exist, but *A. semigranosa* perhaps extends further east, and *A. pauperata* further west.

A closer relation is *Arcularia tasmanica* Ten.-Woods,* which its author thought might intergrade with *semigranosa*, but which I have not yet found to do so. Tenison-Woods' type of the small, sturdy, southern species is preserved in the Tasmanian Museum, Hobart.† Typically, *A. tasmanica* is shorter, more solid, and more closely ribbed than *A. semigranosa*, is strongly sculptured on the back of the last whorl, where *A. semigranosa* is, as its name implies, smooth, and finally has several teeth in the aperture, while *A. semigranosa* is edentulous. As *A. tasmanica* has not been illustrated, a figure of it is here offered (Fig.81).

When Angas‡ recorded *Nassa lirella* from S. Australia, he appears to have had *A. tasmanica* before him. The Cumingian specimens of *N. lirella*, probably Reeve's types, which I examined in London, are distinct, being larger and proportionately broader than *A. tasmanica*; further, they are marked "Japan."

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* Ten.-Woods, Proc. Roy. Soc. Tasm., 1875 (1876), p.150.
† May, Proc. Roy. Soc. Tasm., 1902 (1903), p.108.
‡ Angas, Proc. Zool. Soc., 1880, p.415.

ARCULARIA PARTICEPS, sp.nov.

Nassa suturalis Forbes, Voy. Rattlesnake, ii., 1852, p.365; *Id.*, var., Reeve, Conch. Icon., viii., 1853, Pl ii., figs.11*a*, 11*b*; *Id.*, var., Angas, Proc. Zool. Soc., 1867, p.190; *Id.*, var., Marrat, Variation of Sculpture in the genus Nassa, 1877, Pl. i., fig.3; *Nassa glans* var. *suturalis* Watson, Chall. Zool., xv., 1886, p.179. Not *Buccinum suturale* Lamarck, Anim. s. vert., vii., 1882, p.269, and Kiener, Coq. Viv., Buccinum, 1834, p.54, Pl.24, fig.96.

Nassa intermedia Angas, Proc. Zool. Soc., 1877, p.180, *op. cit.*, 1878, p.865; *Nassa glans* var. *intermedia* Whitelegge, Proc. Roy. Soc. N. S. Wales, xxiii., 1889, p.248. Not *Alectrion intermedia* Frauenfeld, Novara Exped. Zool. Moll., 1867, Pl. i., fig.2. [Preocc., Forbes, Rep. Brit. Assoc., 1843 (1844), p.190; replaced by *N. suturalis dunkeri* Suter, Trans. N. Z. Inst., xl., 1907 (1908), p.350].

Nassa glans Pritchard & Gatliff, Proc. Roy. Soc. Vict., x., 1898, p.280. Not *Buccinum glans* Linné, 1758.

A shell, common on this coast, was first noticed by Forbes, under the incorrect title of *Nassa suturalis*, as having been taken in 6 fathoms in Port Jackson by H.M.S. "Rattlesnake." This Sydney shell has features in common both with *A. glans* Linné, (as shown by Kiener's fig.52) and with *A. suturalis* Lamarck, (as shown by Kiener, fig.96), to each of which it has been in turn referred, but from each of which it consistently differs. In form and painting, it closely resembles *A. suturalis*, but differs, as Angas observed, by lacking the characteristic sutural bead-row, in which feature it approximates to *A. glans*. The prickles on the anterior outer lip, possessed both by *A. glans* and *A. suturalis*, are evanescent in *A. particeps*, which is more slender than either, and has a broad sutural shelf or gutter.

This Sydney shell is about 30 mm. long and 15 mm. broad; it has been figured by Reeve as "A light variety of *N. suturalis*," and by Marrat as "A narrow variety of *N. suturalis*."

A species with subsutural nodules, localised as from Sydney, was described in 1866 by Dunker and Zelebor as *Alectrion intermedia*, and figured by Frauenfeld the following year. Pease*

* Pease, Amer. Journ. Conch., vii., 1872, p.23.

has correctly stated that this name is an absolute synonym of *suturalis* Lamarck. Suter noticed that it was preoccupied by Forbes, and has proposed a substitute.

It is improbable that *A. intermedia* was taken, as alleged, at Sydney. And Angas went astray in substituting that name in his catalogues for his previous *N. suturalis* var. Since this form is still undistinguished by a name, it is now proposed to call it *A. particeps*. From Sydney, it appears to range east to the Kermadecs and Cuvier Island in New Zealand, south to Port Phillip, Victoria, and west to Port Lincoln, South Australia. Both *A. glans* and *A. suturalis* occur in Queensland; I took the first at the Palm Islands, and the second at Mapoon.

Arcularia pilata, sp.nov.

(Plate lxxxiv., fig.80.)

Shell small, narrowly ovate, rather solid. Colour pale buff, with occasionally a narrow spiral orange line, chocolate at the insertion of the lip and the tip of the canal. Whorls six, the first two and a half composing the protoconch, the rest constricted at the suture. Sculpture: radial ribs, about fourteen to the whorl, run from base to suture, over-riding both ribs and interstices are polished cords, ten on the last whorl, and five on the penultimate; in the meshes formed by the intersection of ribs and cords are fine, crowded, spiral hair-lines, as if neatly brushed. Canal short, a little recurved. Aperture slightly ascending, varix broad and projecting, outer lip with six interior denticles. Length, 5·7; breadth, 3 mm.

Hab.—Several specimens, Torres Straits, 12 fathoms; another, Darnley Island, 30 fathoms, J. Brazier.

A. compacta Angas, has a general resemblance to the novelty, but is half as long again, has a more prominent sculpture, and lacks the fine hair-lines of the secondary sculpture of *A. pilata*.

Pyrene felina, sp.nov.

(Plate lxxxiv., figs.82, 83.)

Shell rather thin and light, ovate-acuminate, flattened at the periphery, contracted at the base, spire pointed, later whorls becoming turreted. Whorls eight, the first two smooth, forming a mucronate protoconch. Colour: on a cream ground, orange-brown is irregularly disposed, with a tendency to colour the ribs but not the interstices, to leave an uncoloured spot on the shoulder of the rib, and to cover the back of the last whorl in torn confused meshes. The interior of the aperture is faint lilac. Sculpture: the six adult whorls carry narrow, distant, radial ribs at about twelve to a whorl, discontinuous from whorl to whorl, projecting at the shoulder, and vanishing on the base. Behind the aperture, five ribs disappear progressively, from the base upwards, leaving a tubercle on the shoulder to represent the last. The general surface is smooth and glossy. Ten spiral furrows are engraved on the base and snout. Aperture rather broad, within the outer lip are eight or ten entering bars increasing posteriorly in size. Inner lip continuing as a free edge, slightly corrugated by contact with the revolving lines of the snout. Length, 15; breadth, 7 mm.

Hab.—Seven specimens, collected by self on the ocean-beach near Cooktown, Queensland.

This species seems related to *P. zebra* Woods,* than which it is larger and differently coloured.

ZAFRA DARWINI Angas.

(Plate lxxxiii., fig.74.)

Columbella lentiginosa Reeve, Conch. Icon., xi., 1859, Pl.xxxvii., fig.240; *C. darwini* Angas, Proc. Zool. Soc., 1877, p.181.

A group of Australian brown *Zafra* has received ill-usage in literature, and is now in a confused state. To begin, Reeve, in 1859, figured a shell collected by Strange in Moreton Bay, Queensland, under the name of *Columbella lentiginosa* Hinds. But the shell described under that name by Dr. Hinds,† from Costa Rica, is so unlike the Queensland species, that it is difficult to understand how the mistake occurred. Then, as a corollary to his first error, Reeve redescribed the genuine *C. lentiginosa* as *Columbella guatemalensis*.‡

* Woods, Index Test., 1828, p.13, Suppl., Pl.4, fig. 30; Smith, Proc. Zool. Soc., 1891, p.406.

† Hinds, Zool. Voy. Sulphur, ii., 1844, p.39, Pl.10, figs.21, 22.

‡ Reeve, Conch. Icon., xi., 1859, Columbella, Pl. xxxi., fig.198.

Angas, following Reeve, listed *C. lentiginosa* Hinds, from Moreton Bay and Port Jackson.* Then Brazier reported *C. lentiginosa* as abundant in 10 to 30 fathoms off Darnley Island, Torres Straits. This latter is described below as *Zafra almiranta.* Kobelt and Tryon adopted the expedient of citing the Australian shell as *Columbella lentiginosa* Reeve, not Hinds. But Angas, realising later that Reeve had misrepresented the shell of Hinds, formally proposed to name the Moreton Bay shell, as drawn by Reeve, *Columbella darwini.* In the British Museum are the two types, so marked, of *C. darwini* Angas, presented by the widow of the Rev. T. Lombe Taylor. I have dredged *C. darwini* in 11 fathoms in Port Curtis, and have received it from Stradbroke Island, Moreton Bay. After being led astray in 1867 by Reeve, Angas returned to the subject in 1871, and, renouncing his former error, became involved in another. He "cancelled *C. lentiginosa* as an Australian species," and redetermined, as *C. atrata* Gould, a longitudinally ribbed, olive-brown shell, two lines long, found under stones at Mosman Bay, Port Jackson.† This is the species described below as *Zafra avicennia.*

Columbella atrata Gould,‡ was described from Hong Kong Harbour.

Two specimens, representing Gould's types, are preserved in the Museum of Albany, U. S. Am.,(Report New York State Museum, xxvii, 1875, p.45). At the Natural History Museum, South Kensington, I compared cotypes of *C. atrata* with the Sydney shells which Angas had misidentified as that species. The two I find to be specifically distinct; the Australian shells are more solid, broader, have more prominent and curved ribs, and are paler in colour than *C. atrata.*

To *C. atrata* Gould, Tryon has united *C. pumila* Souverbie, and E. A. Smith,§ in reviewing the South African mollusca, has accepted this reference.

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* Angas, Proc. Zool. Soc., 1867, p.195.
† Angas, Proc. Zool. Soc., 1871, p.89.
‡ Gould, Proc. Bost. Soc., vii., 1860, p.334.
§ Smith, Proc. Malac. Soc., v., 1903, p.374.

But Souverbie's species, *Z. regulus*, seems to me to be more slender and more closely ribbed, and worthy of distinction. From New Caledonia, Souverbie described *Columbella pumila*, but finding that Dunker had appropriated that name for a Japanese species, he altered it to *C. regulus.**

Brazier† has correctly reported *C. regulus* from several localities in tropical Queensland; Eclipse, Fitzroy, Palm, Barnard, and Home Islands.

At Port Moresby, Papua, I found *C. regulus* to be common; this is the northernmost record for the species.

Tryon, having wrongly united *C. atrata* to *C. pumila*, proceeded to link together *C. lentiginosa*, *C. smithi*, and *C. darwini*.‡

It has already been explained that *C. lentiginosa* is a Central American shell, distinct from the Australian species. Compared with *C. smithi* Angas, *C. darwini* is twice as long, more solid, of another colour and sculpture, and of a more northern habitat. In *C. darwini*, the ribs continue on the back of the last whorl, but in *C. regulus*, *C. smithi*, and *C. avicennia* there is a smooth space behind the aperture.

So that two distinct Australian shells, namely, *Zafra regulus* (my fig.77) and *Z. avicennia* (figs.68, 69), have been mistaken for the Hong Kong *C. atrata* and the American *C. lentiginosa*, while *Z. darwini* (fig.74), *Z. smithi* (fig.75), and *Z. almiranta* (fig.92) have also been involved in this confusion. That others may sort out these species more easily than I have done, all are now here figured.

ZAFRA AVICENNIA, sp.nov.

(Plate lxxxiii., figs.68, 69.)

Shell solid, glossy, ovate-fusiform. Colour uniform cinnamon-brown. Whorls seven, gradate, last inflated at the periphery and contracted at the base. Sculpture: first two smooth, remainder radially ribbed, ribs prominent, as broad as their inter-

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* Souverbie, Journ. de Conch., xi., 1863, p.281, Pl. xii., fig.4.; *Id.*, op. cit., xii., 1864, p.41.

† Brazier, Journ. of Conch., ii., 1879, p.189.

‡ Tryon, Man. Conch., v., 1883, p.171.

spaces, discontinuous from whorl to whorl, increasing in thickness as the shell grows, produced to the base, amounting to sixteen on the penultimate; the last five gradually vanish from the base upwards and onwards, leaving a smooth space behind the aperture. Beneath the suture, along all the sculptured whorls, winds a cord less prominent than the ribs, uniting and overriding them. On the anterior extremity are seven small, but sharp, spiral threads, ceasing where the ribs commence. Aperture vertical, narrow, posteriorly channelled, outer lip slightly thickened and everted; within, three small denticles decreasing anteriorly, inner lip with a raised margin plicated by the anterior spirals. Canal short, broad, and slightly recurved. Length, 4·5; breadth, 2·1 mm.

Hab.—Abundant in Port Jackson, under sticks and stones in the zone of the Avicennia mangrove. Compared with its nearest ally, *Z. regulus*, this is a stouter shell, with more widely spaced ribs. Except that the Sydney shell has the ribs a little further apart and knobbed on the summit, it is like Reeve's figure of *C. atomella* (as, but not of Duclos).*

Zafra almiranta, sp.nov.

(Plate lxxxv., fig.92.)

Columbella lentiginosa Brazier, Proc. Linn. Soc. N. S. Wales, i., 1876 (1877), p.228, (not of Hinds).

Shell small, solid, conical. Colour buff with a peripheral and basal row of ferruginous dashes. Whorls six. Sculpture: the first two whorls smooth, remainder radially ribbed. Ribs prominent, widely spaced, fifteen on the last whorl, their tops cut off as a bead-row by a subsutural furrow. The base has six, crowded, spiral cords, of which the smaller inner ones are nodulose at the passage of the ribs. Aperture narrow, several denticles within the outer lip. Length, 3·5; breadth, 1·6 mm.

Hab.—Abundant in 10-30 fathoms, off Darnley Island, Torres Straits (J. Brazier). Named in memory of the ship of Torres, the first European vessel to traverse this Strait.

* Reeve, Conch. Icon., xi., 1858, Pl. xx., fig.108.

ZAFRA DEBILIS, sp.nov.

(Plate lxxxiii., figs.70, 71.)

Shell small, thin, slender, conical. Colour fawn with an opaque white zone median on the last whorl, and supersutural on the spire; sometimes there is also a white subsutural band, the white being plainer on the ribs than on the interstices. Whorls seven, gradate. Sculpture: first three whorls smooth, remainder radially ribbed Ribs prominent, broad, vertical, spaced by about their breadth, continuing to the grooving at the base and to the aperture, discontinuous from whorl to whorl, amounting to fourteen on the last whorl. A slender subsutural cord connects the tops of the ribs; beyond the ribs on the exterior extremity are eight, fine, spiral striæ. Aperture narrow, vertical, a little sinuous, contracted posteriorly, inner lip with a free elevate edge, outer lip simple, canal short, bent rather sharply backwards. Length, 3·3; breadth, 1·1 mm.

Hab.—Many specimens dredged, by self, off the Hope Islands, North Queensland, in 5-10 fathoms; and one by Mr. A. U. Henn, off Cape Sidmouth, N. Queensland.

Z. phaula Melvill & Standen, from Karachi (Proc. Zool. Soc., 1901, p.405), is similar in general appearance, but *Z. debilis* is more contracted anteriorly, and has a different colour-pattern.

ZAFRA ATKINSONI Tenison-Woods.

(Plate lxxxiii., fig.72.)

It was briefly observed by Tryon,* under the heading of *Columbella speciosa* Angas, that "*Mangelia atkinsoni* Tenison-Woods, is a synonym." But the name published by Tenison-Woods† appeared on 21st March, 1876, and that of Angas‡ on 1st June, 1877, so that *Zafra atkinsoni* must take precedence.

Though the two appear to intergrade, the forms which received these names are not identical, and, in a varietal sense, the name of Angas deserves to be maintained.

* Tryon, Man. Conch., v., 1883, p.71.

† Tenison-Woods, Proc. Roy. Soc. Tasm., 1875, p.141.

‡ Angas, Proc. Zool. Soc., 1877, p.35, Pl. v., fig.3.

Typical *Z. atkinsoni* is larger, more solid, more constricted, with fewer and more prominent ribs. Since it has not yet been illustrated, I present a figure of an authentic specimen, kindly communicated by the Rev. H. D. Atkinson, whose name it bears. The species in chief, as well as the variety, occur near Sydney.

ZAFRA LURIDA Hedley.

(Plate lxxxiii., fig.73.)

Pyrene lurida Hedley, Proc. Linn. Soc. N. S. Wales, xxxii., 1907, p.510, Pl.17, fig.19.

The variation of related forms is followed by *Z. lurida.* It It may be translucent with opaque white dots on the shoulder, periphery, and base. These dots may be outlined by brown arrow-heads, which again may be united to those above and below by narrowed waved or crooked lines. On a pellucid ground, there may appear a brown peripheral band margined by an opaque white line or dots, as in the figure. The apex is frequently purple.

MUREX PERMÆSTUS, sp.nov.

(Plate lxxxv., fig.91.)

Murex monachus capucinus Chemnitz, Conch. Cab., xi., 1795, p.123, Pl.192, figs.1849, 1850; *Murex capucinus* Kiener, Coq. Viv., Murex, 1843, p.42, Pl. xlv., fig.2; *Id.*, Reeve, Conch. Icon., iii., 1845, Murex, Pl. ii., fig.10; *Id.*, Brazier, Cat. Australian Shells, Murex, 1893, p.58. (Not *Murex capucinus* Lamarck, Anim. s. vert., vii., 1822, p.164).

A large, massive, dark red shell, four and three-quarter inches long, was named *Murex capucinus* by Lamarck. The type of this is still preserved in the Geneva Museum, where I had the privilege of inspecting it, in October, 1912. As the description would suggest, this type proved quite different from that which, both in books and in Museums, is called *Murex capucinus.* Universal error arose from misapprehension of Lamarck's reference to the account of Chemnitz. The different and adult form described and figured by the latter was erroneously cited by Lamarck as "specimen juvenis" of his greater Murex. Reaching the conclusion that *Murex capucinus* Lamarck, (perhaps related to *M. torrefactus* Sowerby, or *Purpura tubulata* Martyn) is distinct from *Murex monachus capucinus* Chemnitz, that the latter has received no other name, and that the polynomial has no standing in nomenclature, it is proper to advance an unnamed Australian species by the new name of *Murex permœstus.*

This tropical species is about the size and shape of *M. denudatus* Perry, but more massive, with the frills suppressed and almost black. Shell very solid, biconical. Colour uniform chocolate-brown to slate-black. Whorls about eight, apex always eroded, contracted below the suture, which undulates across the ribs of the previous whorl. Sculpture: three to each whorl, thick scaly varices, either shorn or with a few short frills, ascending the spire obliquely; these describe a quarter of a revolution. Between the varices are a pair of broadly undulating peripheral ribs. On the last whorl are about twenty spiral cords between which, on the periphery, smaller threads are intercalated. Aperture comparatively small and round, narrowly channelled above, outer lip slightly everted with half-a-dozen entering denticles, inner lip simple, thickened at the margin, and folded over anteriorly. Snout very broad, canal slightly recurved. Figured specimen, 55 mm. long, 27 broad. Another from Port Darwin, 65 mm. long, 33 broad.

Hab.—10 fathoms, off Mapoon, Queensland, (type, figured specimen, dredged by self); crawling on mud, among the mangroves at Cape York; beach, Port Darwin.

KALYDON VINOSUS Lamarck.

(Plate lxxxv., fig.88.)

In the previous part of this series (*antea*, xxxviii., p.330), the identity of *Buccinum vinosum* Lamarck, with *Purpura littorinoides* Tenison-Woods, was noted. A figure is now presented of a Tasmanian specimen, 14 mm. in length, which was approved as authentic by the Geneva Museum.

The species has two colour-forms; in the type, as the name implies, the interior is purple; in the other, it is yellow. This latter has already been noticed by Crosse as *Ricinula adelaidensis* var. (*gamma*).* For this yellow-mouthed form, as developed on the rocks at the south head of Wineglass Bay, Tasmania, I now propose the varietal name of *aurea*.

THAIS DISTINGUENDA Dunker & Zelebor.

Purpura hippocastaneum var., Quoy & Gaimard, Zool. Astrolabe, 1834, Moll., Pl.38, figs.1, 3; *Id.*, Kiener, 1836, Pourpre Armigères, Pl. xiii., fig.36; *Id.*, Reeve, Conch. Icon., vii., 1846, Pl. viii., fig.36*a*. *P. distinguenda* Dunker & Zelebor, Verh. Zool.-bot. Gesell. Wien, 1866, p.910; *Id.*, Frauenfeld, Novara Exped., Moll., 1867, p.5, Pl. i., fig.3; *Id.*, Schmeltz, Mus. Godeff. Cat., v., 1874, p.122; *Id.*, Pease, Amer. Journ. Conch., vii., 1872, p.23; *Id.*, Martens in Möbius, Mauritius, 1880, p.234.

Though repeatedly figured, this form was not distinguished from the hippocastaneum medley until the time of the Novara Expedition. Under the heading of *P. stellata* Bolten, it was reported from Port Denison by Schmeltz. But D'Argenville's figure, Pl.17, fig.H, on which Bolten founded *P. stellata* (Mus. Bolt., 1798, p.54), is too obscure for determination, and, in particular, does not agree with the proportions of *T. distinguenda*.

I have taken this species at Murray Island, Torres Straits, whence it ranges south along the Queensland coast.

THAIS KIENERII Deshayes.

Purpura kienerii Deshayes, Anim. s. vert., x., 1844, p.101, for Kiener, *Purpura*, Pl. xi., fig.32; *Purpura biserialis* Schmeltz, Cat. Mus. Godeff., v., 1874, p.123; *P. bituberculari*s var., Smith, Zool. Alert, 1884, p.50; *P. alveolata* Melvill & Standen, Journ. Linn. Soc. Zool., xxvii., 1899, p.162.

Schmeltz records this from Port Denison. Coppinger found it at Port Molle, and I have taken it at Gatcombe Head. It closely resembles *T. pica*, but may be easily distinguished by the throat, which is smooth, where *T. pica* has raised, coloured, revolving threads.

THAIS PICA Blainville.

Purpura pica Blainville, Nouv. Ann. Mus., i., 1832, Pl.9, fig.9; *Id.*, Reeve, Conch. Icon., vii., Pl. viii., fig.36.

* Crosse, Journ. de Conch., xiii., 1865, p.50.

Under the name of *Murex hippocastaneum*, several species were confused by Linné. His five original citations of it were distributed by Deshayes* thus: three are *Drupa ricinus* Linné, one is *Melongena galeodes* Lamarck, and one an unrecognisable figure by D'Argenville. Hanley† observes that, in later publications, Linné altered his mind, and shifted the name to *P. pica* Blainville. So *M. hippocastaneum* can be reduced to a synonym of *D. ricinus* or transferred to *M. galeodes*, but it cannot be altered to *P. pica*, since that species was not included in the original references of 1758.

T. pica occurs along the whole coast of tropical Queensland.

Thais costata Blainville.

Purpura costata Blainville, Nouv. Ann. Mus., i., 1832, Pl. xi., fig.8 ; *Id.*, Kiener, Purpura, 1836, p.61, Pl.xvii., fig.51 ; *Id.*, Küster, Conch. Cab., 1858, pp.153, 181, Pl.30, figs.10-12 ; *Id.*, von Martens, Journ. Linn. Soc. Zool., xxi., 1889, p.179.

P. gradata Jonas, Zeit. f. Malak., 1846, p.14; *Id.*, Philippi, Abbild. Beschr., ii., 1846, p.187, Pl. xv., fig.2; *P. trigona* Reeve, Conch. Icon., vii., 1846, Pl. xi., fig.53.

This species does not seem to have been reported from Australia. It occurred to me at Mapoon and Karumba, in the Gulf of Carpentaria. Shirley‡ quotes *Thais hæmástoma* Linné, from Moreton Bay. This is a Mediterranean species, and it is improbable that it should occur in the Pacific.

Thais aculeata Regenfuss.

Purpura aculeata Regenfuss, Recueil de Coquillages, 1758, p.viii., Pl.ii., fig. xviii.; *Id.*, Deshayes, Anim. s. vert., x., 1844, p.104; *Purpura hippocastaneum* var., Quoy & Gaimard, Zool. Astrolabe, Moll., Pl.38, figs.5, 6; *Id.*, Kiener, Purpura, Pl.12, fig.33; *Id.*, Reeve, Conch. Icon., Purpura, 1846, Pl. viii., fig.34*c*.

From the compound of *M. hippocastaneum* Gmelin, this species, first named by Regenfuss, was rehabilitated by Deshayes. If

* Deshayes, Anim. s. vert., x., 1844, p.65.
† Hanley, Ips. Linnæi Conch., 1855, p.296.
‡ Shirley, Proc. Roy. Soc. Queensland, xxiii., 1911, p.102.

Regenfuss be rejected as not consistently binomial, the name may be cited as of Deshayes.

I have taken this species at Murray Island.

THAIS ARMIGERA Dillwyn.

Buccinum armigerum Dillwyn, Descrip. Cat. Rec. Shells, ii., 1817, p.612, for Chemn. Conch. Cab., xi., 1795, p.82, Pl.187, figs. 1798, 1799; Reeve, Conch. Icon., Purpura, 1846, Pl. vi., fig.27; Schmeltz, Mus. Godeff. Cat., v., 1874, p.122; Shirley, Proc. Roy. Soc. Queensland, xxiv., 1913, p.56.

Schmeltz records this species from Port Denison. In the South Kensington Museum are two specimens collected by Prof. J. B. Jukes on the reef of Raine Islet.

THAIS BUFO Lamarck.

Purpura bufo Lamarck, Anim. s. vert., vii., 1822, p.239; *Id.*, Deshayes, x., 1844, p.69; *Id.*, Reeve, Conch. Icon., Purpura, 1846, Pl. ii., fig.7; *Id.*, Roth, Queensland Ethnog. Bull., iii., 1901, p.18; *Id.*, Shirley, Proc. Roy. Soc. Queensland, xxiii., 1911, p.102; *Purpurea grisea* Schmeltz, Cat. Mus. Godeff., v., 1874, p.122.

Deshayes considered that the figures of Kiener do not represent this species. Examples answering to Reeve's figure have been seen by me from Cape Cleveland and Port Curtis. Roth reported it from Cape Grafton, Shirley from Yeppoon, and Schmeltz from Port Denison.

THAIS CRASSULNATA, sp.nov.

(Plate lxxxv., fig.90.)

Ricinula fiscellum Reeve, Conch. Icon., ii., 1846, Pl. iv., fig.28; (not *Murex fiscellum* Gmelin, Syst. Nat., xiii., 1791, p.3552); *Purpura fiscella* var., Hombron & Jacquinot, Voy. Pôle Sud, 1853, Pl.22, figs.19, 20; *Murex* (*Ocinebra*) *fiscellum* var., G. & H. Nevill, Journ. Asiat. Soc. Bengal, xliv., 1875, p.83; *Sistrum undatum* var., Smith, Zool. Coll. Alert, 1884, p.51; *Id.*, Proc. Zool. Soc., 1879, p.213, and 1891, p.409.

Two species, figured and described, but polynomially named, by Chemnitz have been confused together, and with others by Lamarck, Blainville, Kiener, Reeve, and most writers on this genus.* These are *Murex fiscellum*, etc., Conch. Cab., x., 1788, p.242, Pl.160, figs.1524, 1525, and *Murex undatus*, etc., Conch. Cab., xi., 1795, p.124, Pl.192, figs.1851, 1852. For the former, Gmelin's binomial of *Murex fiscellum* is available. As Dr. H. Fischer† points out, there can be little doubt of the identity of *Murex ricinuloides* Quoy & Gaimard, with *M. fiscellum.* But Gmelin's binomial of *Murex undatus* was applied to a species different from that of Chemnitz. Even if the view of Mr. E. A. Smith, that the "undatus" of Chemnitz was legitimate, and could be accepted, it must yield to an earlier *Murex undatus*, interposed by Meuschen‡ eight years before. So that *Murex undatus* of Chemnitz was left nameless till Broderip called it *Murex margariticola.*§ It has also been identified as *Murex lienardi* Crosse.‖

As *Murex margariticola* is extremely variable, the present North Australian form was received as but another phase of that polymorphic species. But it appears to differ not only in a more restricted geographical range, but in fewer and bolder ribs, short and broad shape. It may be defined as follows:—

Shell very solid, subumbilicate, biconical, in outline subrhomboidal. Whorls about seven. Colour externally uniform blackish-brown, aperture edged within by dark purple passing into heliotrope and lilac in the throat. Sculpture: short, thick, widely spaced radial ribs, projecting on the periphery, but vanishing before reaching the base or suture, six on the last whorl. On ascending the spire, these become smaller and more numerous. The entire shell is densely covered by fine spiral threads, on the last whorl forty, and on the penultimate twelve, beset with close minute imbricating scales. Aperture elliptical, subchannelled posteriorly, outer lip denticulated by the spiral sculpture. Four or five small tubercles within the lip. Canal very short, slightly

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* von Martens, Malak. Blatt., xix., 1872, p.242.

† Fischer, Journ. de Conch., xlix., 1901, p.105.

‡ Smith, in Gardiner, Fauna Maldive Arch., ii., 1903, p.609. Meuschen Mus. Gever., 1787, p.330.

§ Broderip, Proc. Zool. Soc., 1832, p.177. Sowerby, Conch. Illustr., Murex, fig.21, 1834.

‖ von Martens, in Möbius, Fauna Mauritius, 1880, p.232.

recurved. Umbilicus variable, usually pervious, surrounded by a funicle running into the canal. Length, 32; breadth, 20 mm.

Hab.—Sweers Island (type) and Mornington Island, Gulf of Carpentaria (coll. self), Port Essington and Port Darwin (Alert), Raffles Bay (Hombron and Jacquinot).

THAIS TURBINOIDES Blainville.

Purpura turbinoides Blainville, Nouv. Ann. Mus., i., 1832, p.217; *Id.*, Kiener, Coq. Viv., p.118, Pl.35, fig.82; *P. thiarella* Quoy & Gaimard (not Lamk.), Zool. Astrolabe, ii., 1833, p.571, Pl.39, figs.4, 6; *Murex iostoma* Sowerby, Conch. Illustr., 1834, p.8, Pl. vii., fig.42; [not *Murex iostoma* A. Adams, Proc. Zool. Soc., 1851 (1853), p.267]; *Murex decussatus* Reeve, Conch. Icon., Murex, 1845, Pl. xxxi., fig.153; (not *Murex decussatus* Gmelin, Syst. Nat., xiii., 1791, p.3527); *Purpura stellaris* Hombron & Jacquinot, Moll. Astrol. and Zélée, 1853, Pl. xxii., figs.13, 14; *Id.*, *op. cit.*, Rousseau, 1854, p.88.

This is another species which has been confused with *T. fiscellum*. A specimen of this was collected at Lizard Island, Queensland, by Dr. A. E. Finckh.

SIPHONARIA VIRGULATA, sp.nov.

(Plate lxxxv., figs.96, 97, 98.)

Siphonaria funiculata Angas, Proc. Zool. Soc., 1867, p.232 [not *S. f.* Reeve, Conch. Icon., ix., 1856, Pl. ii., fig.6, nor *S. f.* (=*lirata* Reeve), *op. cit.*, Pl. vii., fig.35]; *Id.*, Henn & Brazier, Proc. Linn. Soc. N. S. Wales, (2), ix., 1894, p.179.

Shell rather thin, almost symmetrical, suborbicular, apex subcentral. Colour: interior with a central bluish callus, surrounded by a broad dark chocolate zone fading externally to pale brown with white dashes on the margin; exterior with apex dark brown, riblets white, their interstices irregularly chocolate. Sculpture: about seventy radial riblets, which narrow and waver as they ascend. Their size is irregular, about a third or fourth riblet being larger than the rest, margin finely denticulate. Siphonal fold slight and shallow. Length, 21; breadth, 19; height, 9 mm.

Hab.—Terrigal, Sydney, and Twofold Bay; in the wash of the surf on ocean-beaches (self).

This was identified by Angas as *S. funiculata* (No.1) of Reeve. But that Tasmanian species differs by being more solid, narrower, taller, with sharper contrast between light and dark stripes, and fewer coarser radials. From the example in South Kensington Museum, I considered that *S. blainvillei* Hanley,* was an elevated form of *S. funiculata*. In the same collection are two tablets of *S. virgulata*; one, a set of four, was from Manly, the other, a set of three, had been first labelled "funiculata," and then corrected to "not funiculata." Nearer to our novelty than *funiculata* is *S. zonata* Ten.-Woods,† which is taller, narrower, darker in colour, more coarsely and evenly sculptured, and ranging from Tasmania to Victoria, and South Australia, being the Adelaidean correspondent of the Peronian *virgulata*.

Besides this misidentification of *S. funiculata*, Angas apparently was mistaken also in recording *S. denticulata*, *S. cochleariformis*, and *S. atra* from New South Wales. After purifying the genus by their exclusion, I can add *Siphonaria stowæ* Verco,‡ of which I have collected several specimens in Middle Harbour.

Retusa iredaleana, sp.nov.

(Plate lxxxv., figs.93, 94.)

Shell small, cylindrical, rounded anteriorly, truncate posteriorly. Colour dull white. Sculpture: fine radial threads which enlarge and curve in on the vertex. Aperture anteriorly pyriform, medially narrow and constricted, posteriorly rising above the last whorl and looped over towards the axis, a small oblique plait on the columella. Spire deeply sunk, the summits of previous whorls visible, sculptured by transverse riblets descending to a papillary apex. Length, 3; breadth, 1·5 mm.

Hab.—Middle Harbour, Sydney (self). This is like *R. amphizosta* from North Queensland, but lacks spiral sculpture, is not as compressed at the waist, has the aperture carried up higher, and the spire more deeply sunk. From Portsea, Victoria, Messrs.

* Hanley, Proc. Zool. Soc., 1858, p.153.

† Ten.-Woods, Proc. Roy. Soc. Tasm., 1877 (1879), pp.47, 99.

‡ Verco, Trans. Roy. Soc. S.A., xxx., 1906, p.223, Pl. vii., f.3-8.

Gatliff & Gabriel* record a variation of *R. amphizosta*, which may possibly be this. *Cylichna atkinsoni* Ten.-Woods,† which also occurs in Sydney Harbour, is larger than *R. iredaleana*, more inflated medially, more contracted posteriorly, with a narrow vertical pore.

Named in honour of Mr. Tom Iredale, and in remembrance of the excellent critical work that he has done on the Australian mollusca.

Ringicula denticulata Gould.

(Plate lxxxv., fig.95)

R. denticulata Gould, Proc. Bost. Soc. Nat. Hist., vii., 1860, p.325; *Id.*, Tenison-Woods, These Proceedings, ii., 1878, p.256.

From Port Jackson, Angas enumerated four species of *Ringicula*, viz., *caron*, *denticulata*, *doliaris*, and *exserta*. As I have already mentioned (*antea*, xxxviii., p.336), his identifications were incorrect; only *R. denticulata* and *R. doliaris* occur here. In the Challenger Reports, *R. doliaris* was figured, but *R. denticulata* has not yet been illustrated. This deficiency is now made good. *R. denticulata* was taken by the Thetis Expedition in 63-75 fathoms, off Port Kembla; it is a rarer shell than *R. doliaris*.

EXPLANATION OF PLATES LXXVII.-LXXXV.

Plate lxxvii.

Fig.1.—Type of *Lepton concentricum* Gould.
Figs.2, 3.—Type of *Kellia balaustina* Gould.
Fig.4.—Type of *Subemarginula radiata* Gould.
Fig.5.—Type of *Elenchus exignus* Gould.
Fig.6.—Type of *Cerithium lacertinum* Gould.

Plate lxxviii.

Figs.7, 8, 9.—*Leda dysera* Hedley.
Figs.10, 11.—*L. electilis* Hedley.
Figs.12, 13, 14.—*L. narthecia* Hedley.
Figs.15, 16.—*Poroleda ensicula* Angas.
Figs.17, 18.—*Poroleda spathula* Hedley.
Figs.19, 20.—*Arca strabo* Hedley.

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* Gatliff & Gabriel, Proc. Roy. Soc. Vict., xxi., 1908, p.384.

† Proc. Roy. Soc. Tasm., 1876, p.156; 1902, p.113, fig.11.

Plate lxxix.

Figs. 21, 22, 23.—*Cratis progressa* Hedley.
Fig. 24.—*Modiola pulex* Lamarck.
Figs. 25, 26, 27, 28.—*Codakia pisidium* Dunker.
Figs. 29, 30, 31, 32.—*Neolepton novacambrica* Hedley.

Plate lxxx.

Figs. 33, 34, 35, 36.—*Joannisiella subquadrata* Hedley
Figs. 37, 38, 39.—*Erycina helmsi* Hedley.
Figs. 40, 41, 42.—*Panopæa angusta* Hedley.
Figs. 43, 44.—*Solecurtus tenerior* Hedley.

Plate lxxxi.

Fig. 45.—*Gibbula strangei* A. Adams.
Figs. 46, 47, 48.—*Liotia botanica* Hedley.
Fig. 49.—*Charisma compacta* Hedley.
Figs. 50, 51, 52.—*Acmæa mufria* Hedley.
Fig. 53.—*Obtortio lutosus* Hedley.
Fig. 54.—*Bittium elongatum* Sowerby.

Plate lxxxii.

Fig. 55.—*Petterdiana brazieri* Smith.
Figs. 56, 57—*Glyphostoma alliteratum* Hedley.
Fig. 58.—*Daphnella aculeola* Hedley.
Fig. 59.—*Drillia commenticius* Hedley.
Figs. 60, 61.—*Glyphostoma bicolor* Angas.
Figs. 62, 63.—*Polinices ephebus* Hedley.
Fig. 64.—*Marginella inconspicua* Sowerby.
Fig. 65.—*M. malina* Hedley.
Fig. 66.—*M. angasi* Crosse.
Fig. 67.—*M. translucida* Sowerby.

Plate lxxxiii.

Figs. 68, 69.—*Zafra avicennia* Hedley.
Figs. 70, 71.—*Z. debilis* Hedley.
Fig. 72.—*Z. atkinsoni* Ten.-Woods.
Fig. 73.—*Z. lurida* Hedley, var.
Fig. 74.—*Z. darwini* Angas.
Fig. 75.—*Z. smithi* Angas.
Fig. 76.—*Arcularia cœlata* v. *torresiana* Hedley.
Fig. 77.—*Zafra regulus* Souverbie.
Fig. 78.—*Arcularia semigranosa* Dunker; redrawn from a photo of the type of *Nassa optata* Gould.

Plate lxxxiv.

Fig.79.—*Maculotriton gracilis* Sowerby.
Fig.80.—*Arcularia pilata* Hedley.
Fig.81.—*A. tasmanica* Ten.-Woods.
Figs.82, 83.—*Pyrene felina* Hedley.
Fig.84.—*Mitra volucra* Hedley.
Fig.85.—*M. acromialis* Hedley.
Fig.86.—*Duplicaria bullina* Hedley.
Fig.87.—*Engina gannita* Hedley.

Plate lxxxv.

Fig.88.—*Kalydon vinosus* Lamarck.
Fig.89.—*Cerithium tomlini* Hedley.
Fig.90.—*Thais crassulnata* Hedley.
Fig.91.—*Murex permæstus* Hedley.
Fig.92.—*Zafra almiranta* Hedley.
Figs-93, 94.—*Retusa iredaleana* Hedley.
Fig.95.—*Ringicula denticulata* Gould.
Figs.96, 97, 98.—*Siphonaria virgulata* Hedley.

SOME NOTES ON THE FERNS OF NORTH QUEENSLAND.

By the Rev. W. Walter Watts.

(Plates lxxxvi.-lxxxix.)

In the winter of 1913 (July-August), I spent a month in the Cairns district in search of Ferns and Mosses. I collected in the rich scrub-lands between Bartle Frere and the Russell River, more especially in the neighbourhood of Josephine Creek; around Babinda also, and up Frenchman's Creek to beyond the Second Falls. Babinda and Frenchman's Creek lie at the base of Bellenden Ker, along the coastal railway. Following, later, the main line, I visited Stoney Creek, Kuranda, Atherton, Malanda, Yungaburra, Lake Barrine, and, last and best of all, Ravenshoe and the Tully Falls. These Notes deal with the Ferns collected during this trip.

It was a great pleasure to make the acquaintance of species after species that belong to the Malayan flora, and are not found even in Southern Queensland. But therein lay the difficulty of determination. Mr. F. M. Bailey, the veteran Government Botanist of Queensland, had kindly supplied me with a number of species, and others were available in the National Herbarium, Sydney, collected mainly by Mr. R. F. Waller, in the Herberton district, in 1908; but the want of access to types has been greatly felt. Valued assistance has been received from Dr. K. Domin's painstaking work on the Ferns of Australia, published in the "Bibliotheca Botanica," under the title "Beiträge zur Flora und Pflanzengeographie Australiens. i.Lieferung," herein referred to as "Prodr." (Prodromus), the secondary title of the first volume of the Beiträge. This work arrived in Australia just about the time that I began my trip, and I had no opportunity of studying it until after my return. This I regretted exceedingly, for Dr. Domin had spent considerable time in North Queensland, and his work raises problems that escaped my notice while in the field. Students of the fern-life of Australia, especially of the far north, will find Dr. Domin's work, despite its tendency to, in my opinion, undue division of species, quite indispensable. Of the help derived from the various publications of Mr. F. M. Bailey, it is unnecessary to speak. I have only to express my great indebtedness to his published works, and my personal thanks for much kindness received at his hands.

I am greatly indebted also to Captain van A. van Rosenburgh's "Malayan Ferns" (1909).

In recent years, many changes have been made in the nomenclature of the ferns. This is due to historical researches into the earliest specific names, the justice of a return to which must be acknowledged, and also to the inevitable splitting up of such large genera as *Aspidium* and *Polypodium*. Probably the most notable change made has been the discarding of the distinction between *Aspidieæ* and *Polypodieæ*, based upon the artificial character of the presence or absence of an indusium. The genus *Dryopteris* (*Aspidieæ*) contains both indusiate and non-indusiate forms; but a question that will certainly call for attention, sooner or later, is whether the genus *Dryopteris* is not really too comprehensive.

The species herein recorded were all collected by myself, except where otherwise stated.

HYMENOPHYLLACEÆ.

TRICHOMANES L.

Subgen. *Hemiphlebium* Prantl.

T. MOTLEYI V. d. Bosch.

Street's Bush, Kuranda; and Josephine Creek, Bartle Frere; July, 1913.

T. VITIENSE Bak.

Near Tully Falls; August, 1913.

T. BIMARGINATUM V.d.B.; *T. yandinense* Bail.

Street's Bush, Kuranda, and Frenchman's Creek; July, 1913.

Some difficulty has arisen over this plant and its allies. Dr. Christ, in "Die Farnkraüter der Erde" (1897), omits *T. bimar-*

ginatum, but says of *T. muscoides* Sw., "durch die Tropen aller Welttheile." Sadebeck, in Pflanzenfamilien (1899), takes the same view, and merges *T. bimarginatum* in *T. muscoides*, according to earlier determinations. Luerssen, in "Fil. Græf." (1871), held that *T. bimarginatum* was not distinguishable from *T. muscoides* Sw. This opinion he recalled in Bot. Centralbl., ix., 12 (1882). Christensen, in Index Filicum (1906), separates these plants and limits *T. muscoides* to tropical America. Domin follows Luerssen and Christensen in this. Bailey's *T. yandinense* appears to be identical with *T. bimarginatum*. F. von Mueller identified *T. yandinense* with *T. cuspidatum* Willd., but this species is apparently limited to Madagascar and E. and W. Africa.

A plant collected by me at Josephine Creek, where it was plentiful on the stems of trees, I at first regarded as *T. bimarginatum*, with which it agrees in its submarginal spurious vein: but the description of *T. bimarginatum* in A. van Rosenburgh's "Malayan Ferns," is "oblong-lanceolate, *not lobed*, sometimes bifid at apex." With this the fig. (Pl. iii.) in Domin agrees, as do also my specimens from Kuranda. The Josephine Creek plant is cuneate-oblong, distinctly and often deeply lobed, with crenulate and undulate margins; the spurious veins also are stronger and fewer. In general outline it resembles the fertile frond of *T. cuspidatum*, according to Christ's figure, and is apparently the plant figured by Bailey in Q. Bot. Bull. No.13 (1891), and described as *T. muscoides* Sw. Believing it to differ from all the three plants named, I have ventured to describe it as a new species, and have dedicated it to the veteran pteridologist, Mr. F. M. Bailey.

T. Baileyanum, sp.nov. (Plate lxxxvi., fig.1,*a-d*).

Rhizoma filiforme, longe repens, dense et crasse tomentosum. *Stipites* in seriebus, breves, interdum fere nulli, hirsuti. *Frons* 1-2 cm. longa et ad 0·5 cm. lata, basi anguste et longe cuneata, infra hirsuta, supra nuda, in juventate simplex, vel longa et perangusta vel brevis et basi rotundata, in maturitate latior et in parte superiore profunde lobata, marginibus plus minusve crenulatis et undulatis, nervis validis, plerumque viridibus, pinnatis, costâ centrali (in frondibus et sterilibus et fertilibus) ad apicem attingenti, segmentis uninervatis, spuriis venulis interpositis et plerumque cum venula submarginali conjunctis; cellulæ elongatæ, muris crassis, levibus. *Indusium* terminale, minutum, immersum, ore late dilatato, cum paucis longitudinalibus spuriis venulis in parte dilatata. *Textura* membranacea. *Color* viridis ad flavo-viridis. *Receptaculum* (in speciminibus) vel non-exserta vel breviter exserta.

On trees, Josephine Creek, Bartle Frere; July, 1913.

This plant differs from *T. bimarginatum* in the deeply lobed, narrowly cuneate frond, the strong pinnate venation both in the sterile and fertile fronds, and in the longitudinal spurious veins, not always easily detected, in the dilated part of the indusium. I have no specimen of *T. cuspidatum*, but, from Dr. Christ's description and figure, in "Farnkr.", our plant is sufficiently distinct. I accept the judgment of Christensen and Domin, that *T. cuspidatum* is not known in Australia. Our plant is not unlike that figured in Beddome's Ferns of British India (Pl.304) as *T. muscoides* Sw.; but see note under *T. bimarginatum*.

Domin's work contains a description of a new species (*T. paradoxum*) from Bellenden Ker. This I did not find, nor the other recorded species, *T. peltatum* Bak., and *T. Sayeri* F.v.M.

Subgen. *Gonocormus* V. d. Bosch.

T. PARVULUM Poir.

Frenchman's Creek, Babinda; Street's Bush, Kuranda; near Josephine Creek; July, 1913.

T. MINUTUM Bl.

Frenchman's Creek, Babinda; July, 1913.

T. PROLIFERUM Bl.

Frenchman's Creek; July, 1913.

T. MAJORÆ, sp.nov. (Plate lxxxvi., figs.2, *a-d*).

Rhizoma valido-filiforme, repens, obtusis fuscis breviusculis pilis dense vestitum. *Stipes* brevissimus, 1-2 mm. longus, ater, hirsutus. *Frons* olivaceo-viridis, 0·5-1·2 cm. longa, 0·4-0·6 cm. lata, infra cuneata, oblongo-obovata vel rhomboidea, fere ad alatam rhachem pinnatifida, lobis plus minusve elongatis, in 2-3 lobulas breves divisis, apicibus rotundatis; nervus validus, pinnatus; venulæ dichotome ramosæ, infra apicem evanidæ; venulæ spuriæ numerosæ, breves, flexuosæ, inter nervos irregulariter dispersæ, non marginales; cellulæ irregulariter sexangulares, muris crassis, levibus. *Sori* in lobulis terminalibus immersi. *Indusium* infundibuliforme, vix dilatatum, vix bilabiatum. *Receptaculum* breviter exsertum.

Falls, near Major's Selection, Ravenshoe, Herberton district; leg. Miss Major and Rev. W. W. Watts; August, 1913.

The very distinct spurious venules make it doubtful whether this plant is a true Gonocormus, but I place it here tentatively.

The other species of this section recorded for North Queensland are *T. digitatum* Sw.,(Bellenden Ker; Domin); *T. nanum* V.d.B.,(*T. Kurzii* Bedd.) var. *australiense* Bail.; and *T. Wildii* Bail.,(nr. Cairns; C. J. Wild). These I did not find. Christensen, in Index Fil., regards *T. Wildii* as a doubtful species, and Bailey described it with some hesitancy; but it is a good species. It should, perhaps, be described as "pinnatifid," rather than "pinnate," though the lowest segments are sometimes pinnate. The striking characters are the large indusium occupying, upwards, almost the whole segment, with a wide but not two-lipped mouth, and the uninterrupted border of two lines of elongated cells, the inner denser so as to make, apparently, an intramarginal spurious vein, the outer not so long, as a rule, and hyaline. The cell-formation is open, and reminds of that of *T. nanum* var. *australiense*, but the cells are larger. In *T. nanum* also, there is a distinctly thickened submarginal line, and the hyaline cells of the border are short, with thick walls at right angles to the edge, while in *T. Wildii* the hyaline cells are longer and have thinner walls that, for the most part, are slanting (Plate lxxxvi., fig.4,*a-c*).

Subgen. *Eutrichomanes*.

T. Barnardianum Bail.

Frenchman's Creek; July, 1913.

This species was also found in the Evelyn Scrub by Mr. R. F. Waller, in 1908 (Hb. Syd.). It would appear to be fairly frequent. Christensen, in Index Fil., merged the plant in *T. pyxidiferum*, from which, however, it certainly differs. It is more closely allied to *T. bipunctatum*. In the National Herbarium, Sydney, the late Mr. Betche, following Christensen, labelled it as a var. of *T. pyxidiferum*, but, in a note with which I entirely agree, said, "It seems to me so widely different from *T. pyxidiferum* that I would rather keep to Bailey's name." *T. Barnardianum* has the indusium two-lipped, after the manner of *T bipunctatum*, thus differing entirely from *T. pyxidiferum*.

T. BIPUNCTATUM Poir. (*T. filicula* Bory).

Frenchman's Creek and Babinda Creek; July, 1913.

This species has, according to Luerssen (Bot. Centralbl., ix., No.12), been much confused with *T. pyxidiferum* by Australian botanists, as well as in the Flora Australiensis. He had not seen the true *T. pyxidiferum* among numerous Australian specimens in his possession. I did not find it; but it is recorded by Domin from Bellenden Ker.

T. PYXIDIFERUM L.

A small plant collected by R. F. Waller in the Evelyn Scrub, 1908 (Hb. Syd.), I place here provisionally. See note under *T. bipunctatum*.

T. WALLERI, sp.nov. ("*T. bipunctatum*" Betche, in Hb. Syd.).
(Plate lxxxvi., fig.3,*a-d*.)

Rhizoma filiforme, repens, breviter ramosum, fuscis pilis dense vestitum. *Stipes* subsessilis ad 1 cm. longus, supra per pinnas decurrentes anguste alatus. *Frons* 1-2 cm. longa, 0·5-1·5 cm. lata, irregulariter pinnatifida, lobis integris vel in 2-4 angusta integra, irregularia segmenta divisis, rhachi valida, alata, nervis pinnatis, alternantibus, segmentorum apicem versus angustantibus; venulæ spuriæ numerosæ, prominentes, breves, flexuosæ, plerumque a costâ marginem versus divergentes; cellulæ perminutæ, densæ, irregulares, muris crassiusculis, levibus. *Indusium* pro planta magnum, in brevi segmento laterali, obconicum, supra perlatum, distincte bilabiatum, labiis magnis, obtuse triangularibus, cum apicalibus spuriis venulis. *Receptaculum* (in speciminibus) non-exsertum.

Herberton district; R. F. Waller, 1908 (Hb. Syd.).

A very distinctive species. The lips of the indusium remind one of *T. bipunctatum*, but the indusium is differently shaped, being perfectly obconical, very like a pegtop or a boy's kite in outline. The absence of the submarginal vein also separates it very definitely from *T. bipunctatum*. In this respect, it is similar to *T. Majoræ*, in which, however, the spurious veins are more or less parallel to the midrib (not "mostly divergent"), and which differs widely in the shape of the indusium, etc.

T. CAUDATUM Brack.

Herberton district; Waller, 1908 (Hb. Syd.). Not previously known in North Queensland, apparently.

T. PARVIFLORUM Poir.

Creek, half-way to Tully Falls (Gordon track); August, 1913.

T. RIGIDUM Sw.

Creek, half-way to Tully Falls; in creeks at several places near Ravenshoe; also Street's Bush, Kuranda. Common; Aug., 1913.

T. pallidum, *T. serratulum* (found by Domin on the highest peak of Bellenden Ker), *T. Bauerianum*, *T. rigidum* var *laxum*, and *T. cupressoides* (found by Domin on Bellenden Ker and recorded as new for Australia) I did not collect.

HYMENOPHYLLUM Sm.

The characters usually relied upon for distinguishing *Hymenophyllum* from *Trichomanes* are more or less unstable. The exserted receptacle is found among the Hymenophylla as well as in *Trichomanes*, a striking instance being Bailey's *H. trichomanoides* (*H. Baileyanum* Dom.); the deeply divided indusium is distinctive of many Hymenophylla; but a more reliable character, probably, is to be found in the cell-formation of the membrane of the spore-cases; those of *Hymenophyllum* being usually regular and numerous, and those of *Trichomanes* irregular and few. In general, however, it may be said, with the late Baron von Mueller, that the distinctions are rather sectional than generic.

The subgeneric distinctions, within *Hymenophyllum*, though convenient, appear to me to be arbitrary. Sadebeck, in Engler's

"Pflanzenfamilien," divides all the species into *Euhymenophyllum* (leaves entire) and *Leptocionium* (leaves toothed). *Leptocionium* is usually defined as "ultimate segments spinuloso-denticulate." Dr. Christ gives: "Rand des Laubes buchtig gezähnt, Zähne grannenartig zugespitzt." Domin has set up an intermediate subgenus (*Hemicyatheon*), containing plants of both kinds: leaves entire and serrate. His distinctions are:

Euhymenophyllum: ultimate segments entire; indusium consisting of two laminæ; receptacle as long as the indusium or shorter.

Hemicyatheon: ultimate segments entire or spinuloso-denticulate; indusium funnel-shaped below, connate, profoundly bilabiate above (down to half-way or two-thirds) and campanulato-patent; receptacle long-exserted.

Leptocionium: segments spinuloso-denticulate; indusium divided almost or quite to the base; receptacle enclosed.

The new subgenus seems, to me, to be open to the objections, that it over-rates the value of the length of the receptacle, a feature often difficult to detect in older specimens, owing to the ease with which the exserted receptacle is broken away; and that it brings together species that, in other respects, differ very widely. On the whole, I prefer the old division into *Euhymenophyllum* and *Leptocionium*. But the definition of *Leptocionium* (segments spinuloso-denticulate) suggests the question whether some species may not be "denticulate" without being "spinuloso-denticulate." A case of this kind has arisen in Domin's *H. Shirleyanum*. I found specimens of this fern mixed with *H. australe* (leaves entire) in the Sydney Herbarium (leg. R. F. Waller, 1908; Evelyn Scrub). In size, the fronds did not differ seriously from those of *H. australe*, with which they were mixed, but they were more transparent and were somewhat arcuate at the apex. I was inclined at first, before I identified this plant with *H. Shirleyanum*, to regard it as a new variety of *H. australe*, from which it differs, mainly, in having the ultimate segments minutely denticulate. That the presence or absence of minute denticulations should separate two plants into different subgenera, suggests a serious doubt regarding the current subgeneric classification. I take the broadest view of the two subgenera (seeing it is convenient to follow the accepted classification), as does Sadebeck, and divide the species as follows:

Ultimate segments entire.................... *Euhymenophyllum.*
Ultimate segments serrate or denticulate.. *Leptocionium.*

Subgenus i. *Euhymenophyllum.*

Section i. *Receptacle not exserted.*

H. AUSTRALE Willd.; *H. javanicum* Spreng.

Evelyn Scrub, mixed with *H. Shirleyanum* Dom.; R. F. Waller, 1908 (Hb. Syd.).

The fronds are considerably larger than any I have seen from New South Wales, though not larger than specimens from the Islands.

H. WALLERI Maiden & Betche, Proc. Linn. Soc. N. S. Wales, 1910, p.802.

On prostrate tree by creek, Major's Homestead, Ravenshoe, Herberton district; August, 1913.

My specimens are smaller and mostly more orbicular than those of the type (Evelyn Scrub; Waller). They were growing in association with *H. Baileyanum*, both species in rather poor condition.

At first, I intended publishing this plant as a new species, but I am convinced that it is only a small form of *H. Walleri.* The description of that species will, however, need some slight modification in the light of the additional specimens The fronds are described as "$1\frac{1}{4}''$ long and 1″ broad, sometimes narrower in the sterile fronds." My specimens range from 1-2 cm. long and broad (*i.e.*, not more than 2/3″ in greatest length), though they are sometimes, like the type, a little longer than broad. The overlapping pinnæ (in both collections) are very marked; when moist, the pinnules and lobes stand up from the plane of the frond, after the manner of the lobes of a parsley leaf. It should also be noted that scales, similar to those of the rhizome and stipes, are found on the rhachis and costæ, and often fringing the base of the indusium. Perhaps it may be allowable to regard my specimens as var. *orbiculatum*, var.nov.

Section ii. *Receptacle exserted.*

H. Baileyanum Dom.; *H. trichomanoides* Bailey, non V.d. Bosch.

On prostrate tree with *H. Walleri*, by creek, Major's Homestead, Ravenshoe; August, 1913. A most distinctive and beautiful species.

Subgenus *Leptocionium.*

Section i. *Ultimate segments minutely denticulate.*

H. Shirleyanum Dom., Prodr., p.22, Pls. i., ii.

Evelyn Scrub, mixed with *H. australe*; R. F. Waller, 1908(Hb. Syd.).

Section ii. *Ultimate segments more or less spinuloso-denticulate.*

A. *Receptacle not exserted.*

H. gracilescens Dom., *loc. cit.*, p.23.

Evelyn Scrub; R. F. Waller, 1908 (Hb. Syd., under "*H. tunbridgense*").

B. *Receptacle exserted.*

(a) *Leaves not crisped.*

H. prætervisum Christ.(?var.).

Evelyn Scrub; R. F. Waller, 1908 (Hb. Syd.; adjudged by the late Mr. Betche to be "a small form of the common *H. tunbridgense* ").

It is with some hesitancy that I assign this plant to Dr. Christ's species (from Borneo and Samoa) except as a variety. The frond is more compactly ovate, or ovate-lanceolate, and more regularly pinnate than the specimens of *H. prætervisum* (from Samoa) in the Sydney Herbarium; but the two agree in the closely denticulate segments, and the clustering of the sori at the apex of the frond; save that, in Mr. Waller's specimens, the sorus is scarcely stipitate, and the lips of the indusium are crenulato denticulate, not entire. I attach less importance than I might otherwise have done to this last point, since the lips of the indusium in the Samoan plant are scarcely "entire."

Mr. Waller's plant seems to answer very nearly to the description of the type; but possibly the distinctly crenulato-denticulate apex of the indusium would warrant making it a variety ("*queenslandicum*").

Var. AUSTRALIENSE Dom. See *H. pseudo-tunbridgense*.

H. BABINDÆ, sp.nov. (Plate lxxxvii., fig.5,*a-c*).

Rhizoma filiforme, repens, ramosum, parce hirsutum. *Stipes* 0·5-1·5 cm. altus, in superiori dimidio alatus, alâ supra lata sensim deorsum angustanti denticulatulâ, infra parce hirsutus. *Frons* 1-2 cm. longa et 1-1·5 cm. lata, irregulariter ovato-oblonga vel rhomboidea, pinnatifida, pinnis subflabellatis, in segmenta plus minusve elongata sinuato-denticulata divisa, denticulis sæpe elongatis, angustis, et sursum curvatis, apice rotundato interdum emarginato; rhachis parce hirsuta, late alata, alâ integra vel denticulata; cellulæ elongatæ, muris percrassis, levibus. *Sori* solitarii in segmento angustato prope apicem ; indusium basi infundibuliforme, nudum, supra in duas labias profunde divisum, labiis apice subacutis vel anguste rotundatis, integris vel subintegris. *Receptaculum* validum, plus minusve longe exsertum.

On rocks, mixed with *Trichomanes minutum* and Hepatics, Frenchman's Creek, near Babinda; July, 1913.

Very similar to *H. prætervisum*, but the stipes is distinctly winged in the upper half, and the whole of the frond is pinnatifid down to a widely winged rhachis; the segments also, for the most part, are longer, and the denticulations are often strikingly elongated; the sori, too, never seem to be clustered at the apex, as in *H. prætervisum*.

H. PSEUDO-TUNBRIDGENSE, sp.nov.; *H. tunbridgense* var. *exsertum* Bail., 3rd Suppl. Syn. Q. Fl., 1890; *H. prætervisum* var. *australiense* Dom.

Rhizoma valido-filiforme, repens, parce hirsutum, ramosum, ramis atris, hirsutis. *Stipes* 2-3 cm. altus, erectus, angustissime et indistincte alatus, plus minusve hirsutus. *Frons* 4-6 cm. longa et 1·2 cm. lata, ovata vel ovato-lanceolata, erecta vel arcuatula, pinnata, pinnis 6-10-jugis, flabellato-pinnatifidis, segmentis acroscopicis evolutioribus, omnibus modice angustatis (cir. 1-1·25 mm. latis), dense spinuloso-denticulatis, apice rotundato vel interdum emarginato; rhachis angustissime alata, parce hirsuta; cellulæ elongatæ, angustæ, muris crassis, levibus. *Sori* plerumque solitarii, raro bini, in superiore frondis dimidio, in segmentis brevibus anterioribus. *Indusium* elongatum, angustatum, infra infundibuliforme, connatum, parce hirsutum, supra in duas perlongas labias divisum, apice anguste-rotundato, integro. *Receptaculum* (in speciminibus completis) longe exsertum.

Evelyn Scrub; R. F. Waller, 1908 (Hb. Syd., under "*H. tunbridgense* var. *exsertum* Bail.").

This very distinct species agrees with *H. tunbridgense* in having the sori on short anterior segments next to the rhachis, but differs greatly through the half-cupped indusium with its entire lips, the exserted receptacle, the cell-formation, and the hairy stipes and rhachis. In the cell-formation and in the closely placed, sharp teeth of the segments, it approaches *H. prætervisum*, but differs in size and construction, and especially in the position and structure of the sori. I was, at first, inclined to regard this as a different plant from *H. tunbridgense* var. *exsertum* Bail., but having seen a fruiting frond of var. *exsertum*, I am convinced that the two are identical. Domin made this plant a var. of *H. prætervisum* Christ, but the fructification is not at all clustered at the apex, as it is in Dr. Christ's species.

(b) *Leaves strongly crisped throughout.*

H. Kerianum, sp.nov. (Plate lxxxvii., fig.6,*a-e*.)

Rhizoma tenui-filiforme, ramosum, longis flexuosis articulatis paleis parce præditum, præcipue in nodulis frondes gerentibus. *Stipes* 1-2 cm. altus, fere ad basin alatus, alâ sinuoso-denticulata (in speciminibus raro completa), supra latiore. *Frons* 2-3·5 cm. longa et 1-2 cm. lata, ovato-oblonga vel lanceolata, suberecta vel falcatula, pinnis alternantibus, modice distantibus, 4-6-jugis, erecto-patentibus, flabellato-pinnatifidis, ultimis segmentis crispatis, sinuato-denticulatis denticulis elongatis pulcherrimis, nervis distinctissimis, rufo-fuscis; rhachis alâ latiuscula, crispata, sinuato-longedenticulata instructa, costis similiter constructis; cellulæ pulcherrimæ, irregulares, plus minusve rubentes, muris crassis lineâ centrali angusta interrupte-hyalina instructis. *Sori* solitarii, 4-6 in segmentis brevibus, anterioribus, in parte frondis superiore. *Indusium* breviter obconicum, tubo brevi, striis paucis (2 vel 3) prædito, labiis magnis, duas partes tertias ex indusio occupantibus, apice rotundato, sinuato-denticulato ad sinuato-subfimbriato. *Receptaculum* validum, exsertum. Sporæ mediocres, leves, flavæ.

Frenchman's Creek; July, 1913. On rocks.

In the absence of specimens of *H. Neesii* and the allied Boschian species, this new species is set up with some hesitancy. None of these allied plants have, however, so far as I can find, been previously recorded for Australia, and the present plant appears to differ sufficiently, (1) from *H. Neesii* by the sinuato-denticulate wing of the stipes, the absence of the muricate dentations on the indusium, etc.; (2) from *H. aculeatum* by the much narrower wing of the rhachis; and (3) from other species by the striking elongations that often mark the dentations of the wing throughout. The fruiting specimens in my collection are few and old, so that the description of the receptacle and the base of the indusium is liable to correction. The few striæ appear to reach half-way up the indusium, and, in one or two specimens, seem to end in a free seta.

CYATHEACEÆ.

Alsophila R.Br.

A. Rebeccæ F.v.M., Fragm., v., 53.

Domin (Prodr., pp.28-29) distinguishes vars. *normalis* and *lobulata*, the former, in accordance with the original description, having the pinnules crenato-serrate in the upper half only, and the latter being lobulato-crenate down to the base. The var. *lobulata* is set up for the specimen figured by Bailey in Liths., Pl.32 (collected on Bellenden Ker). I possess a frond of this form, kindly sent to me by Mr. Bailey, under the name *A. Rebeccæ*. Domin does not seem to have collected this variety, nor did I, though but few of my specimens are, strictly speaking, crenato-serrate in the upper half only. On many of the pinnæ, the *lower* pinnules are almost entire below and serrate in the upper half, while the *higher* pinnules are serrate throughout, the terminal pinnule often conspicuously lobed. Very few of my specimens have the pinnules really entire in the lower half. Bentham, in Fl Austr., vii., 710, says of *A. Rebeccæ*, "secondary pinnæ undivided, entire or crenate-serrate," and on the same page, "crenate or obtusely serrate." I would suggest that, for the normal form, the description "supra medium crenatis" (F.v.M.), or "supra medium leviter crenato-serratis" (Dom.), should be changed to "supra medium vel ad basin plus minusve crenatis vel crenato-serratis." The var. *lobulata* would still be retained.

Var. LOBULATA Dom.

Herberton district; R. F. Waller, 1908 (Syd. Herb.).

Two pinnæ, in Mr. Waller's collection, correspond, the one exactly, and the other approximately, to this variety. One of these fronds is even more lobed than Mr. Bailey's specimens. In some of the pinnules, the lobe-divisions reach to the rhachis, forming distinct pinnulæ.

A. BAILEYANA Dom.; *A. Rebeccæ* var. *commutata* Bail., 3rd Suppl. Q. Fl., 1890; Liths., Pl.33.

Mr. Bailey calls this the "Wig Fern," and says, that the long hair-like scales and the metamorphosed lower pinnæ "crown the stem with a wig-like growth." Domin compares these veinless growths with the "Adventivblätter" of *Hemitelia capensis*, figured by Dr. Christ, in Farnkr., p.322, fig.1023. These wig-like pinnæ are so distinctive that, though the ordinary pinnæ resemble those of *A. Rebeccæ* so closely that Mr. Bailey might well regard this fern as a variety of it, I think Domin is right in making it a new species. The pinnules are wider and longer than those of *A. Rebeccæ, and, for the most part, a free vein stands between the branched veins throughout.* This fern I did not collect, but there is a specimen in the Syd. Herb., collected by Waller, in the Herberton district—a mere scrap.

A. COOPERI Hook.

Street's Gully, Kuranda; July, 1913.

A. excelsa, *A. Cooperi*, and *A. australis* have given considerable trouble to botanists, largely owing to the inadequacy of the material in Herbaria. The pinnules alone are quite insufficient.

The character of the stem, the roughness or smoothness of the stipes, and the nature of the scales at the base of the stipes, are indispensable factors in the determination of species. The stem of *A. australis* is always densely covered with the distinctly muricate bases of the old fronds; the scales at the base of the stipes are of one kind only, though varying much in size; they are of a rich brown colour, shining, stiffish, more or less appressed, from a broad base gradually narrowed and ending in a very fine prickle-point, entire throughout, or with a margin of hyaline cilia, sometimes slightly serrulate below the prickle-point; moreover, the stipites are comparatively slender. *A. excelsa* and *A. Cooperi* show numerous clean scars on the stem, where the old fronds have fallen completely away; the stipes is much more robust; and the scales are of two kinds, a larger and a smaller, both of them serrate throughout. The differences between *A. excelsa* and *A. Cooperi* are not so sharply defined. The former is much more robust in its growth and attains a much greater height; it is coarser and more coriaceous in the texture of its fronds; the base of the stipes is distinctly muricate, while that of *A. Cooperi* is almost smooth; the scales at the base of the stipes also show distinctive characters; the larger scales of *A. Cooperi* attain a length of 2″ and are of a smoky-white colour, while those of *A. excelsa* are much shorter and are light brown in colour; in both species, the smaller scales are reddish-brown and serrated, but, in *A. excelsa*, the serrations appear to be stronger and more closely set than in *A. Cooperi*. The nerves, in *A. excelsa*, are deeply embedded in the more coriaceous substance of the pinnules, while, in *A. Cooperi*, they are generally distinctly visible; the pinnules, too, are wider, with strongly recurved margins. Moreover, the spores of *A. Cooperi* are more papillose than those of *A. excelsa*. Domin follows C. Moore in regarding *A. Cooperi* as a var. of *A. excelsa*; but, after careful examination of specimens of both ferns in the Botanic Gardens, Sydney, I prefer to keep them distinct. Moreover, I incline to the opinion that the typical *A. excelsa* is limited to Norfolk Island, and that the Australian plant, throughout, is *A. Cooperi*. More extended observations are, however, necessary, especially on Norfolk Island

and in tropical Queensland. Unfortunately, my Kuranda specimens lack the base of the stipes, but the spores are those of *A. Cooperi*. The stem was scarred.

POLYPODIACEÆ.

i. *ASPIDIEÆ.*

DRYOPTERIS Adans.

Subgen. *Eudryopteris.*

D.(?) DECOMPOSITA (R.Br.) O. Ktze.

Stoney Creek, and Railway Cutting, near Cairns; July, 1913. This is recorded with doubt. Domin did not find the true *D. decomposita* in North Queensland. See *D. rufescens*.

D. ALBO-VILLOSA, sp.nov. (Plate lxxxviii., fig.8,*a-d*).

Rhizoma et stipitis basis desunt. *Stipes* elongatus, stramineus, tener, subflexuosus, plus minusve villosus. *Frons* ovato-lanceolata vel subtriangularis; longe acuminata, circa 45 cm. longa et 30 cm. lata, utrinque villosa, rhachi et costis dense villosis, villis longis, albis, mollibus, articulatis; pinnis numerosis, lanceolatis, ad 25 cm. longis et 7 cm. latis, longe acuminatis, subfalcatis, pinnulis lanceolatis, obtusis, pinnatifidis, lobis brevibus, subovatis, acute serratis, pinnatinervatis. *Sori* magni, mediales in lobis, præcipue in nervis superioribus. *Indusium* rotundum, reniforme, glandulari-pubescens, glandibus flavis.

Stoney Creek, near Cairns; July, 1913.

In outline and general structure, very similar to *D. decomposita*, but much more pubescent, and the pinnæ are more regularly shaped. I regret that my specimens were defective. The complete plant, with rhizome and attached stipes, is to be desired.

Subgen. *Phegopteris.*

D. TROPICA (Bail.) Dom.; *Polypodium aspidioides* var. *tropica* Bail.

Cairns district; July to August, 1913.

D. (?)RUFESCENS (Bl.) C. Chr.

Specimens collected in the Railway Cutting between Redlynch and Stoney Creek appear to belong here, but may possibly represent a new species. In the Sydney Herbarium, there is a note by the late Mr. Betche, in which he says, "*Polypodium rufescens* Bl., is given as a Queensland fern in Synops. Filic., and in Christensen's Index Fil., but Bentham writes (Fl. Austr., vii., p.759), 'Some specimens of *A. decompositum* with small fronds and broader, more membranous and less acute segments appear almost identical with specimens of *P. rufescens* from Ceylon. The supposed Australian specimens of that species are undoubtedly referable to *A. decompositum.*' "

The specimens collected by me, I should certainly hesitate to refer to *D. decomposita*, for there is no sign whatever of an indusium, and the differences in other respects are noticeable.

DRYOPTERIS (?) sp.nov.

Specimens collected, I believe, in the Railway Cutting (Redlynch to Stoney Creek) have the base of the stipes castaneous and clothed with very fine hairs. They belong probably to a new species, but the material is not sufficiently complete for definite decision.

D. SETIGERA (Bl.) O. Ktze.; *Polypodium pallidum* Brack.

Stoney Creek, etc.; July, 1913; also a small form in the bed of the Barron River, above Kuranda.

Subgen. *Cyclosorus.*

D. GONGYLODES (Schkhr.) O. Ktze; *Nephrodium unitum* R.Br.

Var. PROPINQUA (R.Br.) Van A. van Rosenb.; *Nephrodium propinquum* R.Br.

Among reeds on margin of Lake Barrine; August, 1913.

Some confusion exists regarding this species and its variety *propinqua*. Bailey, in his "Fern-World of Australia," makes *Aspidium unitum* "pubescent or glabrous." Beddome, in "Ferns of Southern India," p.31, says, of *N. unitum*, "glabrous above, cano-tomentose beneath, especially on the costa and veins;" also, "involucres small, reniform, at length glabrous." His Pl.88 shows these characters. Of *N. propinquum*, Beddome says (p.32 idem), "glabrous or often more or less pubescent, resino-glandulose, especially beneath;" also, "involucres reniform, setose." His Pl.89 shows the setose involucre, but the figure is quite different from the *Aspidium unitum* var. *propinquum* of Bailey's

"Lithograms." Van A. van R. ("Malayan Ferns") says, of *D. gongylodes* (*Nephrodium unitum*), "rachis and surfaces naked;" and, of var. *propinqua*, "rachis and under-surface hairy." Domin apparently follows A. van R., in his var. "*glabra*" (the typical form), and "var. *propinqua*," which latter, he says, has, in Australia, the wider distribution.

This agrees with Robert Brown's original descriptions in the "Prodromus," p. 148, where *Nephrodium unitum* is characterised as, "frondibus pinnatis, pinnis ensiformibus serrato-incisis, glabris; incisuris semiovatis, acutis, venis indivisis, soris submarginalibus, costa rhachibusque glabris." *N. propinquum* is described as "frondibus pinnatis, pinnis ensiformibus, apice attenuatis subtus pubescentibus inciso-pinnatifidis, lobis semi-oblongis acutis venis indivisis, soris submarginalibus confertis, involucris barbatis, rhachi pubescentulâ."

My specimens from Lake Barrine show the pubescent rhachis and under-surface distinctly; and, therefore, I record them as var. *propinqua*.

D. PARASITICA (L.) O. Ktze.; *Polypodium molle* (Jacq.); *Aspidium molle* (Jacq.) Luerss.

Banks of Barron River, Kuranda, and many other places; July-Aug., 1913.

Var. DIDYMOSORA (Benth.) Dom.

Banks of Barron River, Kuranda; July-Aug., 1913.

DRYOPTERIS sp.

Kuranda, on northern side of Barron River; and in Frenchman's Creek, Babinda; July, 1913.

I hesitate to separate this plant from *D. parasitica;* the fronds show very similar characters, save that the stipes possesses several pairs of auricles reaching almost to the base, and giving it a very distinctive appearance. The whole plant looks like a diminutive tree-fern, the rhizome being upright (some 6-9 inches in height). The nervation and fructification are those of *D. parasitica*. Unfortunately, some good specimens of the whole plant I left behind me in a part of Frenchman's Creek, to which I was unable to return.

D. TRUNCATA (Poir.) O. Ktze.

Creeklet at base of Bartle Frere; July, 1913. This is the only spot at which I saw this fine fern during the whole of my trip.

Subgen. *Goniopteris.*

D. UROPHYLLA (Wall.) C. Chr.

By creek, Yungaburra; August, 1913.

Domin records two forms of this magnificent fern, viz., f. *subintegra* and f. *crenata* (both from Harvey's Creek). The description of *Polypodium urophyllum* in H.B., Synops., p. 314, is, "the edge entire or very slightly lobed." My specimens (all taken from one spot, though probably not all from one plant) show considerable variation in the nature of the leaf-margin; in some pinnæ, the lower half is subentire and the upper crenate.

D. PŒCILOPHLEBIA (Hook.) C. Chr.

Rocky Hill, Kuranda; also near Yungaburra, and on the banks of Lake Barrine; July-August, 1913.

(?)Var. DENSA, var.nov.

Textura densior; sori majores; inferior pinnarum margo sæpe profunde incisa.

This variety is set up with some doubt. The deeply incised lower margins are very noticeable where they occur, and the much denser consistency of the leaves is very marked. I place here my own specimens, collected, I believe, at Lake Barrine, and also a specimen of *D. pœcilophlebia* sent to me by Mr. F. M. Bailey; collected on the Endeavour River by Miss Lovall.

(?)D. HILLII (Bak.) C. Chr.

A single frond, among my specimens of *D. pœcilophlebia*, shows distinctly villose costæ, and may possibly belong to *D. Hillii*, a species which I have never seen. The figure in Bailey's "Liths." (149) is, as pointed out by Domin, that of a different species. *D. Hillii*, according to H.B., Synops., p. 505, is "simply pinnate."

D. TRIPHYLLA (Sw.) C. Chr.; *Meniscium triphyllum* Sw.

By creeklet, at base of Bartle Frere, and also in Palm scrub at eastern end of the mountain, near railway line; July, 1913. Mr.

Bailey told me he had not seen specimens of this fern from North Queensland. Domin found it at Harvey's Creek and Lake Eacham. It has a wide Indo-Malayan range.

ASPIDIUM Sw.

A. MUELLERI C. Chr.; *A. confluens* Mett., non Fée.

Very plentiful by creeks throughout the Cairns Hinterland. Some of my best specimens were obtained near the "Crossing" at Malanda. Domin sets up two forms (f. *simplicius* and f. *decompositum*), and figures an intermediate form on p. 55. The species shows so many variations in the leaf-form, that it hardly seems worth while to attempt to distinguish them by exact definition. *A. Muelleri* is one of the most beautiful and striking of the ferns of North Queensland, and a handsome addition to the bushhouse.

In Domin's opinion, there is no need to change Mettenius' name, seeing that Fée's *A. confluens* is a doubtful species; but this is surely an insufficient reason for ignoring Fée's nomenclature, and I have, therefore, followed Christensen (Index).

POLYSTICHUM Roth.

P. CONIIFOLIUM Presl.

In scrub, Ravenshoe, Herberton district; Dr. Joynt, Aug., 1913. (Herb. Watts): Herberton district; Waller, 1908 (Hb., Syd.).

Dr. Joynt brought in but a single frond of this fern, which I at first regarded as *P. aristatum* (Forst.). According to Domin, the main difference between *P. aristatum* and *P. coniifolium* is, that the former has a creeping, and the latter a tufted, rhizome; he believes that the Australian specimens belong mostly to *P. coniifolium*. According to Van A. van Rosenb., the scales of *P. aristatum* are hair-like, or more or less setiform, while those of *P. coniifolium* are long-linear-lanceolate. In that case, Dr. Joynt's specimen is *P. coniifolium*.

P. FRAGILE, sp.nov. (Plate lxxxviii., fig.9,*a-g*).

Epiphyticum, spectabile. *Rhizoma* crassum, repens, paleis brunneis ad 1·5 cm. longis anguste et flexuose acuminatis dense vestitum, paleis apicalibus pallido-brunneis vel pallescentibus. Stipes ad 4-6 dm. longus, flexuosus, basi paleis pallido-brunneis vestitus, supra nudus, parce muricatus, canaliculatus. Frons late lanceolata, basi 6-8 dm. lata, laxe pinnata, pinnis inferioribus oppositis, superioribus alternantibus, subsquarrosis, anguste lanceolatis, 1-4 dm. longis et 1 dm. latis; pinnulis lanceolatis, utrinque æqualibus, inferioribus basi 2-3 cm. latis, ad alatam rhachem pinnatifidis, superioribus subintegris, pinnatinervatis, siccis facile frangentibus, nervis indistinctis; rhachi et costis nudis, glabris, supra canaliculatis, pinnularum costis subtus distincte elevatis supra depressis. Sori mediales ad 8 per pinnulam, solitarii in lobis, indusio rotundo, profunde inciso, cito contrahenti, fugaci, paraphysibus albis articulatis cum sporangiis intermixtis. *Textura* subcoriacea. *Color* pallido-viridis, haud nitens.

This handsome fern was collected in a "Falling" on Major's homestead, near Ravenshoe (Watts, Aug., 1913). It was epiphytic on, I believe, the Bird's-Nest Fern. I mistook it for *P. adiantiforme* (*capense*), from which, however, it differs through the much thicker rhizome, the split indusium, which shrivels even on the young sorus, the more distant and almost squarrose pinnæ, the laxer build, and the less coriaceous texture; also, by the fact that the midrib of the pinnules is prominently raised on the *lower* side and depressed (canaliculate) on the upper side, whereas, in *P. adiantiforme,* the midrib is distinctly raised on the upper side. The ease with which the pinnæ are broken up in drying is very characteristic; it is really difficult to preserve perfect specimens.

Polystichum sp.

Some imperfect specimens of a beautiful species, probably new, are in the Sydney Herbarium (collected by Mr. R. F. Waller in the Herberton district). The late Mr. Betche regarded them as belonging to *P. adiantiforme,* and made the following notes:—

1. "Less coriaceous than any other specimens we have, and with hardly any scales on the stem. It may be undescribed, but the rhizome is needed as well as the base of the leaf-stalk. Not recorded from Queensland. 28.4.09."

2. "This seems to be the tropical form of *P. adiantiforme*, distinguished by the soft texture from the typical form, but by no other essential characters, so far as I can see. 11.09."

The specimens, however, have an indusium with a sinus, which differentiates the plant at once from *P. adiantiforme;* and the secondary rhachis and the costæ are flattened or depressed on the upper side and raised beneath. (See note under *P. fragile*).

Mr. Waller's plant differs greatly from *P. fragile*, and I have no doubt that, given the rhizome and the base of the stipes, it could be described as a new species.

Leptochilus Kaulf.

L. cuspidatus (Presl.) C. Chr.: *Acrostichum repandum* Bl.

Near Josephine Creek, Bartle Frere: Kuranda; and Ravenshoe; July-Aug., 1913.

L. neglectus (Bail.) C. Chr.: *Acrostichum neglectum* Bailey: *Gymnopteris* Diels, Nat. Pflanzenfam.

Kuranda, in creek, on northern side of the river: also at Ravenshoe; July-Aug., 1913.

OLEANDREÆ.

Oleandra Cav.

O. neriiformis (Sw.) Cav.

I did not find this rare fern, but there is a good specimen in the Sydney Herbarium, collected by Mr. Waller, in the Herberton district, in 1908.

DAVALLIEÆ.

Arthropteris J. Sm.

A. obliterata (R.Br.) J. Sm.; *Aspidium ramosum* P. Beauv.

Near the Russell River, at base of Bartle Frere; July, 1913.

This is Domin's var. *normalis.* It is well figured in Bailey's "Lithograms," t. 125. The pinnæ are of unequal length.

Var. linearis (Bail.) Dom.; *Aspidium ramosum* var *lineare* Bail.

Throughout the Cairns district, especially at the base of Bartle Frere, near the Russell River; July-Aug., 1913.

A. Beckleri (Hook.) Mett.; *Polypodium Beckleri* Hook., Spec. Fil., iv., 224; *Aspidium ramosum* var. *Eumundi* Bail.

Ravenshoe (by Falls), etc., Cairns district; July-Aug., 1913.

Domin states (p. 62) that Bailey's plant is perfectly identical with *A. Beckleri.*

A. submarginalis Dom., Prodr., p.62.

On south side of Bartle Frere, near Russell River; July, 1913. Specimens also in Hb. Syd., from Herberton district; leg. Waller, 1908.

Mr. Bailey questions the validity of this species, but my specimens entirely agree with Domin's description, and are differentiated from *A. obliterata* by the submarginal sori and the characteristic leaf-formation.

A. tenella J.Sm.,(common in South Queensland and New South Wales, and better known as *Polypodium tenellum*), I did not find in the Cairns district, nor Domin's new species, *A. prorepens.*

Nephrolepis Schott.

N. biserrata (L.) Schott; *N. exaltata* var. *biserrata* Bak.; *Aspidium exaltatum* var. *longipinnum* Bentham, Bailey et al.; *Aspidium acutum* Schkr.

Stoney Creek; and near Bartle Frere; July-Aug., 1913.

N. hirsutula (Forst.) Presl.; *N. exaltata* var. *hirsutula* Bak.

Stoney Creek, etc.; July, 1913.

Some confusion has crept into the series of ferns, of which *N. exaltata* is the basal form, owing partly to the fact that in leading descriptions of *N. exaltata,* the varieties "*biserrata*" and "*hirsutula*" are included. It is preferable, with Van A. van Rosenb. and Domin, to regard these so-called varieties as distinct species. The typical *N. exaltata* is figured by Bailey, in his "Lithograms," t. 123. *N. biserrata* has a much longer and more acute pinna, and the sori are more distant from the margin; while *N. hirsutula* is distinguished by the woolly scales on the rhachis and surfaces, and the erect, narrow acroscopic auricles at the base of the pinnæ. Domin rightly says, of *N. hirsutula,* "Ab affine N. exaltata var.

biserrata facile distinguitur pinnis utrinque sed præcipue supra paleis albis dispersis latioribus fimbriatis et piliformibus intermixtis instructis, rhachis paleis piliformibus appressis densis sublanuginosa, soris submarginalibus, pinnis basi superne auriculatis, auriculis angustis erectis."

N. exaltata (L.) and *N. acutifolia* (Desv.) I did not find, though I understand that the latter is plentiful near Cairns.

HUMATA Cav.

H. REPENS (L. fil.) Diels; *Davallia pedata* Sm

Frenchman's Creek (Second Falls); July, 1913.

DAVALLIA Sm.

D. DENTICULATA (Burm.) Mett.; *D. elegans* Sw.

Rocky Hill, Kuranda; July-Aug., 1913.

D. PYXIDATA Cav.

Rocky Hill, Kuranda; July, 1913.

MICROLEPIA Presl.

M. SPELUNCÆ (L.) Moore.

Stoney Creek, near Cairns; July, 1913.

SCHIZOLOMA Gaud.

S. ENSIFOLIUM (Sw.) J. Sm.; *Lindsaya* Sw. et al.

Hillside, track to Coffee Plantation, Kuranda; July-Aug., 1913. Very plentiful, and in the most varied forms.

This species is so extremely variable, that the attempt to minutely subdivide it into a number of varieties and forms would appear to be of doubtful value. Domin has subjected the material (Asiatic and Australian) in the Kew Herbarium, as well as that collected by himself in North Queensland, to the most careful and painstaking scrutiny, and has set up the varieties (for Australia) *normale, heterophyllum* (*Lindsaya heterophylla* Dryand.) (with forms *rhomboideum* and *angustipinnum*), *medium* (*Lindsæa media* R Br.), *intercedens* var.nov., and *Fraseri* (*Lindsæa Fraseri* Hook). While appreciating Dr. Domin's painstaking investigations, and attaching great weight to his opinion, my own experience in North Queensland inclines me to think that a careful study of growing plants of *S. ensifolium* would reveal the existence of different forms and even supposed varieties on the same plant. Among my material, I have forms corresponding to Domin's f. *rhomboideum* and f. *angustipinnum* of var. *heterophyllum*, but I am doubtful whether they were not growing on the same plant. Should I have another opportunity of visiting the Cairns district, I would spend some hours on that hillside at Kuranda, carefully examining and comparing the plants *in situ*. Meanwhile, I venture to express the opinion that the variations of form in this species are so bewildering, that it is of little avail trying to tie them all down to distinctive names.

The practice, followed by Domin, in the case of species with variations, of making the type of the species "var. normale," does not commend itself to me; for, of necessity, it means that the description of the species must be made to cover all its varieties, and this, in turn, would mean that, whenever a new variety was discovered, the species would have to be redescribed. Would it not be better to let the specific description stand for the type, and then to let the varieties, as they arose, be described in relation to the type?

LINDSAYA Dryand.

L. CULTRATA Sw., var. CONCINNA (J. Sm., as species) Dom.

Kuranda; July-Aug., 1913.

According to Domin, var. *concinna* differs from the type (*L. cultrata*) mainly in size. All the examples collected by him in North Queensland belonged to var. *concinna*, as well as all the Queensland specimens he had examined. Mine also belong to the variety.

L. DECOMPOSITA Willd.; *L. lobata* Poir.

Kuranda; July-Aug., 1913.

Domin distinguishes vars. *contigua* and *davallioides* (*L. davallioides* Bl.) from the specific type (his var. *normalis*). Among my specimens are the typical form and the var. *contigua;* and in the Sydney Herbarium are specimens of var. *davallioides,* collected by R. F. Waller, in the Herberton district, in 1908.

ASPLENIEÆ.

ATHYRIUM Roth.

A. UMBROSUM (Ait.) Presl., var. AUSTRALE (R.Br.) Dom.

Near Josephine Creek, Bartle Frere; July, 1913.

The typical *A. umbrosum* comes from the Atlantic Islands. Robert Brown (1810) described the corresponding Australian plants as *Allantodia australis* and *A. tenera.* Domin notes the commoner Australian form as *Athyrium umbrosum* var. *australe,* but says that its difference from the typical Atlantic fern is "not large." My specimens (from Josephine Creek) agree with specimens in the Sydney Herbarium, collected at Herberton, by Mr. Waller, and at Atherton by Miss Mackenzie. They, however, differ from the common New South Wales form in having much more attenuated pinnæ, in showing a more narrowly-winged secondary rhachis, narrower and more closely-set pinnules, and a more delicate texture. A specimen in the Sydney Herbarium, collected on the Dorrigo, comes very near to the North Queensland fern. Is this Robert Brown's *A. tenera?*

Var. TENERUM Bail., Fern World of Australia, p.52: Lith. t. 115.

One or two plants that I collected in a creek, near Tully Falls, (mostly in a young state) appear to me to belong here.

Bailey, *loc. cit.*, says of var. *tenera,* that "it is a more membranous form, having darker and more slender stipites. Sori more distant, and the indusium not so much broken at maturity." Domin (p. 57) says that this is an exceptionally delicate fern of very thin texture, with slender dark brown (often blue-brown) stipes, and more deeply coloured rhachis, with distant, shortly but distinctly stipitate pinnules, more distant ultimate segments, and with fewer, narrower, and rather longer indusia. He adds, that the identity of Bailey's var. *tenera* with Brown's *Allantodia tenera* is not fully established.

DIPLAZIUM Sw.

D. LATIFOLIUM (Don.) Moore; *Asplenium maximum* Don.

Close to creek, Yungaburra; Aug., 1913.

The growth of the Yungaburra fern was so much stronger than the form occurring on the Richmond River, that I hesitated in its determination, but its identity is undoubted. There are specimens in the Sydney Herbarium, collected at Atherton by Miss Mackenzie, and at Herberton by Mr. Waller.

D. POLYPODIOIDES Bl.

Stoney Creek, near Cairns; July, 1913.

D. PROLIFERUM (Lam.) Thouars; *Asplenium decussatum* Sw.

By Josephine Creek, Bartle Frere; July, 1913.

This striking fern I found only at one spot. The name, *decussatum,* by which it has been commonly known, must give place to the older *proliferum.* Van A. van Rosenburgh (Malayan Ferns, p. 424) gives var. *accedens* ("stipes muricate or spinulose throughout"), and my specimens must, possibly, be placed under this variety. Domin remarks similarly regarding his Bellenden Ker specimens.

ASPLENIUM L.

A. NIDUS L.

Common in the Cairns district.

A. SIMPLICIFRONS F.v.M.

Throughout the Cairns district especially at Kuranda, in the scrubs on the northern side of the river. Occasionally, the frond is forked at the tip. Bailey, in Bot. Bull. xiii.,(1896) describes a var. *laciniatum.*

A. UNILATERALE Lam.; *A. resectum* J. Sm.

Var. AUSTRALIENSE Bail.

Base of Bartle Frere; July, 1913.

A very rare fern. Previously recorded from Johnstone River (leg. Kefford), and hills of Mulgrave River (leg. Bailey, 1889); also found in the Evelyn Scrub by Mr. Waller, in 1908. I know of no other records. The variety is apparently well-based; the rhizome being shorter and the stipites closer together than in the typical form, while the pinnæ are less cut away on the lower side. The figure of *A. resectum* in Beddome's "Ferns of Southern India" (t. 132) may be compared with Bailey's figure of var. *australiense* in his Third Supplement to "Syn.Qld.Fl.," and in "Liths."

A. ADIANTOIDES (L. as *Trichomanes*) C. Chr.; *A. falcatum* Lam. Common in the scrubs of North Queensland.

Domin describes the varieties *fibrillosum* and *macrurum*, and refers to the vars. *caudatum* (*A. caudatum* Forst.), and *Whittlei* (Bail.). Var. *macrurum* is the very large form occasionally met with; I found it near Malanda and at Ravenshoe. The species is so variable, that it hardly seems advisable to define varieties. Compare Luerssen, "Fil. Graeff.," p. 155-6, 1871.

A. BAILEYANUM (Dom.) Watts; *A. Hookerianum* Col., var. *Baileyanum* Dom.; *A. Hookerianum* var., Bailey, 3rd Suppl. Qld. Fl., p.93.

In scrub at base of Bartle Frere; July, 1913.

This fern is quite comparable with *A. Hookerianum* Col., in some of its forms, but as that species belongs to the far South (New Zealand, Tasmania and Victoria), and as the North Queensland fern has a distinctive outline and other distinguishing features, it seems to me best to regard it as a separate species. Bailey's description of the Queensland variety is as follows (*loc. cit.*): "Rhizome short or shortly repent, the crown and base of stipes densely clothed with dark brown scales; stipes tufted, slender, 4 or 5 inches long, dark brown and slightly scaly. Fronds bipinnate, narrow-lanceolate, in outline attaining 8 inches in length, and not over 3 inches wide in the broadest part; pinnules cuneate, the lower ones often divided to the base, the end inciso-dentate. Sori usually long and narrow."

It may be added that the scales, while similar to those of *A. Hookerianum*, are more shortly-celled at the base, and are entire or denticulate, while in *A. Hookerianum* they are subfimbriate; also that the first acroscopic pinnule on each pinna is more or less prominent, and grows parallel to the rhachis, that the petioles of the pinnæ are much shorter than in *A. Hookerianum* (sometimes almost none), and that the texture of the leaves is firmer and closer than in that species.

A. AFFINE Sw.

Gullies on northern side of Barron River, Kuranda, and at other places in the Cairns district; July-Aug., 1913.

My specimens fully agree with Bailey's figure in Liths., t. 110, though not with that in Hook., Sp. Fil., ii., t. 202, which shows the pinna with longish acumen. The pinna in Beddome's fig. (under *A. spathulinum* J.Sm.), in "Ferns of Southern India," t. 226, is still more long-acuminate, and the whole frond has a different appearance from that of my specimens and of Bailey's figure. Van A. van Rosenburgh (Malayan Ferns, p.472) says, of *A. affine*, "Pinnulæ distinct, rhomboidal-triangular, blunt or acute, inciso-serrate or deeply pinnatifid to pinnate again, the base obliquely cuneate; lowest pinnulæ acute . . . the higher ones and those of the higher pinnæ with the outer edge more or less bluntish or more or less rounded to truncate, crenate." This allows, partly, for the blunt pinnules of my specimens, but none of my fronds have the lowest pinnules "acute"; they are all blunt. I record the species, however, on the authority of Mr. Bailey's figure, which Domin cites without criticism.

A. LASERPITIIFOLIUM Lam.; *A. cuneatum* Lam., var. *laserpitiifolium* F.v.M.(1866). Domin follows F.v.M.

In scrub at base of Bartle Frere; July, 1913.

My specimens are smaller than those described by Van A. van R. (Malayan Ferns, p. 472), but appear to correspond in every other respect with the descriptions and figures available. They are larger and more robust than Domin's var. *orarium*, from Cape Grafton.

A. præmorsum Sw. (*A. furcatum* Thunb.), *A. cuneatum* Lam., *A. affine* Sw., and *A. laserpitiifolium* Lam., form a group of nearly related plants that have given considerable difficulty to students.

A. PARVUM, sp.nov.

Rhizoma fasciculatum minutum radiculosum, radiculis sublongis, cum pilis tenuibus flexuosis brunneis dense vestitis. *Stipes* 2-3 cm. longus, infra fuscus supra (in juventate) subviridis, basi paleis brunneis minutis lanceolatis longe et flexuose acuminatis instructus, nudus vel subglandulosus. *Frons* ad 8 cm. longa et 2·5 cm. lata, ovato-lanceolata, infra pinnata supra pinnatifida; pinnis breviter petiolatis, anguste decurrentibus, cuneato-obovatis vel cuneato-lanceolatis, flabellato-nervatis, margine infra integro supra crenato-serrato; facie antica per nervos elatos flabellato-striata, rhachi viridi flexuosa subglandulosa. *Sori* elongati, duas tertias partes ex inferiori nervi parte occupantes, maturitate totam pinnæ mediam tegentes, sed finem margine distantem habentes. Indusium introrsum aperiens. Capsulæ annulo perangusto. *Textura* herbacea. Color juventate læte-viridis, maturitate fuscus.

Growing, in very small quantity, in bushhouse, Gladesville, N.S.W., on a tuft of *Polypodium subauriculatum* brought from the Cairns district (probably from Ravenshoe); Aug., 1913.

In consequence of the smallness of the material, this species is set up with some hesitancy. It is comparable with *A. Wildii* Bail., which, however, is a larger fern, with a more pronounced acroscopic development at the base of the pinnæ, and with sori that reach nearer the upper margin.

BLECHNEÆ.

Blechnum L.

Subgenus *Eublechnum*.

B. cartilagineum Sw., (?) var. tropica Bail.

Base of Bartle Frere; July, 1913.

B. serrulatum Rich.

In swamp by railway line, Cairns; August, 1913.

B. orientale L.

Banks of Railway Cutting, just above Kuranda; Aug., 1913.

My specimens are much smaller than the typical form, but appear to agree with it in every other respect.

B. Whelani Bail., Rept. Gov. Sci. Exped. Bellenden Ker, 1899, p.77.

Near top of Bellenden Ker; Miss J. S. Gibbs, 1914.

Judging from Mr. Bailey's figure (Liths. 91), Miss Gibbs' specimens are in better condition than were his, and the sori reach nearer to the base of the pinnæ.

Subgenus *Lomaria.*

B. PATERSONI (R.Br.) Mett.; *Stegania Patersoni* R.Br.

(?)Var. ELONGATUM (Bl.) H.B., Syn.

Ravenshoe; Aug., 1913.

Robert Brown's original description of *S. Patersoni* was, "frondibus indivisis; sterili ensiformi-lanceolata crenulata; fertili linearis." Domin, therefore, makes the form with the undivided fronds var. *normale,* and separates the plants with divided fronds under the name var. *elongatum,* following Hooker and others. This hard-and-fast distinction, I am unable to uphold. On the Richmond River, I frequently saw *B. Patersoni,* and, almost invariably, divided and undivided fronds, grew from the same rhizome, which bears out Bentham's remark (F. Austr., vii., 735), "from almost all the Australian localities there are specimens with undivided and with pinnatifid fronds, and sometimes the two from the same rhizome." In the Sydney Herbarium, there are several specimens with undivided fronds, but in one case, attached to a common rhizome, there are both divided and undivided fronds, though the divisions in the pinnatifid fronds are limited in number, not more than two or three. In this specimen, both kinds of fronds are quite typical in their form, and in the possession of crenulate margins. The plants came from the Tweed River, in the far north of New South Wales. Another specimen, collected in the Port Jackson district, possesses small undivided fronds, but also one large frond with two subopposite divisions a little less than halfway up, and a very long (40 cm.) apical continuation, which is 3·5 cm. wide in the broadest part; along with it, is a fertile frond much and linearly divided. Another specimen (from the Richmond River) has both undivided and much-divided fronds with the typical crenulate margins. In the light of these specimens, the var. *elongatum* is scarcely tenable. But, on the other hand, my own specimens (from Ravenshoe) and specimens collected at Herberton by Mr. Waller, both having undivided as well as pinnatifid fronds, show a somewhat different facies, are of a thinner texture (so that the venation is perfectly clear), have entire or almost entire margins, except at the apex of the lobes, and have usually a nervature that is more perpendicular to the rhachis. On these grounds, it may be allowable to separate the var. *elongatum,* but, in my judgment, certainly not on the mere ground of the form of the fronds.

B. DISCOLOR (Forst.) Keys.

Near Ravenshoe; Aug., 1913.

STENOCHLÆNA J. Sm.

S. SORBIFOLIA (L.) J. Sm., var. LEPTOCARPA (Fée) Benth., (*Acrostichum*).

Common in the scrubs of the Cairns district, climbing the trees to a great height. The delicate fruiting fronds I did not see growing, save at the top of the plant, generally high up. Mr. Bailey rightly says that this is "one of the most beautiful of climbing ferns."

S. PALUSTRIS (Burm.) Bedd.; *Acrostichum scandens* Hook.

Climbing up bushes and trees on the margin of Lake Barrine; also in swamp close to Cairns; Aug., 1913.

The pinnæ of this strong climber are very sharply serrate throughout. Mr. Bailey seems to have had before him specimens that were "entire or slightly dentate," but mine are all sharply serrate, in this agreeing with Beddome's figure in "Ferns of Southern India" (t. 201).

DOODIA R.Br.

D. CAUDATA (Cav.) R.Br.

Shaded bank of creek, Tea Gardens, Kuranda; Aug., 1913.

Domin (Prodr., p. 120 ff.) has some very valuable notes upon the species of this genus, *Doodia,* and especially upon *D. caudata,* which always has, at least, its lower pinnæ free and separate ("frei und getrennt"). My specimens appear to be quite typical of the normal form (var. *normalis* Dom.).

PTERIDEÆ.

SYNGRAMMA J. Sm.

S. PINNATA J. Sm.

In bush at edge of track to Coffee Plantation, on northern side of the Barron River, Kuranda; Phillip Mackenzie, July, 1913.

This is a striking species, with a large Indo-Malayan range.

Pellæa Link.

P. falcata (R.Br.) Fée.

Ravenshoe; Aug., 1913.

My specimens appear to belong to the normal type (Domin's var. *normalis;* "robusta, pinnis circa 3 cm. longis"). Domin states that he did not collect this form in Queensland.

Doryopteris J. Sm.

D. concolor (Langsd. et Fisch.) Kuhn; *Pteris geraniifolia* Raddi.

Rocky Slopes of South Cedar Creek Gully, Ravenshoe; Dr. Joynt, Aug., 1913.

Notholæna R.Br.

N. distans R.Br.; *Cheilanthes* Mett.

Ravenshoe; Aug., 1913.

Domin follows Mettenius in making *Notholæna* a subgenus of *Cheilanthes.* I have followed Christensen and others in keeping it as a separate genus.

Cheilanthes Sw.

C. tenuifolia Sw.

Ravenshoe, on rocky slope of the Millstream; Aug., 1913.

Var. sieberi Hook. f.

Ibid.; Aug., 1913.

Domin (Prodr., p. 136 ff.) enters, in great detail, into the various forms of "*C. tenuifolia* (Sw.) s. ampl. et em." He makes Swartz's *C. tenuifolia* a subspecies of his amplified *tenuifolia,* and the following further subspecies: *Sieberi* Ktze; *multifida* Sw.; *queenslandica* subsp. n.; *nudiuscula* (R.Br.); *caudata* R.Br.; *Wrightii* Hook.; *bullosa* Ktze.; *Hancocki* Bak.; *Shirleyana* subsp. nov.; etc. Some of these "subspecies" are again subdivided into varieties and forms. I do not presume to criticise the detailed conclusions based upon a most painstaking examination of the material in herbaria, but I venture to question the practical usefulness of such minute subdivisions. My own specimens, at any rate, appear to fall readily into the typical divisions: *C. tenuifolia* Sw., and var. *Sieberi* Hook.f.

HYPOLEPIS Bernh.

H. TENUIFOLIA (Forst.) Bernh.

Stoney Creek, Cairns district; July, 1913.

ADIANTUM L.

A. ÆTHIOPICUM L.

Banks of Stoney Creek (very large fronds); July, 1913.

A. AFFINE Willd.; *A. Cunninghami* Hook.; *A. affine* var. *Cunninghami* C. Moore.

Cairns district; July-Aug., 1913; Waller, 1908.

Christensen (Index Fil.) keeps *A. Cunninghami* distinct from *A. affine*, limiting the latter to New Zealand; but specimens of *A. affine*, from New Zealand, kindly sent to me by Mr. Cheeseman, appear to be quite identical with the Australian fern. The glaucous colour of the frond (one or both surfaces) is fairly characteristic. Frequently, the upper side of the rhachis is densely covered with stiffish bent hairs; quite as often, it is ebony-smooth. My North Queensland specimens have, mostly, a smooth rhachis, but one frond is densely hirsute. Specimens collected by Mr. Waller, in 1908, all possess the hairy rhachis. This hirsute form, for the most part, has larger fronds than the glabrous, my own specimen being 30 cm. long and 45 cm. broad.

In a note, under *A. Cunninghami* (*A. affine* Willd., teste H.B., Syn., p. 117), Hooker (Sp. Fil. ii., No. 107) states that the pinnules are "very glaucous beneath," the sori "always placed in a notch of a lobe of the margin (not in the sinus between the lobes)"; and, it is added, "the stipes is quite smooth, and the rhachis is everywhere perfectly glabrous." Similarly, H.B., in Syn., 117, "rhachis and surfaces quite naked, the latter very glaucous." Cheeseman (N.Z. Flora, p. 963) says, "quite glabrous, or the secondary rhachises pubescent above."

I have not access to Willdenow's description, but if it has governed, as no doubt it has, the descriptions of Hooker and Baker, the hirsute form should probably have recognition as var. *hirsutum* var. nov.

A. DIAPHANUM Bl.; *A. affine* Hook., Sp. Fil. ii., No. 65, non Willd.

Cairns district; July-Aug., 1913.

(?) Var. AFFINE A. van R.

Cairns district; July-Aug., 1913.

Hooker, *loc. cit.*, rightly called attention to the characteristic black bristle-like hairs (12 or more) which are produced between the veins on the upper surface, towards the lower margin and apex of the pinnules, with a few on the underside. A. van Rosenburgh's var. *affine* lacks these bristles, as does one frond among my North Queensland specimens.

A. HISPIDULUM Sw.

Cairns district; July-Aug., 1913.

Domin has dealt fully with the forms of this species, and has set up a new species, *A. tenue,* allied to *A. hispidulum,* but lacking the hairy surfaces.

PTERIS L.

Subgen. *Eupteris.*

P. UMBROSA R.Br.

Bank of creek by "Crossing," Malanda; Aug., 1913.

A quite typical form, but the lower half of the pinnæ almost, or quite, entire; typically serrate at apex.

P. BIAURITA L. var. QUADRIAURITA Luerss.; *Pt. quadriaurita* Retz.

Near Josephine Creek, Bartle Frere; July, 1913.

This fern and its allies have given considerable trouble to systematists. In H.B., Syn., *Pt. biaurita* is placed in the section *Campteria,* owing to the arched connecting veins at the bases of the pinnules, while *Pt. quadriaurita* is assigned to *Eupteris* (veins all free). The transitional forms, however, are so numerous as to throw doubt upon the tenableness of the sectional divisions. I, therefore, follow Luerssen and Domin in making the North Queensland fern (veins always free) a variety of *Pt. biaurita.* Betche, in Herbarium, Sydney, appears to have regarded the two names as synonymous.

Subgenus *Litobrochia.*

PT. TRIPARTITA Sw.; *Pt. marginalis* Bory.

Stoney Creek, near Cairns; July, 1913.

(?)Var. FELICIENNÆ (F.v.M.) Dom.

With some doubt I place here a young plant found near Major's Selection, Ravenshoe; Aug., 1913.

HISTIOPTERIS J.Sm.

H. INCISA (Thunb.) J.Sm.

Cairns district; July-Aug., 1913.

Pteridium aquilinum var. *esculentum* I did not find, nor the var. *lanuginosum.* Domin's var. nov., *yarrabense,* shows the leaf-formation of var. *esculentum,* with the "hairing" of v. *lanuginosum.*

MONOGRAMMA Schkhr.

M. PARADOXA (Fée) Bedd.; *M. Junghuhnii* (Mett.) Hook.

Var. ANGUSTISSIMA (Brack.) Dom.; *M. Junghuhnii* var. *tenella* Benth.

Among other ferns on branch of tree overhanging the creek above the Falls, near Major's, Ravenshoe; Aug., 1913.

Domin found this dainty rarity near Lake Eacham, and he states that this was but the second locality recorded, the first being "Rockingham Bay (Dallachy leg.)." My specimens were in excellent condition.

VITTARIA J.Sm.

V. ELONGATA Sw.

On dead tree lying in bed of Russell River; July, 1913.

Var. *Wooroonooran* Bail., I did not find.

ANTROPHYUM Kaulf.

A. RETICULATUM Kaulf.

Several localities, especially on rocks, etc., Frenchman's Creek; July, 1913.

The species of the genus *Antrophyum* are difficult to separate, and considerable confusion appears to exist in Herbaria. Mettenius has shown the importance of the cell-formation of the paraphyses that are often found in the sorus. In *A. reticulatum* and *A. callifolium* Bl., the end cells of the paraphyses are linear, while in *A. semicostatum* Bl., they are club-shaped. The separation of the two former species from one another is, failing access to well-authenticated specimens, not quite clear to me. Domin holds that the net-like sori of *A. reticulatum* are decisive; but my specimens vary considerably in that respect. I have no specimen that I can unhesitatingly refer to *A. callifolium*, which Domin succeeded in finding. Most of my specimens possess a distinct, central midrib, sometimes extending nearly half-way up the leaf, which attains as much as 19 inches in length. In the case of two or three plants, which grew on the face of a large boulder in the bed of Frenchman's Creek, the fronds had divided apices. Ferguson, in his "Ceylon Ferns" (p. 52), states that nearly all his specimens of *A. reticulatum* had costæ distinct for 4-5″ up, and also that sometimes the fronds were "bifurcated." The Frenchman's Creek fronds, referred to above, were more than bifurcated. For convenient reference, I record these specimens as forma *apicilobatum*. (Plate lxxxviii., fig.10).

POLYPODIEÆ.

HYMENOLEPIS Kaulf.

H. SPICATA (L.) Presl.

Babinda, Frenchman's Creek, Kuranda, etc.; July-August, 1913.

POLYPODIUM L.

Subgen. *Eupolypodium.*

P. GORDONI, sp.nov. (Plate lxxxix., fig.12*a-c*).

Epiphyticum in arboribus et rupibus; *rhizoma* breve, paleis pallido-brunneis, dense confertis, breviter lanceolatis, plerumque obtusis, levibus præditum. *Stipites* conferti, brevissimi fere nulli, ad basin alati, nudi vel pubescentes. *Frons* erecta vel suberecta, 3-12 cm. vel ultra longa, 1-2 cm. lata, simpliciter pinnata, medio plus minusve oblonga, ad basin longiore, ad apicem breviore angustans, recta vel subfalcata; pinnis usque ad 20 vel ultra, maxime 1-1·5 cm. longis, 0·3-0·5 cm. latis, alternantibus, a basi lato confluente vel subconfluente oblongo-lanceolatis, obtusis, plus minusve recurvatis, inferioribus gradatim brevioribus, infimis in basalem alam mergentibus; rhachi atra, angusta, levi vel sublevi, superficiebus levibus vel sublevibus; venis simplicibus, flexuosis, evanidis; venulis paucis, indistinctis, evanidis. *Sori* parvi, juventate elongati, obliqui vel subobliqui, immersi, depressione elationem in antica facie efficiente, usque ad 5 in serie, mediales, interdum a marginibus recurvis tecti. Sporangia numerosa: sporis magnis, rotundatis, viridibus. Textura subcoriacea.

On trees and the faces of boulders, Tully Falls; Watts and Gordon; August, 1913.

May be compared with *P. Walleri* Maiden & Betche, from which, however, it differs in its larger size, its more numerous elongate sori, etc. By its elongate sori, and its naked or nearly naked rhachis and surfaces, it appears to differ sufficiently from any of its allies. *P. fusco-pilosum* Bak. et F.v.M., with which this plant may be compared, differs in having a longer stipes, the rhachis and surfaces covered with dark red hairs, the scales setaceous, etc.; it also lacks the distinctly black rhachis of *P. Gordoni*, as seen from the under side.

P. Maideni, sp.nov. (Plate lxxxix., fig11*a-d*).

Rhizoma robustum, repens, longe radiculosum, radiculis plus minusve rubro-hirsutis, paleaceum, paleis sub-brunneis lanceolatis, cum rigidis fusco-brunneis setis præditis. *Stipites* approximati, brevissimi, fere nulli, brunneo-setacei. *Frons* 15-25 cm. longa, 3-5 cm. lata, lineari-lanceolata, cito ad basin et subcaudatum apicem angustans, pinnata vel profunde pinnatifida; pinnis erecto-patentibus, multijugatis, alternantibus, linearibus, 1·5-2 cm. longis, 3-4 mm. latis, integris, sed apice subcrenatis et sæpe angustatis, basi confluentibus et subcomplicatis, margine subrecurvis; rhachi et facie postica (interdum facie antica) setis brevibus, rigidis, fusco-brunneis præditis; venis simplicibus, solutis, non marginem attingentibus, plus minusve distinctis. *Sori* pauci (1-8) pinnarum apices versus vel in superiore dimidio, submarginales, profunde immersi in receptaculis crateriformibus, cum elatis setaceis marginibus, in pinnarum crenationibus, in facie antica projicientes. *Textura* subcoriacea.

Evelyn Scrub; R. F. Waller, December, 1908 (Hb. Syd., sub *P. fusco-pilosum* Bak. et F.v.M.).

Judging from the descriptions in A. van Rosenburgh (Malayan Ferns, p. 607), allied to *P. stenobasis* Bak., (from Sumatra), and *P. craterisorum* Harr., (from the Philippines); but sufficiently differing from both. The crater-like receptacles of the sori, with their more or less setaceous edges, are very marked. It differs greatly from *P. fusco-pilosum,* of which Mr. Bailey kindly sent me typical specimens.

Subgen. *Goniophlebium.*

P. VERRUCOSUM Wall.

Babinda and Frenchman's Creek; July, 1913.

P. SUBAURICULATUM Bl., with(?)var. *serratifolium*(Brack.) Hook.

Very frequent throughout the Cairns district, on trees or rocks. Good specimens from Ravenshoe, mostly epiphytic on trees.

Domin (Prodr., p. 172) holds that many of the Australian specimens determined as *P. subauriculatum* belong to the var. *serratifolium.* My own numerous specimens vary considerably in the nature of their serration, but are, all, more or less serrate. A van Rosenburgh (Malayan Ferns, pp. 662-3), says, of *P. subauriculatum,* "the edge entire, slightly crenate, or faintly toothed;" and, of the var. *serratifolium,* "Pinnæ coarsely toothed"; Hooker (Sp. Fil. v., p. 33) says, of this species, "serrated." H.B. (Syn. p. 344) describe the species as herbaceous or subcoriaceous, "the edge entire or slightly toothed," and the var. as "deeply toothed herbaceous form." Hooker, in Sp. Fil. (*loc. cit.*) cites Blume's figure of *P. subauriculatum* (Fl. Jav., ii., t. 83) as "very good"; and Blume's figure is distinctly serrated, though not, or scarcely, auriculate. Bailey's figure (Liths., 162), which Domin considers to be "certainly" var. *serratifolium,* shows stronger serrations than Blume's figure, but very distinctive auricles. Beddome, in Ferns of Brit. Ind. i., t. 78, figures *P. subauriculatum* with strong serrations, though the pinnæ are scarcely typical; his description is "serrated." The name *"serratifolium"* certainly seems to be misplaced, even if the variety itself should be recognised. Blume, in Fil. Jav. p. 177) makes no mention of an entire pinna, but simply says "serrulatæ," the accompanying figure, as stated above, is serrated somewhat strongly.

Subgen. *Pleopeltis.*

P. BROWNII Wikstr.; *P. attenuatum* R.Br., non Willd.

Cairns district; July-Aug., 1913.

On a felled tree, near Malanda, I found large quantities of a form of this fern, with the fronds throughout narrower and less coriaceous than those of the typical plant. It may be allowable to regard it as forma *gracile* (f. nov.).

P. SUPERFICIALE Bl., var. *australiense* Bail.

On tree in "Falling," Major's Homestead, Ravenshoe; Aug., 1913.

This Queensland variety differs from the type in having the sori limited to the upper half of the leaf, and the lamina reaching almost to the base of the stipes.

P. SIMPLICISSIMUM F.v.M.

On trees in "Falling," Ravenshoe, and at the Tully Falls; August, 1913.

Domin distinguishes var. *normalis* (fronds coriaceous, the sterile mostly lanceolate or linear-lanceolate, the fertile long-attenuate-linear, primary veins conspicuous, the rest obsolete) from the var. *wurunuran*, var.nov.(texture thinly herbaceous—not coriaceous—veins and venules strongly prominent, sterile fronds rhomboid-lanceolate, long acuminate, margin subentire). He holds Bailey's fig.(Liths., t.156) to be identical with var. *wurunuran*, which he found to be widespread on Bellenden Ker, while he had not observed the normal type. F. von Mueller published his species first (Frag., vii., 120) as *P. lanceola* Mett., but, on Kuhn's authority, distinguished it on p.156 (*op. cit.*). Domin recognised two forms of var. *normale*, viz., (*a*) margin subentire (obsoletely crenate); and (*b*) margin cartilagineous, conspicuously crenate. While Domin's var. *wurunuran* has wide sterile leaves like f."b" of var. *normale*, they are said to be long-acuminate, while in *normale* (f."b") they are "broadly oblong and obtuse." My specimens, according to this, belong to var. *wurunuran* Dom., and, in the absence of specimens of the specific type, must be so named.

P. MEMBRANIFOLIUM R.Br.; *P. nigrescens* Bl.

On tree. Frenchman's Creek; July, 1913.

Domin has satisfactorily shown (Prodr., pp.176-7) that Blume's *P. nigrescens* is identical with Brown's *P. membranifolium*, which was published 18 years earlier. The nervation clearly separates it from *P. pustulatum* Forst., and *P. scandens* Labill. Domin's var. *subsimplex* I did not find, though my specimens (all from one tree) include a simple frond and a trifid one. These, however, are larger than var. *subsimplex*.

P. PUNCTATUM (L.) Sw.; *P. irioides* Poir.

Stoney Creek, in large masses on the rocky banks, also on rock in bush, Rocky Hill, Kuranda; July-August, 1913.

This striking fern was named *Acrostichum punctatum* by Linnæus in 1763, and *P. irioides* by Poiret in 1804. Thunberg's *P. punctatum* (1784) is now removed to *Dryopteris* (subgen. *Phegopteris*). A return to Linnæus' name is but just; it should never have been changed. Bailey's two forms, *lobatum* and *cristatum*, are handsome additions to the bushhouse.

Subgen. *Grammitis*.

P. AUSTRALE (R.Br.) Mett.; *Grammitis Billardieri* Willd.

On rocks and trees, Tully River, above Falls; August, 1913.

R. Brown and Willdenow published their names in the same year (1810) Christensen gives preference to *P. Billardieri*; Domin to *P. australe*.

P. HOOKERI Brack.

On rocks, very rare, Frenchman's Creek; July, 1913.

P. albosetosum Bail., I did not find.

Subgen. *Selliguea*.

P. AMPLUM (F.v.M.) Dom.; *Grammitis ampla* F.v.M.; *Polypodium ellipticum* Christ; non Thunberg.

Cairns district; mostly round the coastal bases of Bartle Frere and Bellenden Ker; July-August, 1913.

Domin holds that this fern is endemic in Queensland, and is certainly distinct from *P. ellipticum* Thunb., to which it is often assigned. This conclusion is confirmed by specimens of *P. ellip-*

ticum in the Sydney Herbarium (from the Philippines), which have a long, unwinged stipes, a different cell-formation, and shorter rows of sori. Domin's var *stenorhaceum* (from Allumbah and Lake Eacham) does not seem to be represented in my collection.

P. SELLIGUEA Mett., var. SAYERI (F.v.M.) Dom.; *Grammitis membranacea* Bail.; *Polypodium Baileyi* C. Chr.

Herberton district (Ravenshoe, etc.); August, 1913.

In general appearance much like *P. amplum*, but the rows of sori are shorter, and the cell-formation is different. It is common in the scrubs on the Tableland, at Ravenshoe, but not in the coastal scrubs. Domin (Prodr., pp.184-7) gives a careful account of its different forms. His var. *normale* has simple fronds; and A. van Rosenburgh (Malayan Ferns, pp.671-3) defines *P. Selliguea* Mett., in that sense. The Queensland form, which has divided fronds, must, therefore, be regarded as a var. (*Sayeri*). I did not find the form with simple fronds.

CYCLOPHORUS Desv.

C. CONFLUENS (R.Br.) C. Chr.

Cairns district (? loc.); July-August, 1913.

C. ACROSTICHOIDES (Forst.) Presl.

Throughout the Cairns district, but found in large quantities on the northern side of the Barron River, at Kuranda; July-August, 1913.

Domin's notes on the genus *Cyclophorus* (Prodr., p.187) are very useful. He does not recognise *C. serpens* on the Australian continent, except in the var. *rupestris*; and he sets up a new species, *C. spicatus*. The structure of the scales on the rhizome is an important factor in the determination of the species of this interesting genus.

DRYNARIA J. Sm.

D. RIGIDULA (Sw.) Bedd.; *Polypodium* Sw.

At many places throughout the Cairns-Herberton district. The varieties *Vidgeni* and *cristata*, published by Mr. Bailey, are interesting bushhouse plants.

D. QUERCIFOLIA (L.) J. Sm.; *Polypodium* L.

Var. SPARSISORA (Desv.) Dom.; *Polypodium Linnæi* Bory.

On sandy coastal flats, Cairns; on boulder in Stoney Creek, etc.; July-August, 1913.

Var. *sparsisora* differs from the type in having smaller and irregularly scattered sori. My experience accords with Domin's: I did not find the typical *D. quercifolia* in North Queensland.

ELAPHOGLOSSUM Schott.

E. CONFORME (Sw.) Schott.

This species, I did not find.

ACROSTICHUM L.

A. AUREUM L.

This species, I did not find.

PLATYCERIUM Desv.

P. BIFURCATUM (Cav.) C. Chr.; *Pl. alcicorne* Gaud.

Common in the North Queensland scrubs. Domin figures the vars. *normale*, *rhomboideum*, *lanciferum*, and *Hillii* (Moore).

P. GRANDE (A. Cunn.) J. Sm.

North Queensland scrubs.

As I did not bring back with me any specimens of the species of *Platycerium*, I am unable to make any notes on this genus.

GLEICHENIACEÆ.

GLEICHENIA Sm.

Subgen. *Eugleichenia.*

G. FLABELLATA R.Br.

Cairns district (? loc.); July-August, 1913.

G. LINEARIS (Burm.) Clarke; *G. dichotoma* (Thbg.) Hook.

In railway cutting, near Kuranda, and elsewhere; July-August, 1913.

The specimens vary considerably. Some of them have the rhachis and costæ more or less covered, underneath, with ferruginous hairs (? the var. *ferruginea* of A. van R., Malayan Ferns, p.59); others are nearly or quite naked, and have the segments emarginate at the apex.

A. van Rosenburgh (*loc. cit.*) describes the forma typica as, "Texture subcoriaceous; surfaces naked, not glaucous. Ultimate segments under 4 cm. long, entire or emarginate at the apex."

Subgen. *Platyzoma.*

G. MICROPHYLLA (R.Br.) Christ; *Platyzoma microphyllum* R.Br., Prodr., 160; *Gleichenia platyzoma* F.v.M.

This remarkable fern is said by Mr. Bailey (Fern World of Austr., p.25) to be found "in several parts of N. Australia and tropical Queensland," "on sandy hillocks." I did not find it, but specimens in the Sydney Herbarium (from Boorooboloo, Northern Territory; leg. Baldwin Spencer, in 1902) exhibit a character that has been overlooked in many descriptions. I refer to the presence of very small leaves (apparently the sterile fronds) clustered together at the bases of the fertile fronds. These are not more than one-fifth as long as the fertile fronds. Though overlooked in later descriptions, these small fronds are referred to, as follows, in Robert Brown's original description (*loc. cit.*): "Frondes ex eodem rhizomate compresso-filiformes, indivisæ"

SCHIZÆACEÆ.

SCHIZÆA Sm.

S. DICHOTOMA (L.) Sm.; *Acrostichum* L.

In sandy coastal bush, about one mile north of Cairns Post Office (very fine specimens); August, 1913.

S. Forsteri, I did not find.

LYGODIUM Sw.

L. FLEXUOSUM Sw.; *L. japonicum* Benth., non Sw.; *L. semipinnatum* R.Br., fid. Domin.

Near Cairns; August, 1913.

I found very little of this fern. Domin holds (Prodr., 208 f.) that the occurrence of *L. japonicum* Sw., in Australia, is doubtful. He gives figures of *L. flexuosum* and *L. japonicum*, exhibiting the very deeply incised segments of the fertile fronds of the latter species. For the present, all the Queensland records of *L. japonicum* must apparently be transferred to *L. flexuosum*.

L. SCANDENS (L.) Sw.

Swamp at back of Cairns; August, 1913.

L. RETICULATUM Schkhr.

Throughout the Cairns district, especially in the scrubs near Kuranda; Watts and Philip Mackenzie; July-August, 1913.

A striking form was found at Kuranda, with abnormal leafy outgrowth, sometimes partially occupied by the sori, but more frequently quite sterile.

MARATTIACEÆ.

ANGIOPTERIS Hoffm.

A. EVECTA (Forst.) Hoffm.

On and near the banks of Josephine Creek, Bartle Frere; and elsewhere in the Cairns district. Very fine specimens, with fronds some 24 feet long, and 13 or 14 feet across, were seen near the Second Falls, Frenchman's Creek, Babinda; July-August, 1913.

This wide-spread species is so variable, that De Vriese has set up no less than 60 separate species. Domin appears to recognise a number of the species of Presl, De Vriese, and others as varieties of *A. evecta.* Specimens of *A. evecta* are in the Sydney Herbarium, with a note stating that they were collected on the Tweed River, in New South Wales, apparently the only reliable record for this State. No trace of *A. evecta* is to be found on Lord Howe Island.

MARATTIA Sw.

M. FRAXINEA Sm.

At many places in the Cairns district, in the creeks and gullies; common in the scrubs on the northern side of the Barron River, at Kuranda; July-August, 1913. Some confusion appears to exist regarding var. *salicina.* Domin takes it to be the common Australian and New Zealand form, with marginal sori. Mr. E. Betche (Herb. Syd.) regarded it as the form with long submedial sori, found on Lord Howe, Norfolk, and Pacific Islands. The species is very variable.

OPHIOGLOSSACEÆ.

OPHIOGLOSSUM L.

O. PENDULUM L.

Frenchman's Creek; July, 1913.

EXPLANATION OF PLATES LXXXVI.-LXXXIX.

Plate lxxxvi.

Fig. 1.—*Trichomanes Baileyanum*, n.sp.
a.—Rhizome and fronds; nat. size.
b.—Part of frond, showing lobe with fructification; magn.
c.—Part of frond, showing sterile lobes with nerves and spurious venules; magn.
d.—Rhizome and stipes; magn.

Fig. 2.—*Trichomanes Majoræ*, n.sp.
a.—Rhizome and fronds; nat. size.
b.—Part of frond, showing fructification; magn.
c.—Part of frond, showing sterile lobes, with nerves and spurious venules; magn.
d.—Rhizome and stipes; magn.

Fig. 3.—*Trichomanes Walleri*, n.sp.
a.—Rhizome and fronds; nat. size.
b.—Part of frond, showing fructification; magn.
c.—Part of frond, showing nerves and spurious venules; magn.
d.—Rhizome and stipes; magn.

Fig. 4.—
a.—Margin of frond of *Trichomanes nanum* V.d.B., var. *australiense* Bail.; magn.
b.—Margin of frond of *Trichomanes Wildii* Bail.; magn.
c.—Part of frond of *Tr. Wildii*, showing fructification; magn.

Plate lxxxvii.

Fig. 5.—*Hymenophyllum Babindæ*, n.sp.
a.—Plant; nat. size.
b.—Part of lobe of frond, showing dentations and sparsely haired rhachis; magn.
c.—Sorus with indusium; magn.

Fig. 6.—*Hymenophyllum Kerianum*, n.sp.
a.—Frond on rhizome; nat. size.
b.—Sori with indusia; magn.
c.—Lobe of frond, showing sinuato-denticulate margins; magn.
d.—Small piece of margin; magn.
e.—Cell-formation of lobe of frond; magn.

Fig. 7.—*Asplenium parvum*, n.sp.

a.—Frond; nat. size.

b.—Underside of pinna, showing sori and indusia.

c.—Upper side of pinna, showing striations.

Plate lxxxviii.

Fig. 8.—*Dryopteris albovillosa*, n.sp.

a.—Pinna, with portion of villose rhachis; nat. size.

b.—Lobe of pinnule; magn.

c.—Lobe of pinnule, underside; magn.

d.—Sorus, with indusium.

Fig. 9.—*Polystichum fragile*, n.sp.

a.—One of upper pinnæ; nat. size.

b.—Section of rhachis, showing canaliculation on upper side.

c.—An upper pinnule, upper side; magn.

d.—An upper pinnule, underside; magn.

e.—Sorus with indusium—*f*, sorus without indusium—*g*, indusium.

Plate lxxxix.

Fig. 10.—Tip of *Antrophyum reticulatum*, forma *apicilobatum*; half-size.

Fig. 11.—*Polypodium Maideni*, n.sp.

a.—Frond; nat. size, but portion of upper middle cut out.

b.—Rhizome and base of frond; nat. size.

c.—Scales at base of frond; magn.

d.—Crateriform sori with setaceous receptacles; magn.

Fig. 12.—*Polypodium Gordoni*, n.sp.

a.—Rhizome and fronds; nat. size.

b.—Scales at base of stipes; magn.

c.—Sori; magn.

THE DIAMOND-DEPOSITS OF COPETON, NEW SOUTH WALES.

By L. A. Cotton, B.A., B.Sc., formerly Linnean Macleay Fellow of the Society in Geology.

(Plates xc.-xcii.)

CONTENTS.

i. Introduction.

The Copeton diamond-field has its centre of activity at Copeton, a small township on Cope's Creek, about two miles above its junction with the Gwydir River. It is thus on the western edge of the New England tableland. The present paper is the result of observations made during June, 1909, May, 1910, and January, 1913. A number of investigators had previously given some attention to the field, and several papers have been published in connection with it. The earliest report which I have been able to trace, is that of Mr. C. S. Wilkinson(10) to the Surveyor-General, in July, 1873. In this report, he refers to the operations of the Borah Tin and Diamond Mining Company on the alluvial drift, which, he suggests, has been derived from the denudation of the deep leads. It is now known that this suggestion is the correct one. Other reports have been furnished from time to time by officers of the Department of Mines, the chief of these being that of W. Anderson(2) in 1887. This communication was accompanied by a geological map of the district in the neighbourhood of Copeton. This map, somewhat modified and added to, has been incorporated in this paper. Another report of some value is that by G. A. Stonier(8) in 1894. An excellent summary of the work accomplished, up to the date of publication, was given by Mr. Pittman(7) in his book, "The Mineral Resources of New South Wales," which appeared in 1901. The most interesting fact, from the scientific standpoint, was the discovery of a diamond in its true matrix by Messrs. Pike and O'Donnel in 1904. An account of this was published in the Annual Report of the Department of Mines for that year.

More recent contributions to the literature of the subject have been made by Professor David(4), Mr. J. A. Thompson(9), and Mr. A. R. Pike(6).

ii. The Nature of the Leads.

The diamond-bearing drifts fringe the depression which lies between Cope's Creek and the Gwydir River. (See Plate xci., fig. 2). As the first diamonds discovered were won from *recent alluvials*, these will be first described.

Reference has already been made to the fact that diamonds were first found by miners in search of alluvial tin. In all these cases, these gems had been redistributed from Tertiary river-gravels. By this process, small quantities of these gravels were added to relatively large masses of recent river-gravels. In consequence of this, it is at once apparent that the diamonds must be scattered through a much greater amount of barren river-gravel than was the case in the old leads. In exceptional cases, where the denudation of the Tertiary gravels was rapidly effected, the recent alluvial deposits have proved payable. Koh-i-noor deposit and the old football-ground at Copeton are examples of this type of occurrence. The former place lies between two well defined portions of the Tertiary lead. The diamonds are here found distributed through a mass of basalt-boulders, which have been worn down from the neighbouring hills. These boulders have become encrusted and cemented by calcite, resulting from the decomposition of the basalt itself. At the latter place, the diamonds have been derived from the destruction of a tributary of the main lead, which connected Soldier Hill with the Round Mount.

Though a few diamonds have been won from these recent deposits, by far the greater number have been recovered from the Tertiary deposits. In rare cases, the basalt-capping has been denuded, and the gravels lie exposed at the surface. These original deposits are readily detected from the recent alluvials, both by their position and the nature of their gravels. Examples of such deposits are the Streak of Luck, and the Sandy Block. The greater part of the Tertiary gravels, however, are now to be found underlying basalt-flows at various depths from the surface.

The age of the diamond-bearing gravels can be determined only relatively to the rocks between which they lie, as no definite internal evidence has yet been found. Though lignite occurs in several of the mines, no definite plant-remains have been obtained from this locality.

The granites are to be correlated with those at Ashford, which have been stated to intrude Permo-Carboniferous sediments. The coarse grain of the granite indicates that it must have consolidated under a considerable thickness of the sedimentary rock. As, however, but little of the latter remained at the time when the basalt-flows occurred, a considerable interval must have elapsed between the intrusion of the granite and the formation of the deep leads.

The evidence of fossil leaves, from other leads in New England, points to a late Tertiary age for the basalts of the plateau. In the lack of any more definite evidence, therefore, the Copeton diamond-deposits may be regarded as of late Tertiary age.

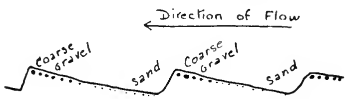
Tertiary gravels.—The nature of the diamond-bearing drifts has obviously been determined by the character of the country over which the prebasaltic streams flowed. The main lead at Copeton has had its course entirely in granite. This rock is of an aplitic character, and, being composed chiefly of quartz and felspar, has, as its products of decomposition, quartz-grains and kaolin. The latter product, on account of the ease with which it is carried in suspension by running water, can be deposited only where the water is comparatively still, as in lagoons. Conversely, the occurrence of any kaolin-deposits implies comparatively still-water conditions of deposition.

A few small tributaries of the main lead have intersected the sedimentary rocks (chiefly clay-slates), and have thus locally introduced a third factor.

As the processes of river-development do not vary with geological time, the Tertiary leads exhibit features in common with present-day streams. Large boulders, for example, occupy a great portion of the old river-channels. These are often so large as to be mistaken for portions of the walls or bottom of the river-channel, and are a source of continual trouble and perplexity to miners. In general, of course, there is an arrangement of the coarsest material at the base of the drift, and a diminishing coarseness of texture with distance from the channel-bed. This type-arrangement is subject to modification in which a number of coarse bands mark the temporary level of the stream.

The drifts are almost invariably of a reddish colour, which is due to the staining effect of the iron-oxides leached from the overlying basalts. The thickness of the drifts varies very greatly, even at short distances. This may be attributed to two causes, the first being the irregularity of the bed of the stream, and the second, the differences in grade; a swiftly flowing current, on a steep grade, tends to sweep the channel-bed free from all loose material.

The greatest thickness of drift observed at Copeton was at the Round Mount. Here a depth of 25 feet was encountered. The "wash," as it is called, differs from the main bulk of the gravel in being coarser in texture and more compact. At the Round Mount, the bulk of the gravels consists of small quartz-grains from 2 to 5 mm. in diameter. The wash, on the other hand, consists chiefly of quartz-pebbles from 5 mm. to 3 cm. in length. The pebbles are of the normal stream-type, being ellipsoidal in form. The slightly predominant tendency of these pebbles to lie with their long axes sloping upwards towards the south-east, indicates that the flow was probably in that direction. Amongst the quartz-pebbles in the wash are to be found a number of blue-coloured rocks, subangular or ellipsoidal in form, and ranging from 2 to 24 cm. in length. This particular band of rock is 20 cm. in thickness, and lies between gravel and drift of normal character. The existence of these bands of wash, at different levels in the drift, is doubtless due to the action of minor floods. Andrews has shown that the work of aggradation is performed in the interflood period. Each moderate flood excavates some of the material aggraded during the interflood period. The largest, or true flood, removes the whole of this material, and corrades the channel. As the flood subsides, aggradation commences; matter held in suspension gradually settles; the coarser material, on account of its greater weight per unit of surface, sinks first, and thus a grade from coarse to fine material is established. Pebbles of greater density associate with larger stones of less density; and, finally, sand covers the whole. The effect of a moderate flood, on the deposit, following a large flood, will now be considered. The moderate flood has not sufficient energy to remove the whole of the material deposited after the large flood, but it can remove some of it. As this moderate flood begins to subside, deposition takes place, and another series is formed having the coarser pebbles at its base. Thus it is possible for many zones to be formed. The coarser pebble-zones formed in this way constitute the layers of wash. The lowest layer of wash is usually the most payable, as the diamonds are larger and more abundant. The layers of wash are somewhat irregular. The bottom-layer follows the contours of the channel-base, which is generally very uneven. The upper layers of wash, on the other hand, conform very uniformly to the horizontal, as they are built up on the loose sands and gravels, which readily adjust themselves to the level under the influence of running water. Yet there is a degree of irregularity: the wash seems to be cut off very abruptly in places, and no clue seems to be afforded by which it may be traced. A very striking illustration, which may explain this irregularity, was observed in the bed of Cope's Creek, near its junction with the Gwydir. A recent flood of considerable strength had passed along the channel of the stream, but, at the time of observation, only a small stream was running. The notable feature was the arrangement of the sands and gravels in the creek-bed. These were deposited in wedge-shaped blocks, having the thin edge of the wedge pointing up-stream. A diagrammatic section of these deposits along the length of the stream is given in Text-fig.1. This would seem to correspond to Andrews' step-like structure in the evolution of stream-development. The slopes were from 20 to 30 feet in length, and the steps from 2 to 3 feet in height. The depressions caused by these steps were of the shape of isosceles triangles (Plate xci., fig.2), having the apex of each triangle pointing down-stream, and the base perpendicular to the direction of flow. The length of the base varied from 6 to 10 feet, and the height of the triangles from 8 to 10 feet. The depressions were in sand having a grain-size from 1 to 3mm. The upward-sloping surfaces of the gravels were covered, to a depth of about 2 inches, with coarse pebbles, from 3 to 7cm. in diameter. If these were buried under a further load of drift and sand, and then covered by a basalt-flow, they would present the same discontinuity, in the beds of wash, as are met with in the deep leads. The study of such features should be of value in the prospecting of deep leads.



Text-fig.1.—Section of bed of Cope's Creek, parallel to the stream.

In a deep lead, there are four well marked zones in the materials deposited, any or all of which may be present. These are—

(1). The coarse gravels known as the wash.

(2). The medium-grained sands and gravels constituting the main bulk of the deposits.

(3). A deposit of fine mud or clay.

(4). A deposit of vegetable-débris, which has, not infrequently, been converted into lignite.

Of these, the wash has been partly discussed in relation to its occurrence at the Round Mount. It has already been noted that the leads under consideration are entrenched in granite, save where a few tributaries have intersected the slate-formation.

It is to be expected, therefore, that the gravels and sands would consist of simple products, and, with regard to the great bulk of them, this is true. There are, however, to be found, intersecting the granite, a great number of small reefs containing many different minerals. It is from these reefs that the bulk of the wash is made. The hard parts of the wash comprise quartz, tourmaline, topaz, jasper, zircon, cassiterite, garnet, and diamond. The soft parts are made up of kaolin, decomposed granite-pebbles, and decomposed pebbles of basic igneous rock.

In the main lead, the wash is fairly coarse, the average size of the pebbles ranging from 1 to 8 cm. in diameter. Occasional boulders are met with, from this size up to several feet in diameter.

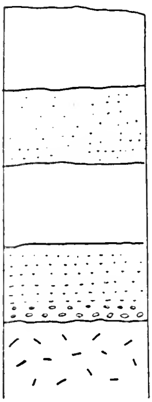
A large percentage of the hard wash-pebbles are quartz, probably more than 90 %; and these can have been derived only from the reefs in the granite. Tourmaline-pebbles are next in order of abundance. These are not of large size, being, as a rule, rather less than 1 cm. in length. They are generally more bean-shaped than the quartz-pebbles, this, no doubt, being due to their formation from the "pencil-tourmaline" so common in the quartz-reefs. The proportion of tourmaline to quartz-pebbles varies greatly from place to place, but rarely exceeds 5 %. The topaz, which occurs in the wash, has, no doubt, been derived from the same source as the tourmaline, but the amount present is very small, and is only noticeable when concentration has been effected. A similar statement also applies to the garnet found in the leads. These gems are small, rarely exceeding 4 mm. in diameter. It is this mineral more than any other which is constant in its association with the diamond. Sapphire is only occasionally met with in association with the Copeton diamonds, and zircon is a rare associate, but special characteristics distinguish the wash from different parts of the lead. The thickness, the degree of coarseness, and the relative amounts of the various constituents, are all very variable quantities. At Soldier Hill, a number of sharp, angular quartzes are present in the wash, so that, doubtless, a reef is close to this deposit. Here, also, a number of jasper-pebbles occur. These are grey stones, much flattened and waterworn. It is evident that they have travelled a considerable distance, having probably been derived from jasperoid bands in the slate-formation. At Benson's farm, better known, perhaps, as the Old Farm, the wash is unusually coarse, boulders up to 20 cm. in diameter being very common.

In some places, the wash has undergone secondary change, as at Kirk's Hill, and the Banca mines. Here, a very common feature is what is locally known as the iron-band. This is a layer of wash which has been cemented by the infiltration of iron-bearing waters. It so happened that the wash, thus altered, was rich in diamonds, and a considerable quantity of it has been profitably mined. It was found that the band was too hard to be crushed without risk of fracturing the diamonds. This difficulty was overcome by heating the material on iron.plates, care being taken not to raise the temperature to the combustion-point of the diamond. The differential expansion of the diamond and its host caused the stones to become freed by this method.

The second zone of the deep lead deposits—*the drift*—constitutes by far the greatest bulk of the material. The sands comprising this possess a grain-size of about 2 to 3 mm., and frequently enclose one or more subsidiary layers of wash. The maximum thickness observed was about 35 feet at the Round Mount. Some of the grains are waterworn, while others are angular, but there is nothing very distinctive about the main mass of the material. It is not found to contain diamonds in payable quantities, even where the gems are most abundant, though occasional stones have been recovered from it.

The third zone—comprising fine mud and clay—occurs only at a few places on this field. At Rider's lead, the most noticeable feature is the presence of a large body of pipeclay, which overlies the gravels of the diamond-bearing wash. This portion of the lead has been worked for nearly a mile, and the bed of pipeclay has been found practically continuous throughout that distance. The clay is a soft, white material, almost pure kaolin, and has an average thickness of about 2 feet. Below it, lies the drift, and below this, again, is a bed of wash, from a few inches up to a foot in thickness. The whole series is covered by a considerable thickness of alluvium, in some places as much as 50 feet in depth. The lead runs from south to north, and only the latter end is covered by basalt.

Again, between the Star of the South Mine and Davis' block, a section of the lead is to be seen, where it has been exposed by mining operations. In this case, a rather unusual arrangement occurs (See Text-fig.2). The pipeclay-band, which is 3 feet in thickness, is overlaid by a fine granite-sand, and rests on gravels, the pebbles of which have a diameter of about 4 mm. This deposit lies at the junction of the two main streams of the Tertiary lead, and is capped by basalt.



Text-fig.2.—Section of the Tertiary Lead between the Star of the South Mine and Davis' Block.

The fourth zone mentioned—that comprising vegetable-débris—is of relatively rare occurrence on this field. The most typical example is that of the Crown Jewel Mine. Here, the vegetation, which has been converted into lignite, overlies the drifts, and is of considerable extent. A tunnel was driven through the drifts for more than 100 feet, and the roof of this drive was in lignite for the whole distance.

iii. Physiography.

In an investigation of the kind embodied in this paper, the two phases which are of most physiographic interest are evolutionary ones. The problems presented are – How has the present topography been developed; and what is its relation to the pre-Tertiary condition? Several elements have contributed to the process, and the chief of these are as follow: (1) denudation, (2) earth-movements, and (3) volcanic phenomena.

If it were possible to replace, in its original position, the mass of material removed by the agency of denudation since the basaltic period; to remove the basalts entirely; simultaneously to readjust, in their proper chronological order, the results due to earth-movements; there would then appear, in its original state, the topography of the pre-basaltic period.

Mr. E. C. Andrews has given an excellent general account of the physiography of northern New England. He has shown certain stages of peneplanation, the youngest of which has left its record as the Stannifer peneplain; and the physiography of Copeton is dominated by this feature.

A study of the contours on the accompanying geological map reveals three topographical units. These are :—

(1). A relatively low-level area bounded, on its north and east sides, by the Gwydir River. This is about 2,200 feet in height.

(2). An area of moderate relief situated north of Cope's Creek and the Gwydir. This area has an altitude of about 2,800 feet.

(3). An area of relatively high relief situated to the east of the Gwydir, and to the south of Cope's Creek. This area attains an altitude of as much as 3,400 feet.

The first of these is wholly in the Oakey Creek granite-area. I examined about one hundred square miles of this area, but failed to obtain any evidence that it had been covered by basalt. If such has been the case, denudation has removed all trace of the lavas. The channel of the Gwydir is about 200 feet below the general level of this area.

The second unit presents more variety in its geological structure. The basal rock is granite. Two types—the Oakey Creek granite and the Acid granite—are present, and these are separated approximately by a tributary of Cope's Creek (see Plate xcii.). There are also masses of clay-slate included in the area, mainly to the east of the Auburn Vale Creek. Basalt overlies a considerable portion of each of these rocks. This area represents the denuded surface of the Stannifer peneplain.

The third unit is composed of the Acid and Tingha granites, and basalt has been found only along old valleys cut in these structures. This area also represents part of the original Stannifer peneplain. Further data are yet required for the solution of the problem. These are supplied by a knowledge of the positions and directions of flow of the Tertiary streams. These may be seen by a reference to the accompanying geological map, on which they are represented by thick black lines.

As a preliminary step towards solving the problems connected with the pre-Tertiary stream-development, it will be well to consider the present rivers and their origins. The chief of these are the Gwydir River, and its tributary, Cope's Creek. The question arises, has the course of the Gwydir been determined by the re-opening of some Tertiary stream, or has it had its direction controlled by some large structural feature developed subsequently to the basalt-period?

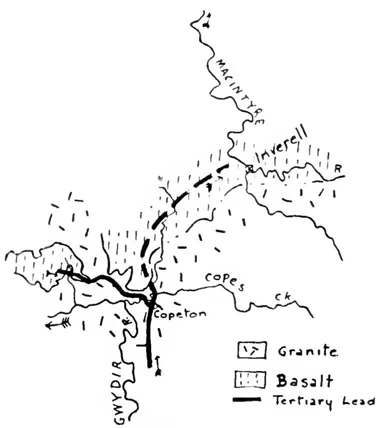
The accompanying map shows that a pre-basaltic stream flowed from Oakey Creek to Copeton, in a direction approximately parallel to the Gwydir, but in a contrary direction. Moreover, the distance between the two streams is less than two miles, while the difference in their levels is about 100 feet. The great instability of such a system is opposed to the existence of the Gwydir as a pre-basaltic stream. Again, it would be strange indeed if the basalts, which covered the Oakey Creek lead with a thickness of several hundreds of feet of basalt, had not filled the valley of the lower adjoining river. The fact that no trace of basalt has been found on the low-lying area to the south-west of the map, is also opposed to this view. It may be concluded, therefore, that the present Gwydir has been developed in a direction quite independent of the pre-basaltic drainage-system.

If the present course of the Gwydir be regarded as post-basaltic, its position must be due either to haphazard denudation, or to some definite structural feature. The presence of the relatively low-lying block, bordered on its north and east sides by the Gwydir, is the factor which serves to discriminate between these two explanations. It is highly improbable that the processes of denudation can have exerted such a selective influence on the low area lying to the south and west of the Gwydir, while steep escarpments rise abruptly from the other side of the river. The assumption of a faulted block, on the other hand, accounts both for the low level of the area discussed above, and also for the marked change of direction of the Gwydir at its junction with

Cope's Creek. This explanation, moreover, implies that, at the period of basaltic intrusion, this block-faulted area was at a much higher elevation, and, consequently, more likely to have escaped being flooded with lava; and it has been pointed out that no evidence of basalt was found on this area.

It thus appears probable that the Gwydir is a post-basaltic stream, which has followed the direction of the two faults bounding the north-east corner of a fault-block.*

The reconstruction of the pre-basaltic physiography, then, involves the elevation of the fault-block into its original position. If we suppose this to be done, there remains only the removal of the basalts to restore the conditions of the pre-basaltic physiography. The presence of river-gravels, and of V-shaped sections of basalt lying on granite-foundations, enables a large amount of this imaginary construction to be readily performed.



Text-fig.2*a*.--Map showing the Tertiary and Recent river-systems of the Gwydir and Macintyre near Inverell.

The final result of this readjustment of the effects of natural processes transforms the area into a denuded peneplain at an elevation of 3,000 feet above sea-level. The discussion on the disposition of the Tertiary leads indicates that the pre-Tertiary streams united to form a north-flowing river. This tendency of the pre-basaltic drainage to flow north is in marked contrast to the present trend, which is towards the west.

From the junction of Auburn Vale Creek with Cope's Creek, a broad basalt-flow trends northwards towards the western side of the town of Inverell. For about half the distance, the flow is limited on each side by granite; but, near Inverell, only the eastern boundary is

* Further evidence of faulting occurs to the west at Keera Station.

well marked. The level of the basalt on the western side is above the peneplain-surface of the granite-area. This flow undoubtedly represents a pre-basaltic valley, which was completely obliterated by the lava-flows. Subsequent denudation has exposed the granite along the eastern side, and partly on the western side. (See Text-fig. 2*a*).

As the pre-basaltic Gwydir has been traced directly into the southern, truncated end of this flow, there can be no doubt that the Gwydir originally continued in this direction.

Moreover, it is clear that the Macintyre at Inverell has been redeveloped along the course of a pre-Tertiary stream from Newstead to Inverell. Thus it would appear that the Macintyre-Gwydir originally formed one stream-system, which has been severed by the large basalt-flow extending from Copeton to Inverell.

iv. The Distribution of the Diamond-leads.

The subject-matter of this Section will be rendered clear by reference to the accompanying geological map (Plate xcii.). This map is practically that of Mr. Anderson, published in 1887. A few additions and alterations, including the contours, have been made by the author. Previous workers have held the opinion that the main Tertiary stream flowed west from Copeton to Bingara. It has been stated, in support of this hypothesis, that the size of the diamonds found in the river-gravels decreases from Copeton towards Bingara. It has been argued that the largest diamonds would remain nearest their source of origin, and the smallest would be carried farthest down stream. This argument is, no doubt, correct, but the converse is not, in this case, true. The observation of numerous aneroid readings, which were checked and standardised, has shown that the Tertiary lead on the north side of the Gwydir has not flowed towards Bingara, but in the opposite direction. Some other reason must, then, be assigned to account for the fact that the diamonds are larger at Copeton than at Bingara.

The levels observed are recorded on the sketch contour-map. The gaps between the remnants of the basalt-leads have been examined, and the Tertiary stream-channel reconstructed as shown. A short description of the various places, where diamonds have been found, will serve to connect these, and to illustrate their relationships.

The most southern claim is that known as Rider's Lead. This lead heads on the present divide, between Maid's Creek and Sandy Creek, at an elevation of about 2,600 feet above sea-level. This is near the junction of the Acid with the Tingha granite, but the lead itself lies chiefly within the Acid granite-area. Very little basalt is now present, and the greater portion of the lead is now concealed by alluvial deposits at a depth of about 50 feet. The characteristic feature of this occurrence is the zone of pipeclay, which overlies the drift and wash. Owing to the neglected state of the workings, I was not able to investigate underground; but, from information supplied by Mr. Skippen, it would appear that the body of wash was not more than a few inches in thickness. This was overlaid by about three feet of rather coarse drift (containing pebbles up to 1 cm. in diameter), and the whole covered by two or three feet of pipeclay. The basalt-capped part lies three-quarters of a mile below the head of the lead. It is probable that, when this lower portion was overwhelmed by basalt, a lake was formed in which the fine kaolin from the decomposition of the felspars was deposited. There is no evidence that the head of the lead was ever covered by basalt. Little success has attended the exploitation of the deposits underlying the basalt, most of the diamonds having been won from that part underlying the alluvial deposits.

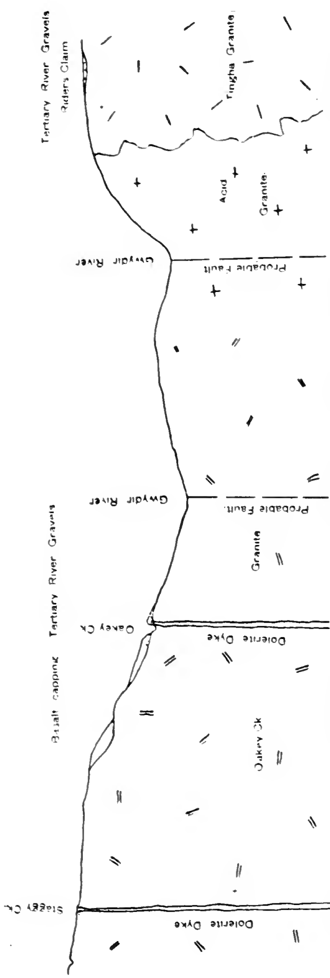
The minerals associated with the diamond in this lead are tourmaline, topaz, tinstone, jasper, and garnet. The diamonds, as usual, were recovered from the wash, in which they were irregularly distributed. Several good finds were made in small potholes. The stones were of better size and quality than the average production of the Copeton field, and numbered about three to the carat. Bort is also recorded from this locality.

Following the lead north, the next place where diamonds have been found is at Kenzie's claim. Here the lead has been almost entirely swept away by the present creek, but a small area of basalt, considerably less than an acre in extent, still remains. The discovery of diamonds here is only of importance, for the purpose of this paper, as a piece of evidence as to the course of the lead.

At Collas' Hill, diamond-bearing drifts have been worked with some success. Here, the basalt has been intersected by the present stream-course, and has exposed the Tertiary gravels on the side of a hill. These deposits were prospected by means of tunnels, driven at the level of the wash, which stands at an elevation of about 2,280 feet. The diamonds found here averaged about four to a carat, and contained a number of triangular, flattened crystals.

The Streak of Luck Mine is situated on the next remnant of the Tertiary lead. Here the basalt has been entirely denuded, and the gravels lie either exposed at the surface, or buried under a few feet of alluvial. The level of the wash at this mine is about 2,250 feet. The diamonds from this locality averaged about four to the carat.

The Deep Shaft Mine adjoins the lease just mentioned. The diamond-bearing drifts are here covered by basalt, varying in thickness from 50 to 130 feet. This has been one of the most productive mines on the field. A small tributary from the south-east joined the lead at this point. This has introduced, into the lead, boulders of clay-slate from a small area of this rock about half a mile distant. In places, these boulders are several feet in diameter, and overlie the sandy drift. The wash is normally about one foot in thickness, and is covered by sandy drift, the grainsize of which is from 3 to 6 mm. The diamonds occur in the wash, and are associated with quartz, topaz, tourmaline, garnet, sapphire, zircon, and tinstone. The gems are found unevenly distributed, often occurring in clusters where concentration has taken place. It is recorded that 150 carats have been recovered from a single load of wash-dirt. It is noteworthy, that the diamonds won from this mine are larger than those from the lead above this place. The stones average three to the carat, and are of good quality. From 40 to 50 per cent. of the stones are white, rather more are a light yellow, while a few are brown and green. Well developed octahedral crystals are conspicuous; probably 6 to 8 per cent. of the diamonds being of this nature. A number of the crystals exhibit twinning. Pieces of bort, several carats in weight, have also been found at this mine.



Text-fig. 3.—Section from Staggy Creek to Rider's Lead, showing the relations of igneous rocks and faults.

The lead next passes through Davis' block. Here it is also concealed by basalt, though the depth of the wash from the surface is lessened by the fact, that a small stream has removed a considerable portion of the basalt-capping. The lead, at this point, swings round from a north-east and takes a north-west course.

At the Koh-i-noor Mine, which is situated about 150 yards beyond the last-mentioned block, the basalt has been removed from the lead on its western side. A section of the deposits (see Text-fig 3) shows that the bedrock is a very decomposed granite. Upon this rests a body of gravel, some three feet in thickness. There is no prominent band of wash in this, but the whole consists of small quartz-grains and pebbles about 4 mm. in diameter, which have been derived from the decomposition of the granite. Above this lie three feet of pipeclay of the same nature as that noticed at Rider's lead. This, again, is covered by three feet of fine granite-sand. The whole section has been exposed by tunnelling, and is overlaid by basalt. Immediately to the west of this is situated the redistributed, Tertiary gravels previously mentioned.

The Star of the South has been more productive than any other mine on this field. The bulk of the material mined was hauled from Skippen's shaft, which is 90 feet in depth. The shaft was sunk through basalt until the underlying granite was encountered. The sinking was then continued into the granite, and two drives put in to intersect the wash, and so drain the lead. Both drives intersected a dyke nearly at right angles. In one drive, the dyke attained a thickness of one foot, and in the other it was six inches. The dyke-material was decomposed to a yellow clay. Boulders of this clay were found in the diamond-bearing wash in association with the gemstones.

Adjoining the Star of the South Mine, is Benson's block, better known as the Old Farm. The lead is here covered by 60 feet of basalt, and a considerable amount of water was present in the drift and gravels. The wash was of a very coarse nature, and contained a great number of quartz-boulders up to six inches in diameter. Boulders of granite were also abundant. The diamonds recovered from this mine were similar to those found in the Star of the South, and averaged from three to four to the carat. This mine is of special interest, as here the lead terminates abruptly at the northern end. This disappearance of the lead is explained by the fact that, at this point, the Tertiary stream-channel has been reopened by a recent watercourse, which has removed all traces of the diamond-bearing gravels. The recent stream has its channel on the floor of a steeply sloping gully, less than one quarter of a mile in length, and joins Cope's Creek at a very rugged spot. Beyond this, the lead must have crossed the present position of Cope's Creek. About half a mile to the north-west of this point, there is a large body of gravel and wash at an elevation some 20 feet lower than the gravels at the Old Farm. There can be no doubt that this was part of the main Tertiary stream-channel. The gravels have been prospected by means of tunnels, but no diamonds were found. A tributary flowed in at this spot from the south-west, and recent denudation has exposed, in several places, the gravels deposited along its course. These deposits have been exploited, but without success. The course of the main Tertiary stream has now been traced from Rider's lead, on the south, to a spot half a mile to the north-west of Cope's Creek on the north. Beyond this point, the Tertiary river-system is completely hidden by basalt-flows as far north as Inverell.

The western lead has not yet been considered. This was a large tributary stream, which flowed from a spot 10 miles west of Copeton, and joined the main stream at the town itself. The course of this lead is nearly parallel to that of the Gwydir, but the fall is in the opposite direction. The continuity of the lead has been destroyed by several creeks, which have worked back from the Gwydir. The effect of this is, that there now exist a number of isolated basalt-areas with a linear arrangement, yet separated by steeply flowing creeks. The extreme western limit of the lead, which has proved diamond-bearing, is at Oakey Creek. Here a north-flowing tributary of the Gwydir has intersected the east-flowing Tertiary lead, leaving the gravels exposed at the surface on each side of its valley. The deposits were worked by means of tunnels, and both diamonds and tinstone recovered from the wash. It was while driving a low-level tunnel in the granite underlying these deposits, that Messrs. Pike and O'Donnel met with a very remarkable occurrence. The tunnel was found to intersect a large body of decomposed igneous rock, and it was noticed that a great deal of this was found in the wash in association with that part of it which was richest in diamonds. The dyke-rock is a dolerite. It does not outcrop on the hill-slope, but is entirely covered by basalt.

The diamonds found at Oakey Creek are rather smaller than the average Copeton diamonds, ranging from four to five to the carat. About half the stones recovered are white, and most of the remainder straw-coloured. Few octahedra have been found, and there is no record of bort having been discovered.

The lead continues through the hill forming the watershed between Oakey Creek and Kirk's Creek, and the gravels again outcrop on the eastern slope of this hill. Here another drive, known as Dodd's tunnel, was put in to reach the wash near its bottom-level. This tunnel, like that at Oakey Creek, also intersected a dyke, boulders of which were in the adjacent diamond-bearing wash.

About half a mile further east is Kirk's Hill. This claim is renowned for having produced the richest find of diamond-bearing wash in the district. It is reported that, from four loads of wash-dirt, 1,100 carats of diamonds were recovered. A number of large boulders were present in the wash, and these seem to have acted as a series of ripples in concentrating the diamonds. The usual associates of the diamond, topaz, tourmaline, tinstone, garnet, and quartz were also found here. Another decomposed dyke also occurs in association with these deposits. The gravels overlie the dyke in part, and soft, yellow, decomposed boulders, derived from it, are present in the wash. The wash here is at an elevation of about feet. A notable characteristic of the wash at this mine is the presence of what is known as the "iron-band" This name is applied to a layer of wash cemented by iron oxide of a very hard and tough character.

Following the lead further east, the Banca Mine is reached. This lies on the eastern side of Kirk's Creek, and was one of the earliest worked mines. Here, again, a dyke was met in one of the tunnels. The "iron-band" was also found at this mine, where it reached a thickness of two feet, and rested on a granite-floor. Tinstone was found associated with the diamonds.

Beyond Kirk's Hill and on the western side of the Malacca Creek, is another isolated area of basalt covering Tertiary gravels. The Malacca Mine is responsible for the exploitation of these deposits. The basalt has here been denuded so that the lead outcrops on both the eastern and western sides of the hill. The lead lies at the southern extremity of a basalt-capped hill, which bears north and south : it still maintains its east and west trend, and so outcrops on both the east and west sides of the hill. It has, however, narrowly escaped entire destruction, for the gravels, lying on its southern bank, have been exposed in several places on the southern slope of the hill. The distribution of the gravels is still mere obscured by the fact that a tributary stream joined the main lead from the south-west at this point. The result of this configuration is, that the wash outcrops at different levels at various parts of the hill. This is all very confusing at first, and the failure of the prospectors to interpret these facts has made the mining of these deposits a very difficult matter. There is sufficient tinstone present in the wash to make it worth while to recover it, when mining for diamonds. The diamonds are small, ranging from four to five to the carat. Bort is only rarely found at this mine. Here, again, another dyke was met in driving a tunnel into the hill from the west side. The tunnel was driven in a direction about north-east, and two cross-cuts were put in to the north-west, at a distance of 100 feet apart. Both these cross-cuts intersected a dyke. In the more western one, the dyke attained a thickness of 8 feet, but, in the eastern one, the thickness was only 2 feet. It is evident, from the position of this dyke, that the diamonds of the Malacca Mine lie on the downstream side of it. Accompanying the diamonds in the wash were numerous, small, bluish-coloured boulders, from 2 to 3 inches in diameter, derived from this dyke.

To the east of this occurrence, the lead has been denuded by the Malacca Creek, which is a short, steep stream flowing south into the Gwydir. On the eastern side of this creek, the basalt is again to be found covering the Tertiary gravels. This part of the lead has not yielded diamonds in payable quantities, and no local name has yet been assigned to it. The deposit is here from 10 to 12 feet in thickness. A band of coarse wash, containing quartz-boulders up to 2 inches in diameter, occurs about 3 feet from the granite-floor. A few clay-boulders were also noted, and these must have been derived from some dyke in close proximity. About 100 yards to the north-west is another body of drift, some 20 feet higher than the drifts just described. This also contains a number of clay-boulders, and may have been a tributary stream.

To the south-east of the deposit just described, is situated the outcrop of gravels known as Soldier Hill. This was one of the earliest mines worked for diamonds. The discovery of the gems was first made among the sand-grains on a soldier-ants' nest, and hence the name of the mine. The lead here turns to the south, and, beyond the south end of Soldier Hill, has been entirely denuded. Both diamonds and tinstone have been recovered from the wash. The stones recovered average from 3 to 4 to the carat. In this mine, besides the wash on the granite-floor, a top seam was also found to be diamond-bearing. A little free gold has been found in this deposit.

The bottom layer of wash is made up of granite-boulders, from 2 to 4 inches in diameter. These range from subangular to perfectly waterworn, ellipsoidal stones. This band also contains quartz and tourmaline pebbles, and is about one foot in thickness. About one foot above this band, are a number of waterworn pebbles, decomposed to a soft bluish clay. These are mostly about an inch in diameter, but occasionally are of larger size.

Another occurrence of considerable interest is that known as the Round Mount. This is, as the name implies, a small, round hill, possessing a capping of basalt from 10 to 20 feet in thickness, and a series of river-gravels about 25 feet in depth. These gravels are isolated, and their position has given rise to much speculation. There is a ridge of granite separating them from the deposits at the Deep Shaft and the Streak of Luck. The internal evidence, as deduced from the slope of the bottom of the gravels from the edge to the centre of the channel, and also from the arrangement of the pebbles, indicates that the direction of the stream was from west to east at this point. On the northern side, and at a distance of about 100 yards, is another patch of river-gravels, also capped by basalt. The basalt is continuous between the two outcrops of gravel. At this place, the direction of the stream is to the south-east. The wash consists chiefly of quartz-pebbles from 4 mm. up to 4 cm. in diameter, with tourmaline, topaz, and garnet. A number of bluish boulders, from 2 cm. up to 20 cm. in length, resembling those of Soldier Hill, are also present. The isolated position of the Round Mount, and the fact that its river-gravels are at the same level as those of the Deep Shaft, have rendered the problem of determining the relation of the Round Mount, to the main Tertiary stream, a difficult one. The solution of the problem is to be found from the following facts. The trend of the lead at Soldier Hill is in a southerly direction, and, between this place and the Round Mount, occur the redistributed river-gravels at the football-ground. Again, the small patch of gravels, to the north of the Round Mount, is in the line of these occurrences. Moreover, the level of the gravels, at the Round Mount, is lower than that of the Soldier Hill deposits. It has also been pointed out that another mass of redistributed gravels occurs at the Koh-i-noor Mine, which lies between the Round Mount and the Star of the South Mine. There can, then, be little doubt that the part of the lead, flowing from Oakey Creek, continued through the Round Mount, and joined the main stream at a point between the Deep Shaft, and the Star of the South Mine. The position of the surface-gravels at the Sandy block, just west of the Round Mount, is doubtless due to the presence of a tributary joining the Oakey Creek branch at the Round Mount.

In addition to the occurrences just described, which have now been linked up into a continuous river-system, there are a few isolated patches of gravels which deserve a short description.

The Lone Star is the name given to a mine, which comprises two small basalt-capped hills overlying the granite and slate junction to the north of Cope's Creek. The gravels here underlie the basalt, but are at an elevation of 2,380 feet, which is considerably above that of the Tertiary system previously described. The lead at this point trends in a north-westerly direction. Mining is carried on chiefly for tinstone, but a few diamonds are almost invariably found in each washing. At about three miles to the north-west, another outcrop of gravels was noted; it is probable that these all belong to the same stream-course, and that this was a tributary to the main Copeton lead, which flowed north after crossing the present position of Cope's Creek. The general fall of the country was in this direction, as the Tertiary lead at Inverell is at an elevation of about 1,700 feet, and the level at Gragin, still further to the north-west, is about 1,400 feet.

Another isolated area of diamond-bearing gravels, is that situated at Staggy Creek, about 7 or 8 miles to the north-west of the Oakey Creek occurrence. The gravels are exposed at the surface, and no basalt is present. The deposit consists, for the greater part, of quartz-pebbles and boulders, ranging from 5 mm. to 20 cm. in diameter. A relatively large amount of tourmaline is present, and many of the larger quartz-boulders contain pencil-tourmaline. Topaz and jasper are also to be found, and garnet is invariably present where the gravels are diamond-bearing. An iron-band, similar to that at Kirk's Hill and the Banca, was also noted. The whole diamond-bearing area is some 300 yards in length, and rather less than 100 yards in breadth. Its general direction is south-west. The gravels rest on a granite-surface, except at a spot near the centre of the area. Here, a small dolerite-neck, which is 60 yards long, by 10 to 15 yards wide, outcrops at the surface. The diamonds recovered were largest and most abundant in the vicinity of this neck. There are two shafts in the neck; and the dolerite has been examined, but no diamonds have been found in it. The deepest is 70 feet in depth, and the other is 30 feet deep. The dolerite was soft and decomposed for a considerable depth, but was hard and fairly fresh at the bottom of the deep shaft. Gold was found in washing for the diamonds, but only large flakes were recovered, as the method of diamond-washing could not save pieces less than 1·5 mm. in largest diameter. About 10,000 carats of diamonds are reported to have been won from this locality.

v. Geology.

The geological features of the district include

(1) A series of clay-slates.
(2) A series of granites.
(3) Several basalt-flows.
(4) A number of basic dykes.

The clay-slates are the oldest rocks in this area. These have been mentioned in a former paper(**3**) on the district, and are not important from the point of view of this publication. The granites have been classified, in the same paper, into three types, the Acid granite, the Tingha granite, and the Oakey Creek granite. The granite which occurs at Copeton itself is intermediate in character to the first and second types, and was included, in the paper quoted, with the Tingha granite. A closer examination, however, has indicated that it is perhaps better classed with the Acid type. It is intermediate in chemical composition to the above types, resembling the Acid type more in chemical composition, and the Tingha type in physical characters.

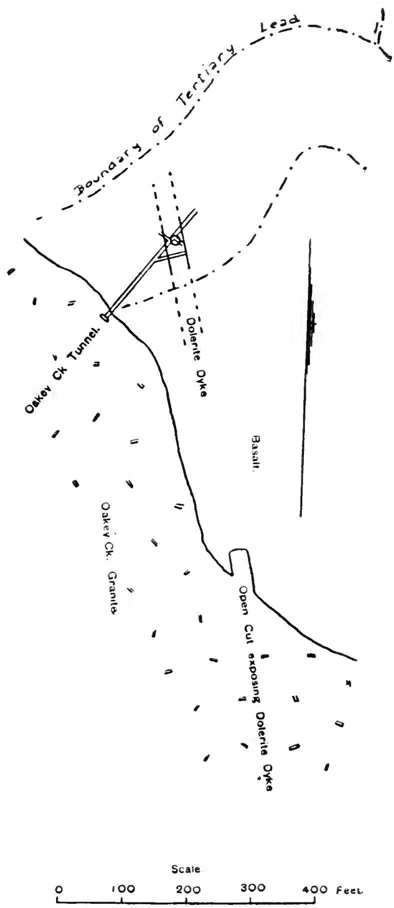
The Acid granite has been shown to be intimately associated with the tin-deposits of the New England plateau. It is a coarse-grained granite, containing quartz-grains from 2 to 5 mm. in diameter, and tabular crystals of pink orthoclase up to as much as 15 cm. in length. A small amount of biotite is usually present, and the rock is not infrequently tourmaline-bearing. It thus has close affinities with the Alaskite of Spurr. The whole Tertiary system of diamond-bearing gravels at Copeton has this rock as its channel-base, with the exception of that part between the Oakey Creek and the Malacca mines, which rests upon the Oakey Creek granite. It is worthy of note that the portions of the Copeton leads which are diamond-bearing are nowhere far distant from the junction of the Acid granite with some other formation, of a greater geological age.

The Tingha granite has been shown to be older than the Acid granite. It is a hornblende-biotite type, containing tabular phenocrysts of plagioclase-felspar. It occurs only at the south-east portion of the area now under consideration. Text-fig. 3 shows the relationships of the series of rocks from Staggy Creek to Rider's Lead.

The Oakey Creek granite has been further investigated since it was last described, and has been found unique in the nature of its inclusions. The granite itself is very coarse, containing phenocrysts of plagioclase up to three inches in length. It is intersected by numerous tourmaline-bearing veins, in which this mineral occurs in long pencils up to three inches in length. The most striking feature, however, is the presence of a great number of inclusions. These are uniformly of one type, and consist of masses of dark-coloured rock containing phenocrysts of felspar similar to those in the granite. The inclusions are frequently more than a foot in diameter, and range in size down to small masses only an inch across. The shape of these is very variable. Some are spherical, others ellipsoidal, while others, again, are subangular. In all cases, the contact of these bodies with the granite is fairly sharp and well defined. The inclusions possess a dark base, consisting chiefly of biotite and quartz, in which are set phenocrysts of felspar and quartz. The felspars normally show signs of corrosion, and may be subangular or even ellipsoidal. A large inclusion, showing corroded felspars, is represented in Plate xc., fig.1.

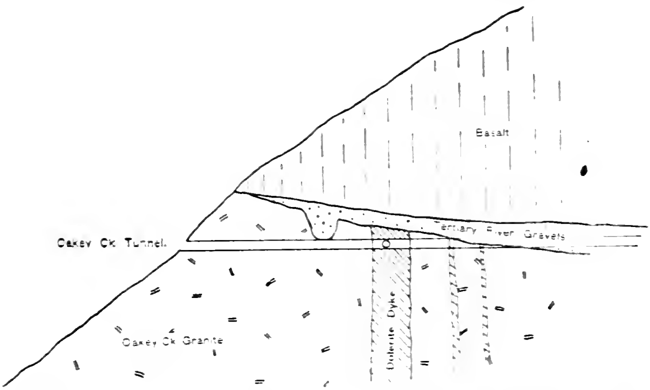
It is of interest to note that inclusions of an identical nature exist in the Acid granite at the Dutchman tin-lode, near Torington. This is about 70 miles to the north-east of the Copeton occurrence. As no such inclusions have been found in the Tingha granite, it is probable that the Oakey Creek granite is more closely related to the Acid granite than to this more basic type. As its morphological affinities, however, are more related to those of the Tingha granite, it is probably intermediate to these two types.

Dykes.—A number of felsite-dykes occur in the Copeton area, and these intersect both the Oakey Creek and Acid granites. None of these have yet been proved to be diamond-bearing, but some of them occur in positions which suggest that they may, at least, be regarded as possible sources of diamond-supply. In addition to these, there are two intrusions of dolerite known in the Oakey Creek granite, and both of these are undoubtedly intimately asso-



Text-fig.4.—Plan of the dolerite-dyke at Oakey Creek showing the spot (marked by a circle) where the diamond was found in matrix.

ciated with diamond-bearing gravels. These have been mentioned in connection with the Tertiary deposits at Oakey and Staggy Creeks. A petrological description of the rocks, and an analysis from each locality, are given under the section on Petrology. It is evident that the rocks are very similar in chemical and physical characters. The analyses show that they differ considerably, in chemical composition, from the peridotite of the South African mines. The Oakey Creek occurrence (Plate xci., fig. 1) deserves special mention. The plan (Text-fig. 4) illustrates the position



Text-fig.5.—Section illustrating the dolerite-dyke at Oakey Creek.

and known extent of the dolerite-mass at Oakey Creek. The section (Text-fig. 5) shows the relationships of the dyke, granite, river-gravels, and basalt. The linear development and the plane slickensided wall, showing in one of the drives, enable the mass to be classed as a dyke. It is 26 feet wide in the main drive, and is a considerable width at a distance of 500 feet to the south of this drive. The width here cannot yet be determined, as the open cut has disclosed only one boundary of the dyke-mass. There is very clear evidence that this dyke was older than the river gravels overlying it, as an exposure in the easterly drive shows the contact of these. Moreover, decomposed boulders of the dyke-mass are abundant in the river-gravels.

The dyke intrudes the Oakey Creek granite, and the junction is sharp and well defined. Though there is no marginal differentiation in the dolerite, it is common to find in it fragments of quartz, which have undoubtedly been derived from the granite. The microscopic examination reveals the presence of a very small amount of free quartz, but this appears to have crystallised from solution, and not to be of an included nature.

The small neck at Staggy Creek, is composed of practically the same rock. As the localities are distant about four miles, it is probable that the magma, from which the rocks were formed, was of some considerable extent. This neck also intrudes the granite-mass, and no sedimentary rocks occur within some 4 or 5 miles of either occurrence. It must be noted that, in each case, diamond-bearing river-gravels of later age have been found overlying the dolerite-masses.

Not only is this so, but, in the case of one of these, it has been amply demonstrated that a diamond was found fast embedded in the dolerite-matrix. The specimen has been preserved, and has been shown to many eminent geologists by Prof. T. W. E. David, who writes* as follows :—"At the meeting of the British Association at York, England, as well as that of the International Geological Congress of Mexico last September, this specimen was most critically examined by the chief scientific authorities on diamonds in the world, and all were satisfied as to the absolute genuineness of the discovery, and considered it of the highest possible scientific interest." A second diamond was also exhibited with the one embedded in matrix. This was stated to have been found free in the heap of decomposed dolerite. It was agreed, by scientific observers, that this was even better evidence of the genuineness of the discovery, from the fact that the diamond was pitted, and that the pits were filled with finely crystallised dolerite, evidently *in situ*.

Having examined both the above-mentioned specimens, and the spot where they were found, I also feel quite convinced of the genuineness of the discovery.

Active interest was aroused in 1912, and about 100 tons of the dolerite were mined and exposed to the weather. Shortly

* Prof. T. W. E. David, Sydney Morning Herald, 19th and 26th January, 1907.

before my visit, in January, 1913, some nine tons of this were screened and washed. Two diamonds were shown to me, which were reported to have been recovered from this test. About three tons more were washed in my presence, but no diamonds were recovered.

It thus appears that, quite apart from the fact that diamonds have been found in the dolerite, the evidence points to the dykes as the probable source of the diamond-supply. From the great variety, both in size and character, of the diamonds from different parts of the leads, it is probable that the diamonds have been derived from a great number of such dykes or necks. These are, probably, like the Oakey Creek occurrence, still hidden by the recent basalt-flows.

vi. Petrology.

The Oakey Creek Granite.

Crystallinity: holocrystalline.

Grainsize: *relative*, porphyritic; *absolute*, smaller crystals from 3 to 6 mm.; phenocrysts up to 8 cm.

Fabric granitoid; also graphic intergrowth of quartz and orthoclase in some instances.

Minerals in order of decreasing abundance: quartz, orthoclase, albite, biotite, microcline, muscovite, magnetite, apatite, and fluorite.

Secondary minerals: kaolin and chlorite.

The felspars have crystallised out in two generations; the older ones are idiomorphic, zoned, and fairly free from decomposition, while the opposite characteristics mark the later felspars. These remarks apply to both the orthoclase and the albite. The biotite is a dark variety, its pleochroism varying from yellowish-brown to very dark brown.

A small amount of microcline is present in subidiomorphic crystals.

The muscovite is rather rare, and is mostly included in the orthoclase. It oppears to have been corroded by the magma subsequently to its complete crystallisation.

The apatite possesses its characteristic, prismatic habit.

One or two very small allotriomorphic grains of fluorite were observed in one slide of this rock.

Quartz-dolerite. *Loc.*—Oakey Creek.

Crystallinity : holocrystalline.

Grainsize : evengrained, the typical crystals varying from 2 to 6 mm.

Fabric : a network of plagioclase felspars with subordinate augite. The interstitial material is a brown chlorite, with a few decomposed biotite crystals.

The chief minerals, in descending order of abundance, are oligoclase, labradorite, augite, chlorite, magnetite, biotite, and quartz.

A little secondary hornblende is present, and the felspars, though fairly fresh, on the whole, show some signs of kaolinisation along some of the major cleavage-cracks. The felspars vary from oligoclase to basic plagioclase. The most basic felspar-crystals, as determined by the method of Michel Levy, are labradorites of the composition Ab_2An_3. Many of the crystals are strongly zoned, and the different zones vary widely in composition. The outer edge is often oligoclase, and the central area anorthite. The augite, which is very fresh, is an almost colourless variety, with a faint colour suggesting that it is titanium-bearing. It is intermediate in composition between diopside and true augite.

The most interesting, and, at the same time, most puzzling feature, is the presence of the brown, chloritic, interstitial material, and also idiomorphic quartz-crystals The chlorite is often arranged in a manner which suggests that it has been derived from an augite, which was originally involved in an ophitic structure with the plagioclase. The structure has been variously interpreted by different observers. Professor Bonney and Professor David have suggested that the chlorite is a secondary product derived from a primary hornblende. Dr. A. Thompson has considered its derivation from augite unlikely, because of the freshness of the augite associated with the felspar in the rock. He has suggested that the chlorite may represent a devitrified glass.

There is, however, a constant association of idiomorphic quartz-crystals with the chlorite, which has not, so far, been recorded. In Plate xci., fig.3, this arrangement may be seen. The small, clear, hexagonal crystal, in the darker mass surrounding it, is a quartz-crystal in chlorite. This structure occurs only on a small scale, but it is very characteristic of the whole rock. In places, the quartz has been partly resorbed, and the chlorite-fibres penetrate into it. Again, it is not uncommon to find a modified graphic intergrowth of chlorite and quartz. From this, it would seem that the quartz crystallised rather before the chlorite, on the whole, but that, in certain parts, the crystallisation was simultaneous.

These relations of the quartz and chlorite seem opposed to the derivation of these minerals from a primary mineral, such as hornblende or augite, or even from a glassy base. On the other hand, much of the magnetite and ilmenite appears to be of a secondary nature. The opaque crystals are, in places, moulded about the felspars and the augite. A considerable amount of the iron-ores appears to be associated with the chloritic material.

A number of acicular crystals are present, which are idiomorphic to the felspar. These appear to be tremolite. They do not appear to bear any definite relation to the chloritic material.

Leucoxene is present, bordering the ilmenite.

Quartz-dolerite. *Loc.*—Staggy Creek.

Crystallinity: holocrystalline.

Grainsize: relatively evengrained, the normal crystals varying from 2 to 5 mm. in diameter.

Fabric: a network of plagioclase felspars, with grains of nearly colourless augite. The augite is very subordinate in amount, being distinctly less abundant than in the Oakey Creek dolerite. There also occurs a considerable amount of interstitial chlorite, as in the Oakey Creek dolerite.

The chief minerals, in descending order of abundance, are oligoclase, labradorite, augite, chlorite, ilmenite, magnetite, quartz, and biotite.

The felspars are very similar to those of the Oakey Creek dolerite, but the sample was not so fresh in this rock, and the felspars, consequently, are more kaolinised. The most basic felspar observed was labradorite of the composition Ab_3An_7, and, the most acid, an albite-oligoclase. Zoning occurs in the felspars, the composition of the zones varying from albite-oligoclase at the margin, to basic plagioclase in the centre of the crystals.

The augite, which is slightly more coloured than that of the Oakey Creek dolerite, is much less abundant than in that rock. The grains, moreover, are much smaller in size.

The chlorite, which is also less abundant than in the Oakey Creek dolerite, has the same characteristic relation to the felspars, and, moreover, the same strange property of including idiomorphic quartz-crystals. These quartz-crystals are, however, less abundant in this rock. The same problem as to the origin of the chlorite, therefore, exists.

Ilmenite is more abundant than in the Oakey Creek dolerite, as also is leucoxene.

Analyses and Molecular Ratios.

i. Oakey Creek quartz-dolerite.
ii. Staggy Creek quartz-dolerite.
iii. Hard rock (blue ground) De Beer's Mine, Kimberley.
iA. Molecular ratios of i.
iiA. Molecular ratios of ii.

	i.	ii.	iii.	iA.	iiA.
SiO_2	50·43	51·16	49·50	841	853
Al_2O_3	14·72	17·98	18·40	144	176
Fe_2O_3	2·90	2·85	} 13·10	18	18
FeO	4·59	4·09		64	57
MgO	6·67	4·10	5·25	167	102
CaO	7·13	7·30	2·24	128	130
Na_2O	2·47	3·92	4·65	40	63
K_2O	1·23	1·61	1·48	13	17
H_2O-	3·49	2·51	} 5·23	193	139
H_2O+	3·82	2·32		212	129
CO_2	1·67	1·03		38	23
TiO_2	0·82	1·27	—	10	16
P_2O_5	0·22	none	—	1	none
MnO	0·03	—	—	—	—
Cr_2O_3	0·02	—	—	—	—
V_2O_5	0·03	—	—	—	—
SO_3	0·01	—	—	—	—
	100·25	100·14	99·85	—	—

Norm of the Oakey Creek quartz-dolerite.

Quartz	9·36
Orthoclase	7·21
Albite	20·96
Anorthite	24·20
Hypersthene	20·14
Calcite	3·80
Corundum	0·30
Magnetite	4·18
Apatite	0·31
Ilmenite	1·52
Water	7·31
	99·29

Norm of the Staggy Creek quartz-dolerite.

Quartz	2·70
Orthoclase	9·62
Albite	33·01
Anorthite	26·69
Diopside	14·52
Magnetite	4·16
Ilmenite	2·44
Calcite	2·30
Water	4·83
	100·27

Both the microscopical examination and the analyses of the Oakey Creek and Staggy Creek rocks indicate their close relationship. The association of each of them with diamonds in Tertiary river-gravels is another harmonic relation. In view of the evidence for the occurrence of diamonds in the Oakey Creek dolerite, there can be little doubt that the Staggy Creek rock is also diamond-bearing.

The diamonds in South Africa seem to be found associated with a more basic rock—a peridotite in which the silica-percentage is often below 40 %, and the percentage of magnesia above 25 %. There cannot, therefore, be said to be a close relationship between the South African peridotites and the Copeton dolerites.

It is interesting to note, however, that rocks very similar to the Copeton dolerites have been found in the peridotite-necks of South Africa.

Analysis numbered iii., is of a "hard rock" from the blue ground of De Beer's mine at Kimberley. This rock closely resembles the Staggy Creek dolerite, the chief difference being that the South African rock possesses about 6 % more of the iron oxides, and about 5 % less lime than the New South Wales variety.

In addition to this rock, I have examined microscopically an olivine-dolerite stated to be from the Kimberley pipe, which, apart from its relatively small percentage of olivine and absence of quartz, is not unlike the Oakey Creek dolerite.

Although these two South African rocks do not appear to represent the type-rocks of the South African diamond-bearing necks, it is interesting to note that they do occur associated with the diamond-deposits.

vii. Summary.

The first discovery of diamonds in the Copeton district was made in 1872 or 1873, simultaneously with the discovery of tinstone in the district. The diamonds were first found in alluvial workings, but these had been derived from the denudation of basalt-capped leads. These leads are probably of late Tertiary age. The physiographic investigation shows that the present drainage-system of the district trends to the west, but the prebasaltic drainage was in a northerly direction. The original course of the Gwydir was northwards from Copeton to Inverell, and it then received the Macintyre as a tributary stream. The present course of the Gwydir has followed the eastern and northern edges of a block-fault. The western boundary of this block-fault has been examined by W. N. Benson, and we have agreed to name the sunken area "Keera," from a Station of that name situated in the area of subsidence. The basalts and river-gravels (which are after Anderson) shown on the accompanying map, illustrate the Tertiary river-system in its relation to the present-day drainage.

The material filling the beds of the Tertiary stream-channels is grouped under four heads: (1) the wash; (2) the drifts; (3) clay-deposits; (4) lignite. There is no locality in which all four are developed, and, as a rule, only the first two are present. The wash is the term applied to the coarser bands of material. This has usually collected on the base of the stream-channel, and contains the heavier minerals. Consequently, it is essentially the diamond-bearing stratum of the deposit. The wash seldom exceeds one foot in thickness. The drifts are aggregates of loose and rather fine, sandy material, usually stained red from the leaching of iron oxide from the overlying basalt. These deposits attain, in several places, a thickness of 20-25 feet. The clay-deposits consist of kaolin derived from the decomposition of the felspars in the granite, and have been deposited under lacustrine conditions. Lignite occurs rarely, and overlies the drifts. It does not appear to have been much affected by the overlying basalt.

The geology of the district is represented on the accompanying map. It will be seen that there are present (1) slates; (2) granite; (3) dykes; (4) basalt.

The slates cover a small area, and are unimportant in connection with this paper. The granite is represented by three types —the Acid, Tingha, and Oakey Creek granites. The first is the younger, and the last is probably intermediate in age to the first two types. The dykes are of two varieties—(*a*) fine-grained felsites; (*b*) dolerites. These dykes have intruded the granites, but are older than the basalts and the basalt-capped leads.

The basalts are the youngest rocks in the district. These overlie the Tertiary gravels, and obviously cannot have been a source of diamond-supply. It is also shown that it is highly improbable that the diamonds can have been derived from either the slate or the granites. This points to the dykes as the probable origin of the diamond-supply.

This "proof by exhaustion" evidence in favour of the dyke-material as the diamond-matrix has been confirmed by the discovery of a diamond in the dolerite-dyke at Oakey Creek. A Tertiary stream-channel has crossed this dyke, and diamonds were found in the gravels adjacent to the dyke on the downstream side of it. A similar dyke, or small neck, of an almost identical rock was found at Staggy Creek, some 4 miles north-west of this occurrence. In this case, also, diamonds were found in the gravels overlying the dolerite-mass. The occurrence of two such masses of dolerite, associated with the diamond in this area, gives strong grounds for supposing that the whole of the diamonds of the Copeton field have been derived from similar sources. The two known dolerite-masses are so situated that they cannot have supplied more than a portion of the Tertiary deposits.

It is probable that most of the sources of supply of the diamonds are now concealed by the later basalt-flows, in the same way as the Oakey Creek occurrence.

In conclusion, I take the opportunity of here thanking those who have assisted me in this work. To the miners of Copeton, and pre-eminently to Mr. A. R. Pike, my best thanks are due for kind assistance in field-work. I am also indebted to Professor David, for help and encouragement during the preparation of this paper; and to Mr. A. Pain, for some assistance in rock-analysis.

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EXPLANATION OF PLATES XC.-XCII.

Plate xc.

Fig. 1.—Inclusion in the Oakey Creek granite, near its junction with Cope's Creek, showing large phenocrysts of felspar set in a ground-mass of felspar and biotite.

Fig. 2.—View of Copeton from Soldier Hill, looking east. The foot-hills in the distance mark the trend of the Tertiary lead from the Deep Shaft to the Old Farm.

Plate xci.

Fig. 1.—Oakey Creek, showing the mouth of the tunnel in which a diamond was found in the matrix.

Fig. 2.—The bed of Cope's Creek, near its junction with the Gwydir, showing remarkable triangular depressions left after a small flood.

Fig. 3.—The Oakey Creek dolerite, showing felspars, augite, ilmenite, and chlorite. Note the small hexagonal section of quartz embedded in chlorite.

Plate xcii.

Geological Map showing the Tertiary Leads of the Copeton Diamond-field.

CONTRIBUTIONS TO OUR KNOWLEDGE OF SOIL-FERTILITY,

xii. The Action of Toluene upon the Soil-Protozoa.

By R. Greig-Smith, D.Sc., Macleay Bacteriologist to the Society.

In their experiments upon the partial sterilisation of soils, Russell and Hutchinson, as a rule, employed toluene in the proportion of from 0·5 % to 1 % of the soil, leaving it to act for about 30 hours, and then allowing it to evaporate completely.* They found that 1 % of toluene entirely suppressed the detrimental factor, which limits the growth of bacteria, when the disinfectant was allowed to act for two days.† In richer soils, however, the toluene often failed to kill all the protozoa, just as it failed to destroy nitrifying organisms, and to cure soil-sickness. The failure was traced to the low solubility of toluene, and its consequent inability to penetrate any but the smallest particles of soil, in the presence of much moisture or organic matter.‡ Regarding certain discrepancies between laboratory and pot-experiments, Russell and Petherbridge said that their experiments showed that toluene acted best in finely sifted, fairly dry soils, and lost much of its effectiveness in rich soils, when too much moisture was present or the soil-particles were too coarse.§ Yet, in their conclusions upon their work with sickness in glass-house-soils, which, I submit, must be classed as "rich" soils, they said that the factor, detrimental to bacteria, resembles in every way that present in ordinary arable soil. It was put out of action by antiseptics, and, in all respects, its properties agreed with those of the protozoa.||

In considering these various findings, one is driven to the conclusion that, as protozoa cannot be trusted to be absent in

* Journ. Agric. Science, v., p.157.

† *Op. cit.*, p.171. ‡ *Op. cit.*, p.190. § *Op. cit.*, p.107. || *Op. cit.*, p.111.

rich soils, which have been treated with toluene, all work done upon such soils cannot be taken as indicating the inactivity or otherwise of the protozoa. The bulk of the work was done, as they say, with 1 % of toluene, and it was taken, generally, that the protozoa had been eliminated, yet their latest work contains many footnotes to the effect that the protozoa had not been destroyed.

There is so much claimed for the protozoa by Russell and his co-workers, and, at the same time, there are so many points wherein they safeguard themselves, while pushing forward the protozoal hypothesis, that it appeared to be opportune to examine the limits of the action of the volatile disinfectant, toluene. This was all the more desirable, as I had already found that even 10 % of toluene did not kill off all the ciliates in soil.

In the experimental work embodied in this paper, the general procedure consisted in sifting the soil through sieves varying from 12, for damp soils, to 30 meshes to the inch, for dry soils. Weighed portions were put into bottles, treated with varying amounts of toluene (Kahlbaum), and thoroughly stirred with a sterile wire. Disinfection was allowed to act for two days. The soils were then spread on paper, and returned to their bottles when the toluene had evaporated. About five grams of each portion of the soil were put into inch test-tubes, containing 10 c.c. of culture-fluid, and these were incubated at 22°. At convenient intervals, generally 3, 5, 7, and 10 days, a small quantity of the fluid was carefully pipetted from the surface-edge of the liquid, while the point of the capillary pipette was rubbed against the glass wall of the tube. This was done with the intention of dislodging the amœbæ, and allowing them to be sucked up in the pipette. The teat was then pressed, and the drop blown upon a glass-slide, which was dusted with fine sand, and a cover glass was placed over the drop. When the amœbæ had been given time to settle and attach themselves to the surface of the slide, the film was examined.

Many culture-fluids were tried. At first, an infusion of French beans was used, but an improvement was found in dilute nitrate bouillon, containing one part of ordinary nitrate bouillon to seven parts of water. The addition of 0·1 % of dextrose greatly helped the growth of the protozoa, but, noting that Killer had found Giltay's solution to be one of the best for the purpose, it was tested and found to be eminently suitable. The weakening of the Giltay's solution did not accelerate the growth of the protozoa, neither did the replacement of the potassium nitrate by similar weights of either asparagin, peptone, ammonium sulphate or chloride, urea, or of meat-extract. Finally, 1 % hay-infusion with 0·1 % of nitrate was shown to be best for the growth of ciliates, and Giltay's solution for the growth of amœbæ.

With the idea of obtaining a maximum growth of protozoa, a poor alluvial soil* from the Hawkesbury Agricultural College was air-dried, sifted, moistened, and spread out in a large photographic developing dish. It was maintained in the moist condition for three weeks. Portions of the soil, containing 10 % of moisture, were treated with varying amounts of toluene. The remainder was air-dried, and also treated with toluene.

Moist soil	Ciliates survived 1·5 %, killed by 2 %. Amœbæ survived 2 %.
Air-dried soil	Ciliates and amœbæ survived 20 %.

The sandy soil of the Society's garden contained 12 % of moisture. It was treated with toluene at once, and then air-dried.

Moist soil	Ciliates survived 1 %, killed by 2 %. Amœbæ survived 2 %, killed by 5 %.
Air-dried soil	Ciliates and amœbæ survived 20 %.

Control-experiments confirmed these findings.

During the experiments, which were comparatively numerous, it was noted that the ciliates were less in number, and that the flora was more varied in the untreated, than in the toluened

* The protozoa, noted in cultures from this soil, were *Colpoda cucullus*, *Vorticella*, *Paramœcium*, *Peridium tripos*, *Trachelocerca viride*, *Cercomonas*, *Chætomonas*, *Dileptus*, *Trepomonas agilis*, *Amœba lobosa*, *Amœba diffluens*.

soils. The volatile disinfectant favoured the development of an active, though restricted, fauna, and a flora consisting largely of slime-forming bacteria. The control-tests had a very diverse flora and fauna, while the toluened tests grew a very numerous crop, consisting almost entirely of colpodæ, amœbæ, and small monads, and the suspensions were covered with a thick, gelatinous film of bacteria. In Giltay's solution, the controls were always of a paler colour than the treated tests. The flora had undoubtedly suffered a considerable diminution in its species, and the idea appeared feasible, that, possibly, the reason for the non-appearance of the protozoa in the toluened moist soils, might be due to the absence of certain bacteria, killed off by the toluene.

In order to test the matter, a raw garden-soil was shaken up in Giltay's solution, and the supernatant liquid was centrifugalised. Minute drops were taken, and examined microscopically for protozoa. Those free from all suspicion of protozoa, were taken up in capillary tubes and dropped into Giltay's solution. The growth consisted of bacteria only. Drops of this subculture were introduced into tubes containing Giltay's solution and portions of treated soil. Examination of these, from time to time, showed that they were no better, so far as the growth of protozoa was concerned, than tests without the addition of the bacteria. The idea that the bacteria might have an influence upon the development of the fauna in treated soils, therefore, was not substantiated.

In one medium, namely, dilute dextrose nitrate bouillon, an observation was made, which appeared to explain the inability of ciliates to grow in the tests made with the alluvial soil. Other media containing easily reducible organic matter, such as hay-infusion, showed the same phenomenon. The soil is of a pale smoke-colour, and it was noted that the medium remained normal, when ciliates were present, but, in their absence, a dark-coloured, filmy growth formed in the dilute bouillon. This settled on the sedimented soil, the upper layers of which were distinctly black. The dark-coloured film consisted of bacteria and soil-particles, containing black fragments, which became blue upon treatment with acetic acid and potassium ferricyanide. Sulphide of iron was thus indicated. The presence of sulphide and the absence of ciliates, and vice-versâ, point to the possibility of the sulphur-oxidising bacteria having been destroyed by the treatment with toluene. The fact was recalled that, in some of the tests, the amœbæ moved sluggishly, and it appeared probable that they had been partly poisoned by traces of sulphuretted hydrogen in the culture-fluids.

The following experiment was made to confirm the idea. Garden-soil was suspended in Giltay's solution in a conical flask, containing a test-tube holding potassium sulphide. A few drops of dilute sulphuric acid were added to the sulphide, and the flask was corked. Five days later, amœbæ and monads were detected, but no ciliates were found. The living protozoa moved slowly, and were undoubtedly unhealthy. In another experiment, a stream of sulphuretted hydrogen was passed through two bottles, one containing a damp, the other a dry soil. After five minutes, the bottles were corked. Next day, the soils were spread out and aired. The dry soil, when sown in Giltay's solution, gave rise to a mixed fauna; the damp soil was free from protozoa.

It is clear that, if the conditions are such that a reduction of sulphate is possible, as, for example, in soils containing much organic matter, there is the possibility that the action of a volatile disinfectant, by destroying some of the groups of the sulphur-oxidising bacteria, may indirectly affect the growth of the protozoa, and especially of the ciliates. This, however, is not always the reason for the non-appearance of ciliates in cultures from toluened damp soils, as will be shown subsequently.

In view of the fact that toluene had been found to have no effect upon protozoa in air-dried soil, so far as certain members of each group were concerned, it was thought advisable to confirm the matter by examining a few more soils. Accordingly, six fresh soils were obtained from the Hawkesbury Agricultural College, through the kindness of the Principal, Mr. H. W. Potts. The weather had been very dry for the preceding four months, and the soils reached the laboratory in the air-dry condition. The moisture ranged from 0·5 % in a gravelly soil (W.H.C. = 16), to 2·3 % in a chocolate loam (W.H.C. = 36). Treatment with varying quantities of toluene showed that all percentages, up to twenty, failed to destroy the protozoa, taking *Colpoda cucullus* as being typical of the ciliates, *Cercomonas* or *Trepomonas* as representing the flagellates, and the usual *Amœba limax* or *lobosa* for the amœbæ.

GRAVELLY SOIL.—W.H.C., 16.

Moisture-percentage.	9·3	5·2	4·0	3·5	2·0	0·3
No toluene	C.A.M.	C.A.M.	C.A.M.	C.A.M.	C.A.M.	C.A.M.
Toluene, 1%...	none	none	none	M.	M.	C.A.M.
Toluene, 2%...	none	none	A.	M.	A.	C.A.M.
Toluene, 5%...	none	none	A.	none	none	C.A.M.
Toluene, 10%	none	A.M.	M.	M.	none	C.A.M.
Toluene, 20%	none	none	M.	A.M.	M.	C.A.M.

CHOCOLATE LOAM.—W.H.C., 36.

Moisture-percentage.	17·6	13·8	13.5	11·3	9·1	6·9	3·0	2·7
No toluene	C.A.M.	C.A.M.	C.A.M.	C.A.M.	C.A.M.	C.A.M.	C.A.M.	C.A.M.
Toluene, 1%	M.	A.M.	—	M.	A.M.	A.M.	C.A.M.	C.A.M.
Toluene, 2%	none	A.	A.	A.M.	A.	A.M.	C.A.M.	C.A.M.
Toluene, 5%	none	A.	A.	A.M.	A.	A.M.	A.M.	C.A.M.
Toluene, 10%... ...	none	none	A.M.	M.	A.	A.M.	A.M.	C.A.M.
Toluene, 20%... ...	none	none	A.M.	A.M.	none	A.M.	A.M.	C.A.M.

C. = ciliates; A. = amœbæ; M. = monads or flagellates.

The two extreme soils, one with a W.H.C. of 16, and the other of 36, were put into jars, and water was added to over half the water-holding capacity. They were kept for two months at the air-temperature, the water being replaced from time to time as it evaporated. After this time, they were allowed to dry slowly, while portions were taken at intervals and treated with toluene. Giltay's solution was used for the cultivation.

The experiments show that there is considerable irregularity, either in the effect of the disinfectant or in the capability of growth after treatment. It appears, however, that toluene has little disinfecting action, when the moisture-content is lower than from one-tenth to one-twentieth of the water-holding capacity of the soil, and that when soils are quite moist, amœbæ and flagellates may not be affected to any great extent. It is possible that, had nitrate hay-infusion been used instead of Giltay's solution, the ratios would have been narrower.

It appears to make no difference, whether the water is originally present in the soil, or is added at the time of toluening. A garden-soil with 6·2 % of moisture was allowed to dry slowly in the air, while portions were taken from time to time, and treated with 1 % of toluene. When air-dried, the soil was moistened with varying quantities of water, and treated straightway with toluene.

Garden-soil (W.H.C.=40).					Field-soil (W.H.C.=25).			
	Soil slowly dried.		Moisture added.		Moisture added.			
Moisture %	Giltay.	Nitrate hay-infusion.	Moisture %	Giltay.	Moisture %	Giltay.	Nitrate hay-infusion.	Nitrification, six weeks.
6·2	A.M.	M.	5·9	A.M.	3·0	A.M.	none	none
4 4	A.M.	M.	4·4	A.M.	2·5	A.M.	A.	none
4·1	A.M.	M.	3·9	A.M.	2·0	A.M.	A.M.	none
2·9	A.M.	C. M.	3·9	M.	1·5	A.M.	A.M.	none
1·5	A.M.	C.A.M.	2·0	A.M.	1·0	A.M.	C.A.M.	none
1·4	C.A.M.	C.A.M.	1·4	C.A M.	0·5	C.A.M.	C.A.M.	active

These experiments show that, if the moisture falls below one-twentieth of the water-holding capacity, one per cent. of toluene does not destroy the ciliates completely, as tested by nitrate hay-infusion, or one-fortieth as tested by Giltay's solution. Incidentally, they also show that nitrate hay-infusion is better suited for the growth of ciliates, and Giltay's solution for the growth of amœbæ.

The influence of the soil-moisture upon the action of the disinfectant, points to the ciliates either existing in the moist soil in the motile state, or, if encysted, to the cyst-membrane being more pervious to the combined action of moisture and toluene. The age of the cyst may be a controlling factor. Recently encysted ciliates and amœbæ are delicate and colourless, while the older ones are more or less brown and look undoubtedly stronger. One can imagine that the destruction of the delicate cyst may be an easy matter compared with the stronger.

In the belief that a knowledge of the effect of heat might throw some information upon the action of the volatile disinfectants, a series of examinations was made upon the appearance and the activities of protozoa after they had been heated at different temperatures. Cultures of protozoa in Giltay's solution were taken up in capillary pipettes, and after the end had been sealed, they were heated in water for ten minutes at different temperatures. The pipette was then cooled, the point broken off, and the suspension blown upon a slide and examined.

Paramœcium was either still or moved about slowly after having been heated at 39° or 40°. At 41°, it became quite still, with the cilia moving slowly. At 42°, the organisms were completely broken up into masses of débris. *Colpoda cucullus* behaved somewhat differently, according to the size of the cells. At 39°, some of the smaller or younger organisms were slowly motile, others had stopped moving about the field, but the cilia still vibrated; others were more or less spherical, with an extruding slime-drop. At 40°, they were all non-motile, mostly rounded, with a lateral slime-drop. This extrusion of slime occurs during rapid encystment. Heated at 41°, they were all rounded, and some appeared to have burst. The nuclei of the rounded cells stained with methylene blue, the rest of the cell did not take up the colour, from which it is inferred that the cells were not dead but were encysting. The older cells at 41° or 42° moved about, but, at 43°, they had come to rest, and a few showed the cilia moving slowly, while others were rounded and entire or had apparently burst. At 44°, they were spherical or slightly ovoid, and were apparently encysting.

The amœbæ began to be affected at 43°, when their motility ceased. At 44°, they were rounded or spherical, some with the pulsating vacuole active, others with it still. That they were not dead, was shown by their refusing to take up methylene blue.

The flagellates became non-motile and irregularly shaped at 39°, and did not take the stain. Tabulating these observations, we have :—

	Immobile.	Rounded.	Destroyed.
Paramæcium	41°	—	42°
Colpodæ, mature	43°	44°	—
Colpodæ, immature	40°	41°	—
Amœbæ	43°	45°	—
Flagellates	39°	40°	—

Omitting the flagellates, which appear irregular, the action of heat upon the protozoa is very similar to the action of the volatile disinfectants. Paramæcium is quickly destroyed, while the amœbæ are less affected than Colpoda. Still, there should be a greater difference between the amœbæ and the mature colpodæ.

The motile colpodæ and amœbæ, after becoming immobilised and rounded at 44° and 45°, behaved to stains as if they were still alive and encysting, but they really had become so altered that subsequent growth in nutrient solutions did not occur. This was shown by suspensions, which contained motile forms only, becoming sterilised after being heated for ten minutes at 45° (amœbæ), and 46° (colpodæ).

The lethal temperature of the protozoa, as occurring in the soil, is always higher than the motile forms, on account of the presence of cysts. Work upon such encysted forms has been done by others, but a few tests are given, chiefly to show the influence of the culture-fluid.

LETHAL TEMPERATURES OF SOIL-PROTOZOA.

	Culture-fluid.	Ciliates.	Amœbæ.	Flagellates.
Moist soil, No. 2 ...	Giltay	under 54°	63°	under 54°
Moist soil, No. 1 ..	Giltay	56°	over 62°	over 62°
Air-dried soil, No. 4	Giltay	54°	70°	58°
Air-dried soil, No. 4	1% hay-infusion	50°	64°	58°

The low lethal temperature in hay-infusion, as compared with Giltay's solution, was traced to the presence of sulphuretted hydrogen. On the twelfth day of cultivation, a slight deposit of ferrous sulphide was noted lying on the surface of the soil, in the tube which had been heated at 50°, while, at 52° and all higher temperatures, the deposit of the black sulphide was pronounced. The sulphide films were not seen in Giltay's solution.

The development of sulphuretted hydrogen in the hay-infusion indicates that this medium is not suitable for demonstrating the effect of heat upon the protozoa. It is the medium which has been used by many investigators for work connected with the action of heat and volatile disinfectants upon the protozoa. As it is unsuited for showing the action of heat, it is possible that it may also be unsuitable for growing the fauna, that survive in soils, treated with volatile antiseptics. A test was made, therefore, with two light-coloured soils. But for the use of such pale-coloured soils, the films of ferrous sulphide would probably never have been detected.

A light-coloured soil, with a W.H.C. of 25, contained 7·5 % of moisture when toluened. After treatment, it was sown in tubes of hay-infusion and of Giltay's solution, and the suspensions were examined on the 2nd, 7th, and 11th days.

	1 % Hay-infusion.		Giltay's solution.	
	Protozoa.	Sulphide-formation.	Protozoa.	Sulphide-formation.
Control	C.A.M.	none	C.A.M.	none
Toluene, 0·5 % ...	A.	slight	A.M.	none
Toluene, 0·75 % to 20 %	none	pronounced	A.M.	none

Another soil with 0·5 % of moisture was treated at the same time, and sown in hay-infusion. Ciliates, amœbæ, and monads were found in all the tests, from none up to 20 %. There was only a suspicion of sulphide in all the tubes, with the exception of the control, 3 %, and 4 %, which were free from any trace.

The same light-coloured soil, with 11·6 % of moisture, was toluened, and subsequently sown in 1 % hay-infusion, with and without the addition of 0·1 % potassium nitrate.

	1 % Hay-infusion.		Hay-infusion with nitrate.	
	Protozoa.	Sulphide-formation.	Protozoa.	Sulphide-formation.
Control	C.A.M.	none	C.A.M.	none
Toluene, 0·5 % to 20 %...	A.M.	pronounced	A.M.	none

In these experiments, we see that, after toluening a damp soil and adding it to 1 % hay-infusion, there is a formation of sulphuretted hydrogen similar to what was obtained in dilute dextrose nitrate bouillon.

The presence of potassium nitrate in Giltay's solution and in the nitrate hay-infusion prevented the formation of ferrous sulphide, but it did not accelerate the development of the ciliates. The ciliates were destroyed by the toluene, and it was immaterial whether sulphuretted hydrogen was formed in the culture-medium or not.

Sulphides were found in media containing easily reducible organic matter, such as 1 % hay-infusion and dilute dextrose nitrate bouillon, but not in Giltay's solution or in hay-infusion with nitrate, even although the latter never became acid to litmus-paper.

Regarding the action of toluene upon the bacteria, there is indicated, in the formation of the sulphide, the probability that certain oxidising organisms in the wet soils are, by the treatment, either destroyed or overwhelmed in numbers by the surviving reducing bacteria. In dry soil, this does not occur.

Conditions which cause the apparent destruction of the sulphur-oxidising bacteria also cause the destruction of the ciliates. This is much akin to the conclusion of Russell and his colleagues, who say that conditions which preclude the presence of the nitrifying bacteria, also preclude the presence of a mixed fauna. While this does not appear to hold for the nitrifying bacteria (see p.845) of dry soils, one has to bear in mind that experiments with the protozoa are always more or less variable.

THE POLLINATION OF *GOODENIA CYCLOPTERA*.

(N.O. Goodeniaceæ.)

By Archdeacon F. E. Haviland.

Plate xciii.

Goodenia cycloptera R.Br., in the State of New South Wales, is generally confined to the Western Plains. It is a decumbent species, having axillary flowers furnished with indusia to the styles, and with auricles to the upper lobes of the five-partite corolla. These auricles are sufficiently induplicated to form a pocket into which the indusium, at a certain stage, becomes intruded, as explained below. As appears to be the case in other decumbent species, the indusium is inflected into the auricles, whereas, in erect species, it appears that the indusium remains erect, and the auricles press down over it.

The pollination and fertilisation of certain species of Goodenia have frequently engaged the attention of botanists, with occasionally dissimilar results; and I may specially mention, among the workers on the Australian flora in this connection, the labours of the late E. Haviland, F.L.S., and Mr. A. G. Hamilton. Both authors had treated of different species of Goodenia, and with the following results, which are of interest to this paper. Mr. E. Haviland, writing of *G. ovata*,* in the year 1884, observes—"The stigma covered by the indusium has re-entered [the corolla] through the passage by which it had passed out, the division of the upper lobe"; and, after referring to the ciliated indusium as being intended to brush the pollen off an insect visiting the flower, came to the conclusion that the flowers are cross-fertilised. I compare this with the observations noted by Mr. A. G. Hamilton† in the year following the above, and who says, of *G. hederacea*, that "the basal portion of the style is bent upwards so as

* These Proceedings, ix., 449.

† *Op. cit.*, x., 157.

to protrude the indusium through the slit between the two upper lobes of the corolla"; and, then remarking that the indusium re-enters the corolla, came to the conclusion that this species is self-fertilised. But he records the remarkable feature, that "the same set of organs which, in *G. ovata*, prevent self-fertilisation, in *G. hederacea* ensure it."

Now, if this divergence in the mode of pollination and fertilisation in these two species has been rightly decided by these two careful observers, one would be inclined to conclude, that *G. ovata*, being an erect, and *G. hederacea* a decumbent species, then other erect species of this genus would be likely to be cross-fertilised, and the decumbent species self-fertilised. I do not, however, find this to be the case in *G. cycloptera*, the decumbent species under consideration. In fact, in this species I find divergences from both the above species, as observed and noted by the authors mentioned; principally, in the fact, that they state the indusium, in both the species noted, exserts itself from the flower, and then, becoming inflected, re-enters it. In the case of *G. cycloptera*, I find that the style bends upon its ventral side, and thus protrudes its middle portion through the upper division of the corolla; but that the indusium, at the same time, and by reason of this exsertion, and aided also by the tendency of the corolla to bend back, presses hard against the auricles, which, by reason of their excessive induplication, are constitutionally enclosed well within the bases of the lobes of the upper part of the corolla. Hence, the indusium of *G. cycloptera* does not at any time protrude itself from the flower, as is stated to be the case in the species compared above.

Now, in inquiring further into the pollination of *G. cycloptera*, I think it will be found, contrary to the expectations expressed above, that, though it be a decumbent species, it is, after all, cross-fertilised. The method of pollination in this species may be thus stated. When the bud is but half-grown, the stamens are connivent around the style, with the base of the anthers just pressing against the indusium; the style at this stage develops rapidly—from observations most carefully made, I have calculated the rate of growth to be one line an hour—such a rapid movement upwards irritates the anthers, causing them to dehisce, and the ciliated edge of the indusium, in passing, brushes the free pollen into its cup. The indusium, thus having outgrown the anthers, and being filled with pollen, becomes inflected against the induplicated auricles of the upper divisions of the corolla, as well as contracted at its mouth, thus locking up the pollen. By this action of the indusium, the upper portion of the middle of the style becomes dorsally exserted between the upper lobes of the corolla, and thus causes a false or premature opening of that part of the corolla; but, really, it is internally blocked by the induplicated auricles. This opening is apparently of no direct service in the pollination. I have noticed a "native Bee" visiting a flower at this stage, and trying to force its way through this false opening, but eventually giving up the struggle, and flying away.

The indusium, so far, contains the stigma, as yet rudimentary, in its base; and not till now does the flower open, having those limbs on the upper side and beyond the auricles, reflexed over the gynæcium; the indusium still pressing hard against the auricles, and beginning to re-open, and the three lower lobes of the corolla spreading platform-like, intimate to insects that all is ready for their kind offices. The stamens are withered and dejected, and the only entrance is along the lower limb, and then down the partially closed throat of the flower, where a little force is needed by the insect; but in doing so, the upper lobes of the corolla, with their auricles, become forced apart, exposing the mouth of the indusium, which is then brought into contact with the insect's back, and the pollen, if ripened sufficiently, which condition is intimated by the fact that the indusium has now re-opened, becomes brushed on to the back of the insect, by the ciliation of the indusium. Thus, also, is seen that this ciliation is for the double purpose of brushing in the pollen from the stamens, and again brushing it on to the insect.

From many observations, I have noticed that, as soon as the indusium becomes completely inflected, the stigma, which hitherto had remained rudimentary at the base of the indusium, begins to develop rapidly in the form of a two-lobed tuberculated body, and does not become viscid till it has exceeded the edge of the indusium. All this time, prior to its viscidity, it has been pressing out the ripened pollen, and has become quite free from this load before it becomes viscid. Another insect visits the flower, and, probably, brings along some pollen from a previously visited flower; and, on entering the same central passage, gets the pollen brushed off its back by the ciliated indusium and on to the viscid surface of the stigma.

From these observations, it is hardly possible to draw any other conclusion than that the flowers of *G. cycloptera* are cross-fertilised. To satisfy myself further on this point by practical means, I tied some gossamer-bags over several bunches of flowers in the open bush-lands, where they would have every chance from natural causes, and watched for results; in every case, the ovaries withered, and fell off the peduncles with the flowers. In no case was there a single ovary or ovule developed; while the ovaries of the neighbouring flowers were developed and bore seeds. From the fact that these flowers were enclosed, not singly, but in bunches of three or four, in the bags, it would appear that not only are the flowers of this species cross-fertilised, but, also, that there is ground for very strongly suspecting that the pollen of one flower does not fertilise the ovules of another flower of the same plant; and this seems the more reasonable on account of the flowers being protandrous. This question, however, I leave till further opportunities of observation offer.

EXPLANATION OF PLATE XCIII.

Fig. 1.—Upper part of corolla, and two stamens removed, to show method of collecting pollen.

Fig. 2.—Same, but after stamens have withered, and the indusium has become filled with pollen.

Fig. 3.—Bud shortly before opening, to show bending of style and corolla apart, and the former becoming exserted.

Fig. 4.—Same, with portions removed to show the indusium pressing against the auricle of the remaining lobe. One auricle removed.

Fig. 5.—Flower with sides removed, to show the action of an insect in forcing itself under the indusium. (This was caught *in situ*).

(Figs. 1-4 much enlarged.)

ON A COLLECTION OF FOSSIL *POLYPLACOPHORA* FROM NORTH-WESTERN TASMANIA, WITH DESCRIPTIONS OF THREE NEW SPECIES.

[MOLLUSCA.]

By A. F. BASSET HULL.

Plate xciv.

I have had the privilege of examining a number of fossil valves belonging to the genera *Chiton*, *Lorica*, and *Loricella*, collected by Messrs. E. D. and R. N. Atkinson from the well-known beds between Wynyard and Table Cape, Tasmania.

This collection is remarkable for the number of valves of *Lorica duniana* Hull,* associated with valves of no less than three hitherto undescribed species of *Loricella*. One anterior valve of *Lorica duniana* (which I described from a median valve) is included. This specimen is imperfect and greatly eroded, but sufficient of the sculpture remains to show that it consists of numerous radiating riblets, low, and broken transversely by irregular grooves. One median valve of *Chiton fossicius* Ashby & Torr,† was with the collection. The type-locality of this species is Table Cape.

The occurrence of no less than three strongly marked species of the genus *Loricella* in the Table Cape beds, and another species (*L. gigantea* Ashby & Torr) in the Mornington (Victoria) beds, is particularly interesting, in view of the fact that this genus is represented by a single living species, *L. angasi* Adams & Angas, which is common to South Australia, Tasmania, Victoria, and New South Wales. The fossils all differ from the living representative of this dwindling genus, the sculpture varying to a marked degree. The closely allied genus, *Lorica*, is also represented by three species in these beds, while one only, *L. volvox* Reeve, is now extant.

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* These Proceedings, xxxv., p.264(1910).

† Trans. Roy. Soc. S. A., 1901, p.140.

1. Loricella magnifica, n.sp.

Plate xciv , figs.1, 1*a*.

Anterior, and one median valve.

Shell exceptionally elevated. Anterior valve with anterior slope straight, sculptured with five prominent radial ribs, bifurcating, or with subsidiary riblets, crossed by six concentric riblets. The number of slits is indeterminable owing to the worn state of the specimen. Width, 26; height, 11 mm.

Median valve: lateral areas strongly raised, irregularly sculptured with wavy lines; central areas with similar but shallower lines, crossed by numerous faint grooves. Width, 38 mm.

This species differs from *L. gigantea* Ashby & Torr (*Loc.*, Mornington, Victoria) in its remarkable elevation, and generally bolder sculpture. From a comparison of the median valve with a corresponding valve of *L. angasi* Adams & Angas, the specimen under review probably exceeded 70 mm. in total length.

2. Loricella octoradiata, n.sp.

Plate xciv., fig.2.

One anterior valve.

Shell elevated. Anterior valve with anterior slope slightly concave, sculptured with eight very strongly marked and prominent ribs, increasing in width towards the margin; the interspaces very finely sculptured with irregular V-shaped lines. Width, 22; height, 8 mm.

3. Loricella atkinsoni, n.sp.

Plate xciv., figs.3, 3*a*.

One anterior, and several median valves.

Shell moderately elevated. Anterior valve with anterior third of slope convex; sculptured with ten strongly raised irregularly pustulose radial ribs, crossed by a number of concentric wrinkles, the lines of which, in most instances, intersect the radial ribs at the pustules. Width, 20; height, 6 mm.

Median valve: lateral areas strongly raised, with two diverging pustulose ribs; central areas with marked wrinkles extending horizontally to the anterior row of pustules on the lateral areas, where they curve and then cross the lateral areas at right angles. These wrinkles are crossed by faint vertical lines.

I associate this species with the collectors, who have discovered many interesting fossils in the Table Cape beds.

Types in collection of Messrs. Atkinson.

EXPLANATION OF PLATE XCIV.

Fig. 1.—*Loricella magnifica*, anterior valve.
Fig. 1*a*.—*Loricella magnifica*, median valve.
Fig. 2.—*Loricella octoradiata*, anterior valve.
Fig. 3.—*Loricella atkinsoni*, anterior valve.
Fig. 3*a*.—*Loricella atkinsoni*, median valve.

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[Printed off, 22nd February, 1915.]

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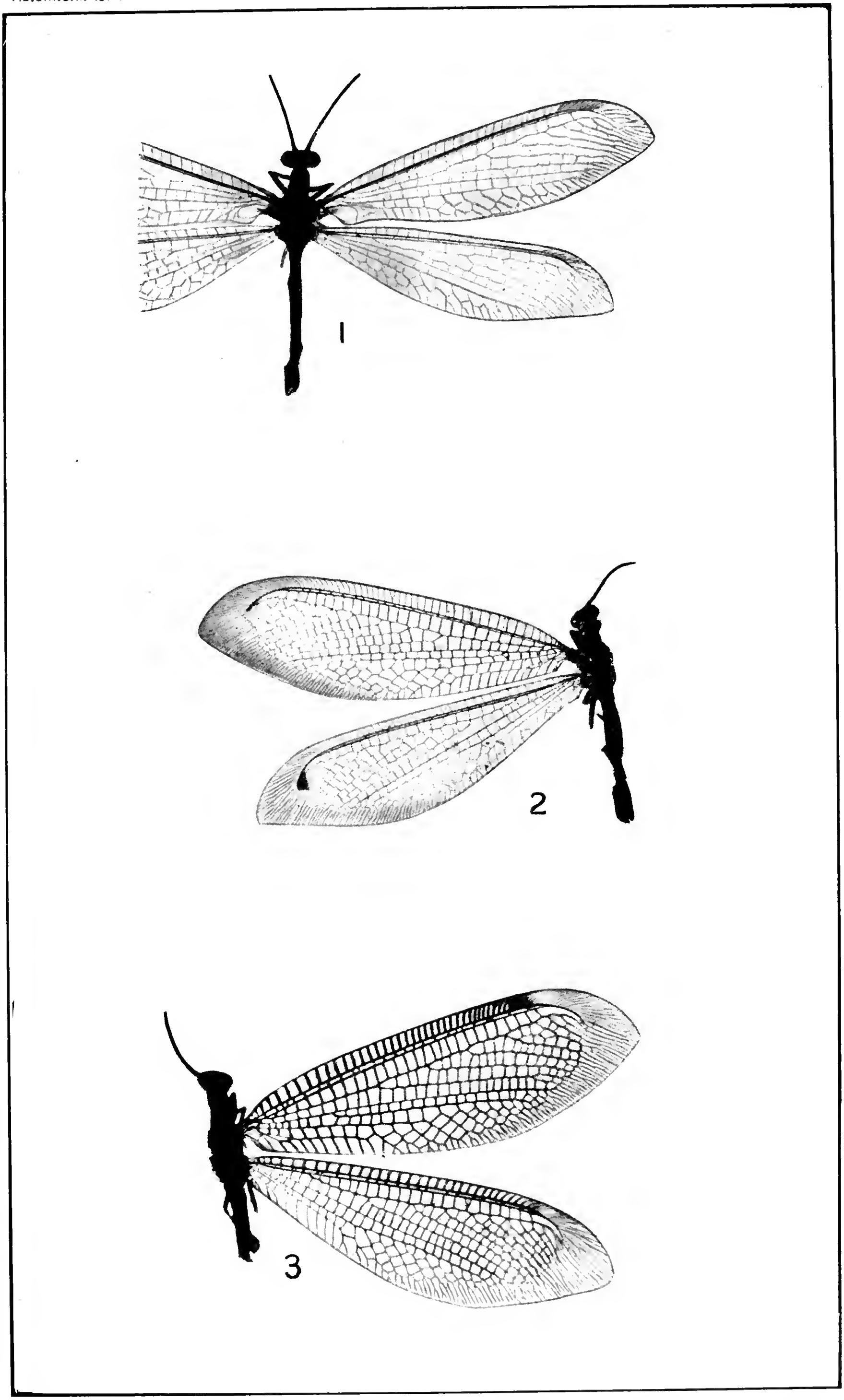
(1914.)

(*a*) GENERAL INDEX.

(*b*) BIOLOGICAL INDEX.

Names in italics are synonyms.

[Printed off, February 22nd, 1915.]



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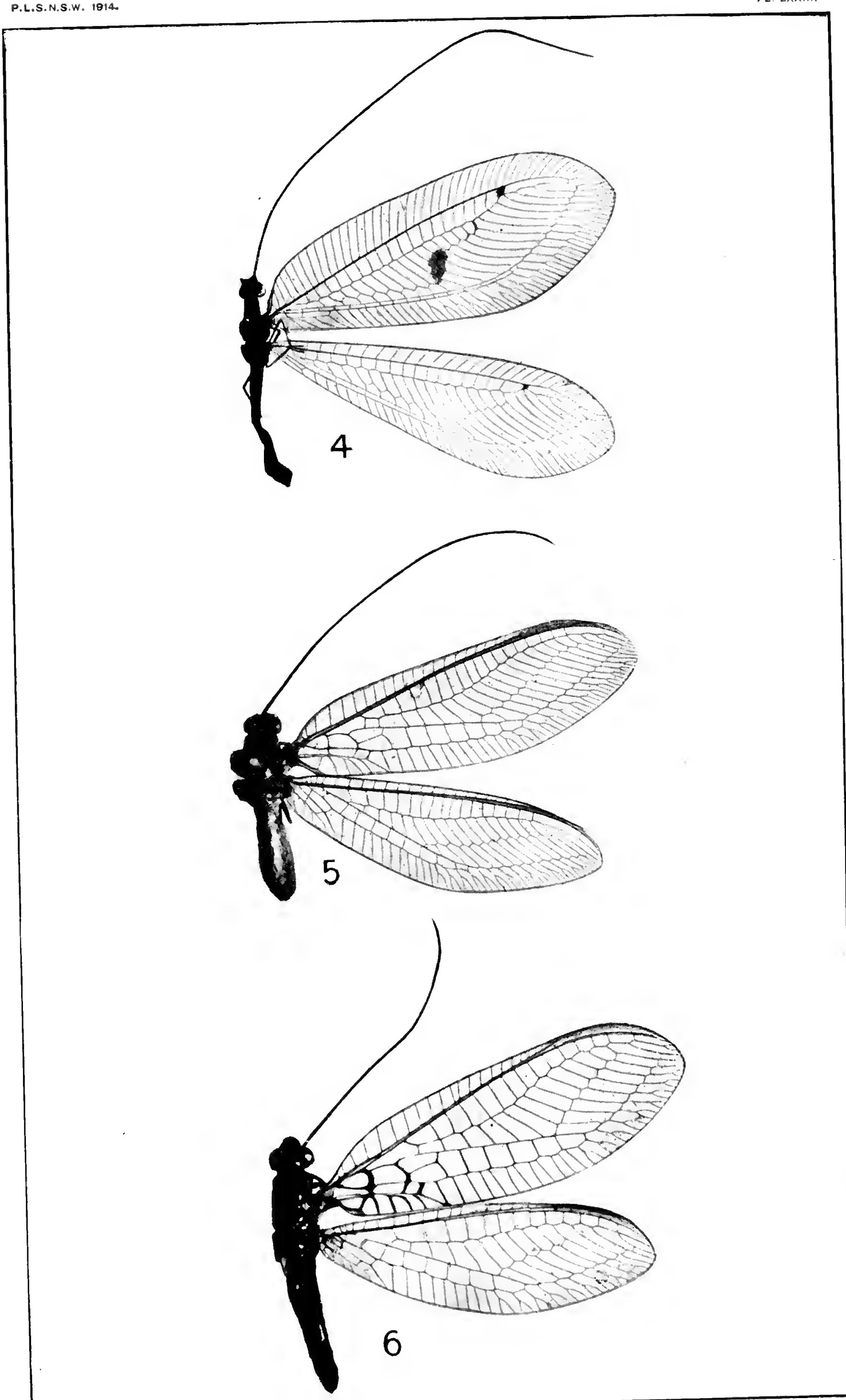
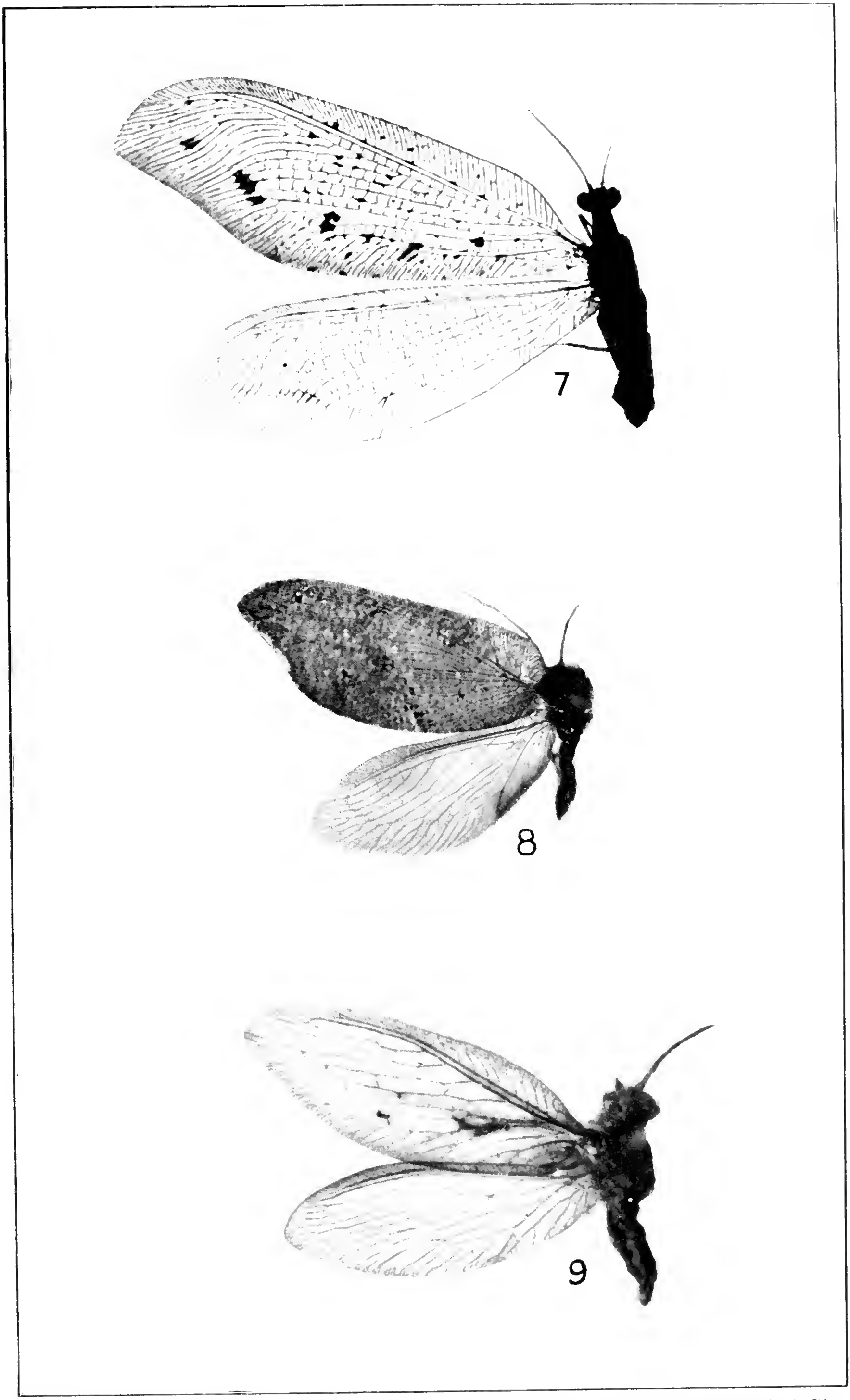
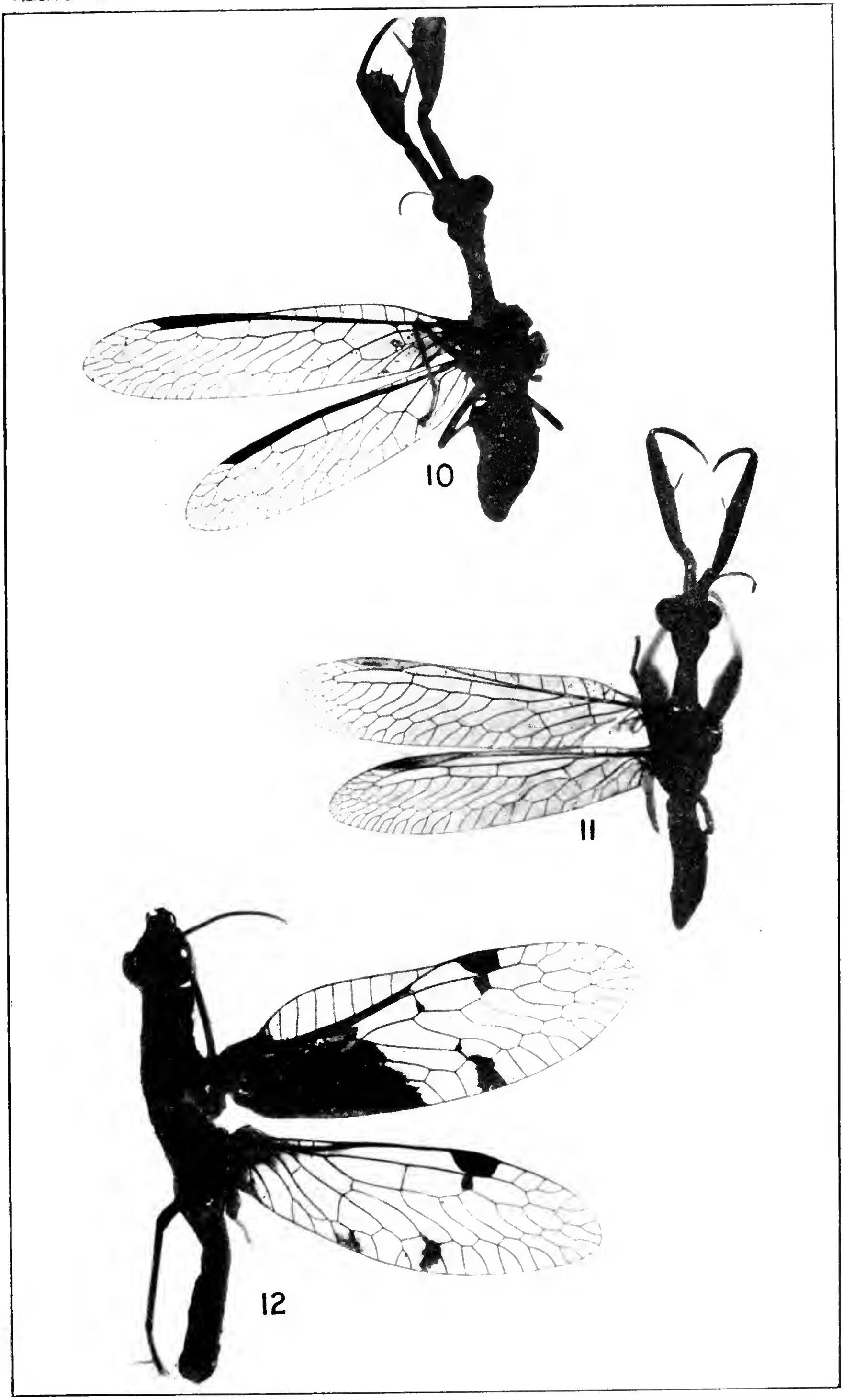


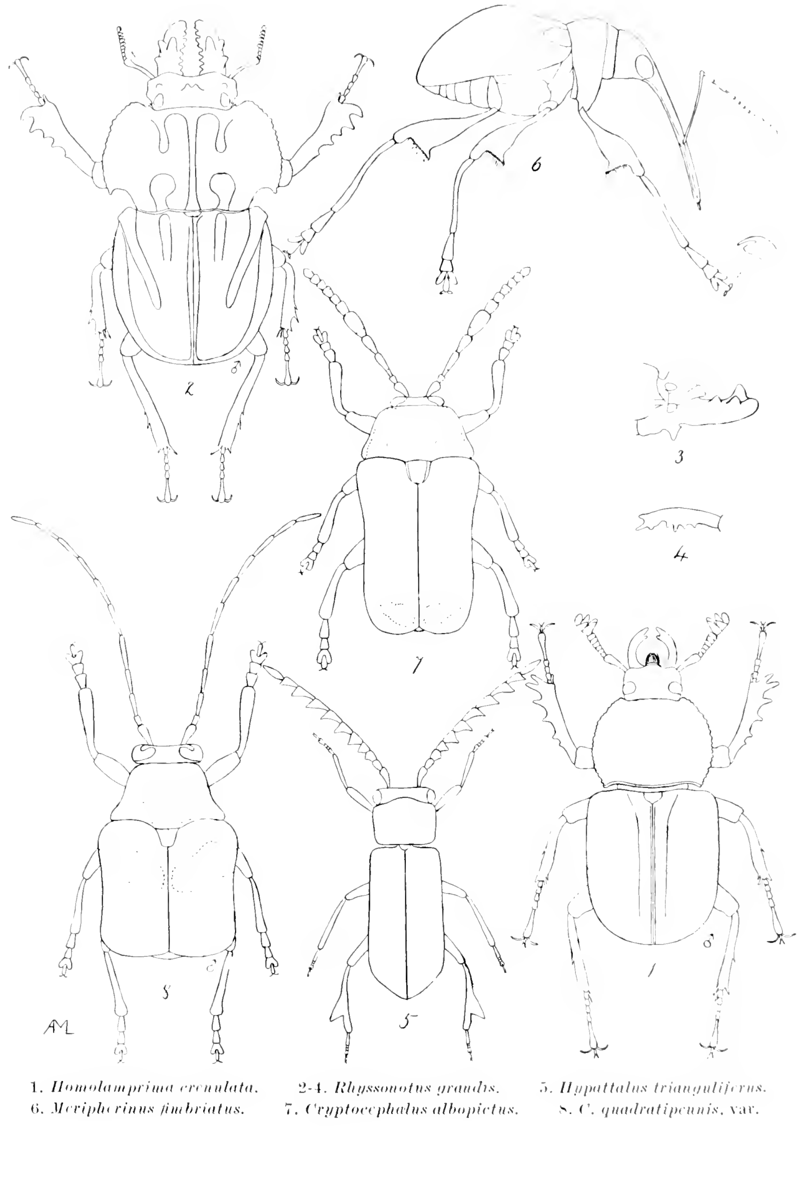
4. *Oligochrysa gracilis*, sp.n. 5. *Nothochrysa froggatti*, sp.n. 6. *Nothochrysa chloromelas* Girard.



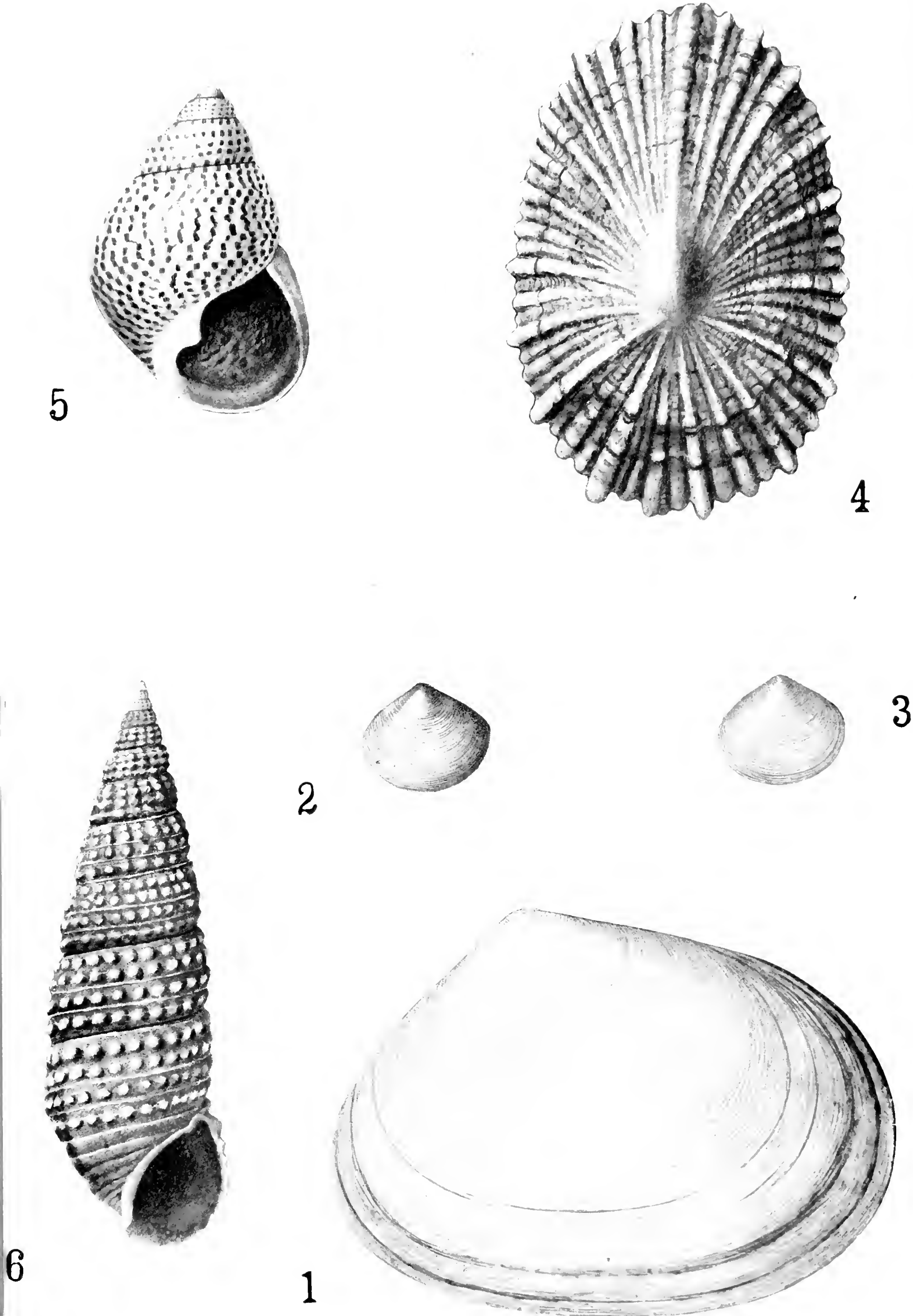
7. *Oedosmylus pallidus* MacLachl. 8. *Drepanopteryx humilis* MacLachl. 9. *Megalomina acuminata* Bks.



10. *Mantispa tillyardi*, sp.n. 11. *Theristria felina* Gerst. 12. *Calomantispa spectabilis* Bks.



1. *Homolamprima crenulata.* 2-4. *Rhyssonotus grandis.* 5. *Hypattalus trianguliferus.*
6. *Meripherinus fimbriatus.* 7. *Cryptocephalus albopictus.* 8. *C. quadratipennis*, var.



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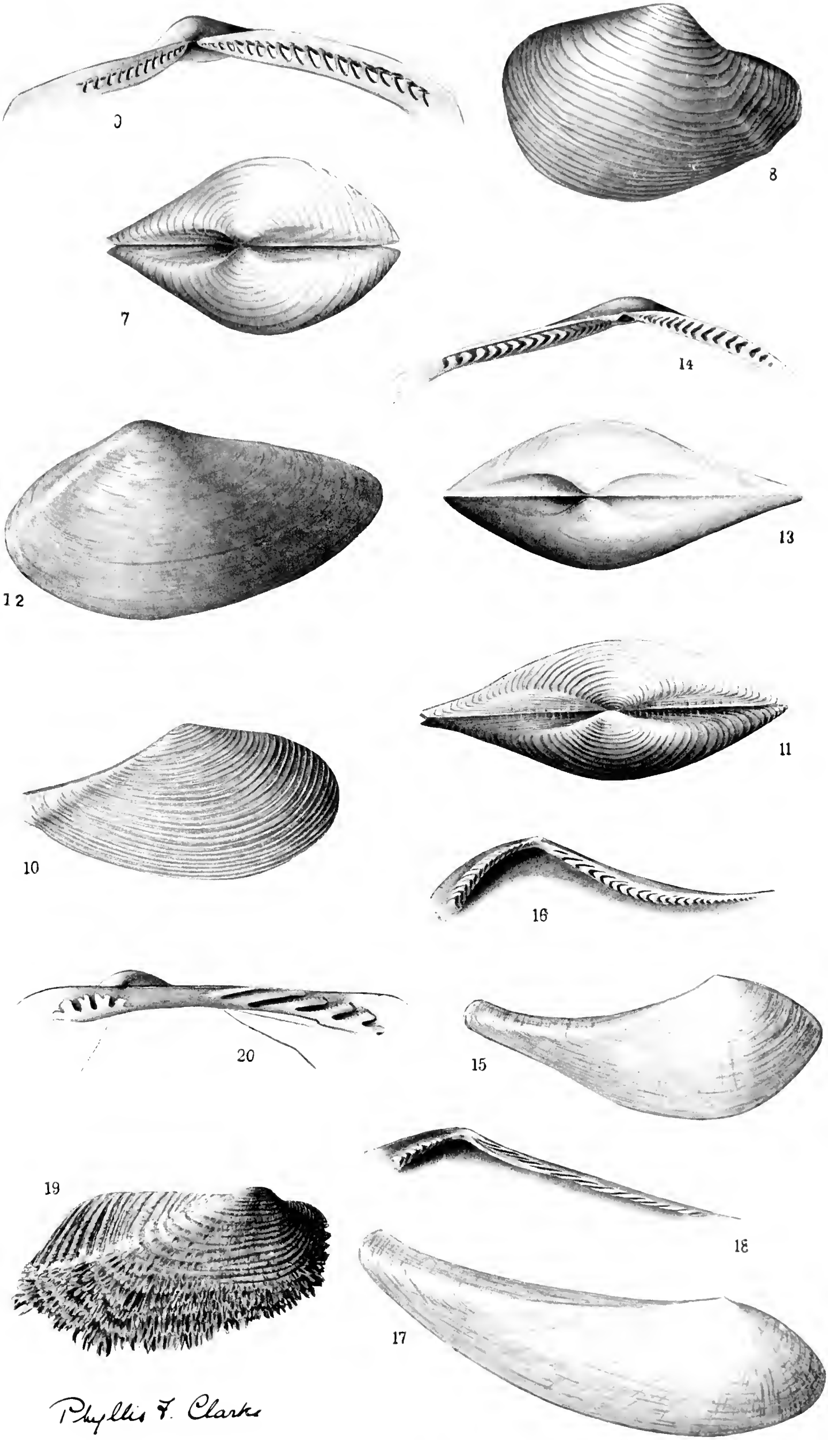

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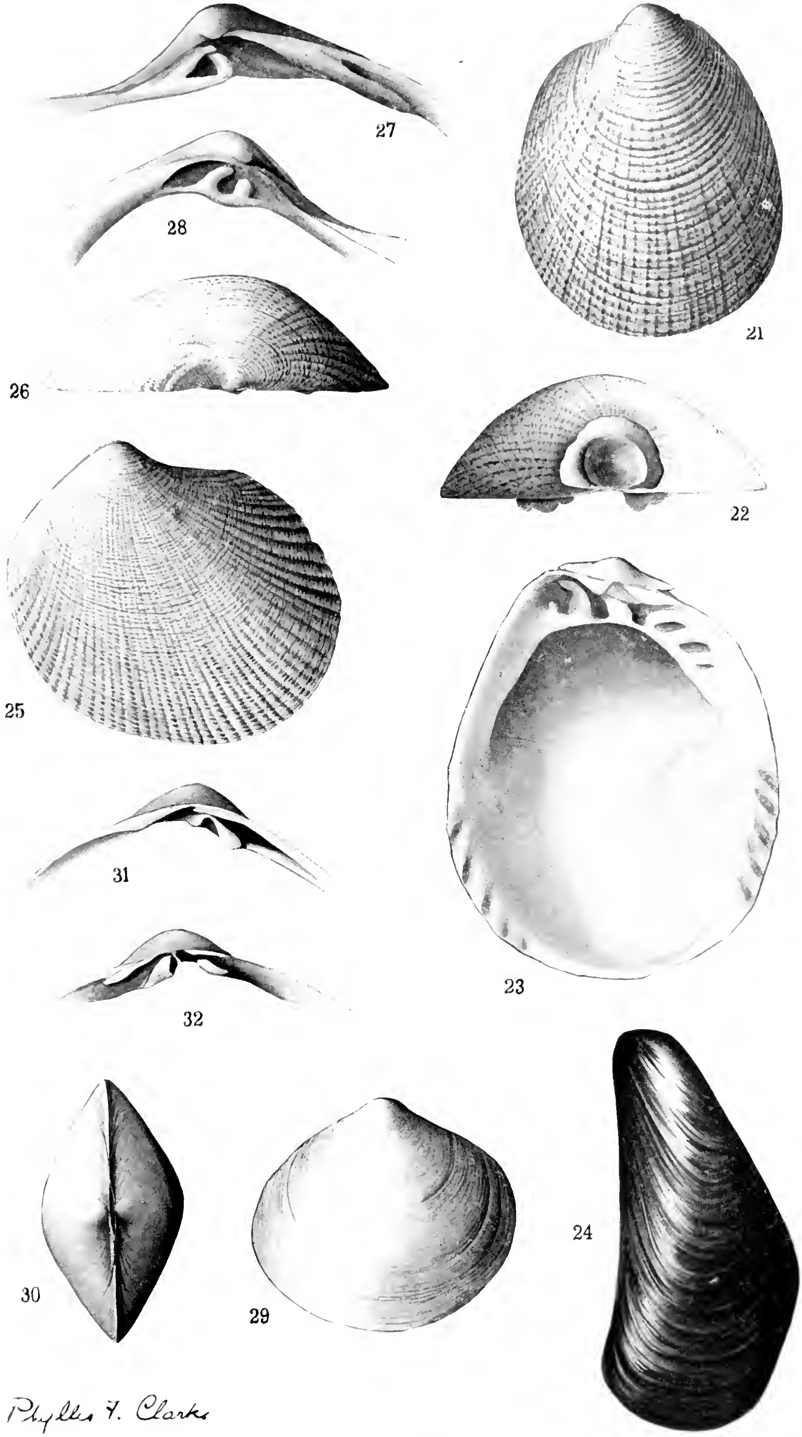

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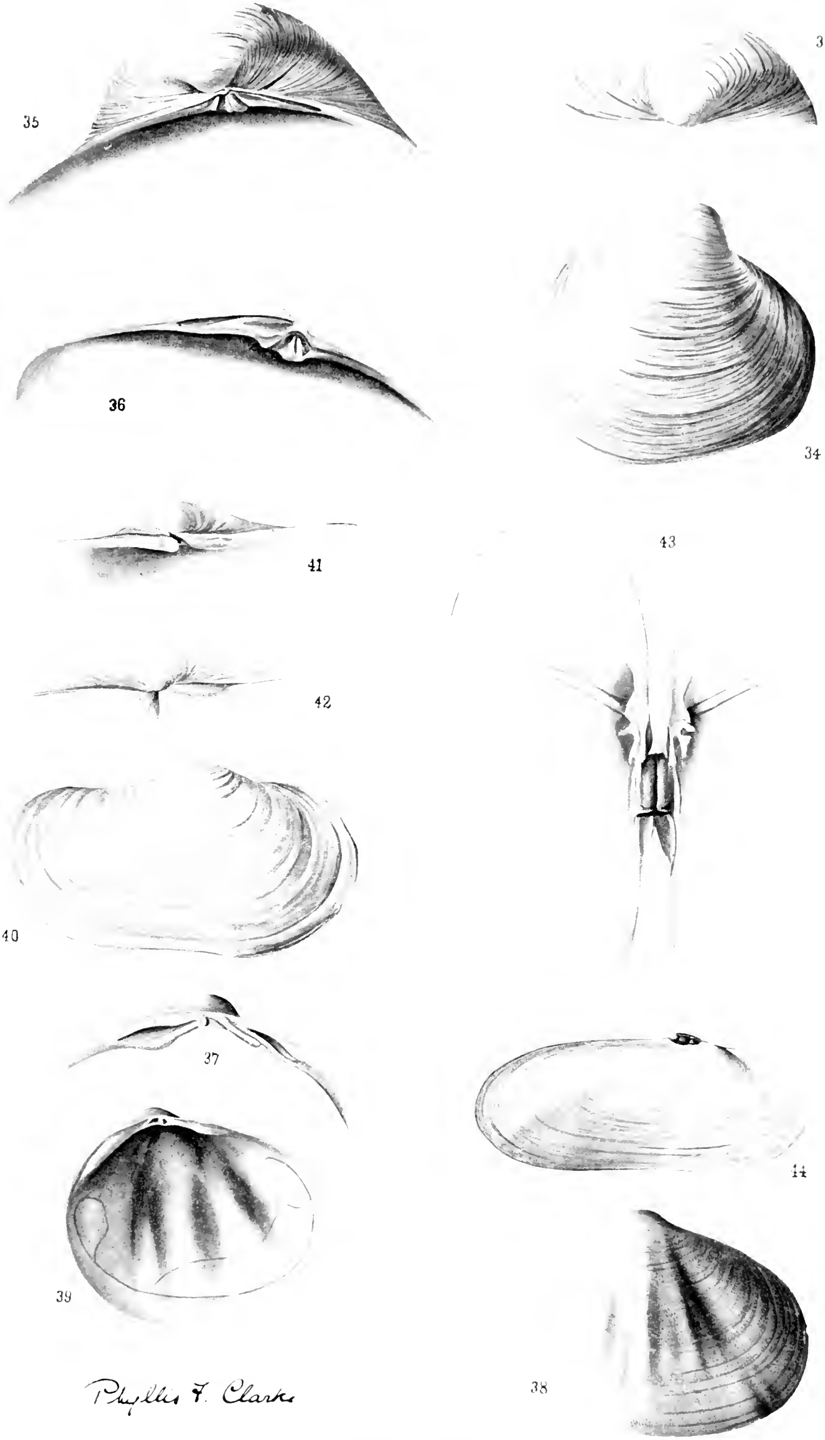

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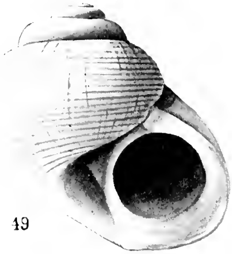

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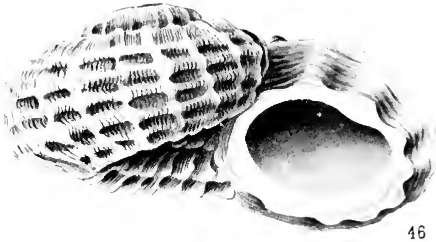

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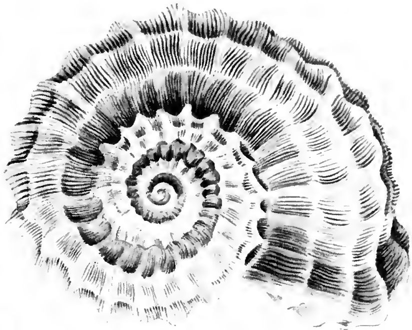

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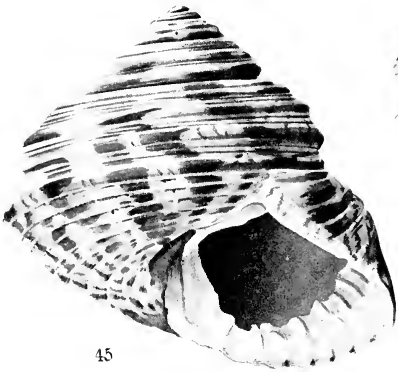

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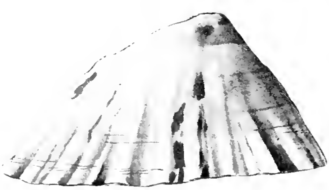

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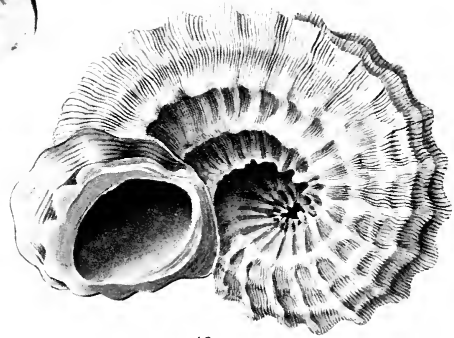

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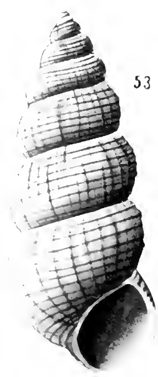

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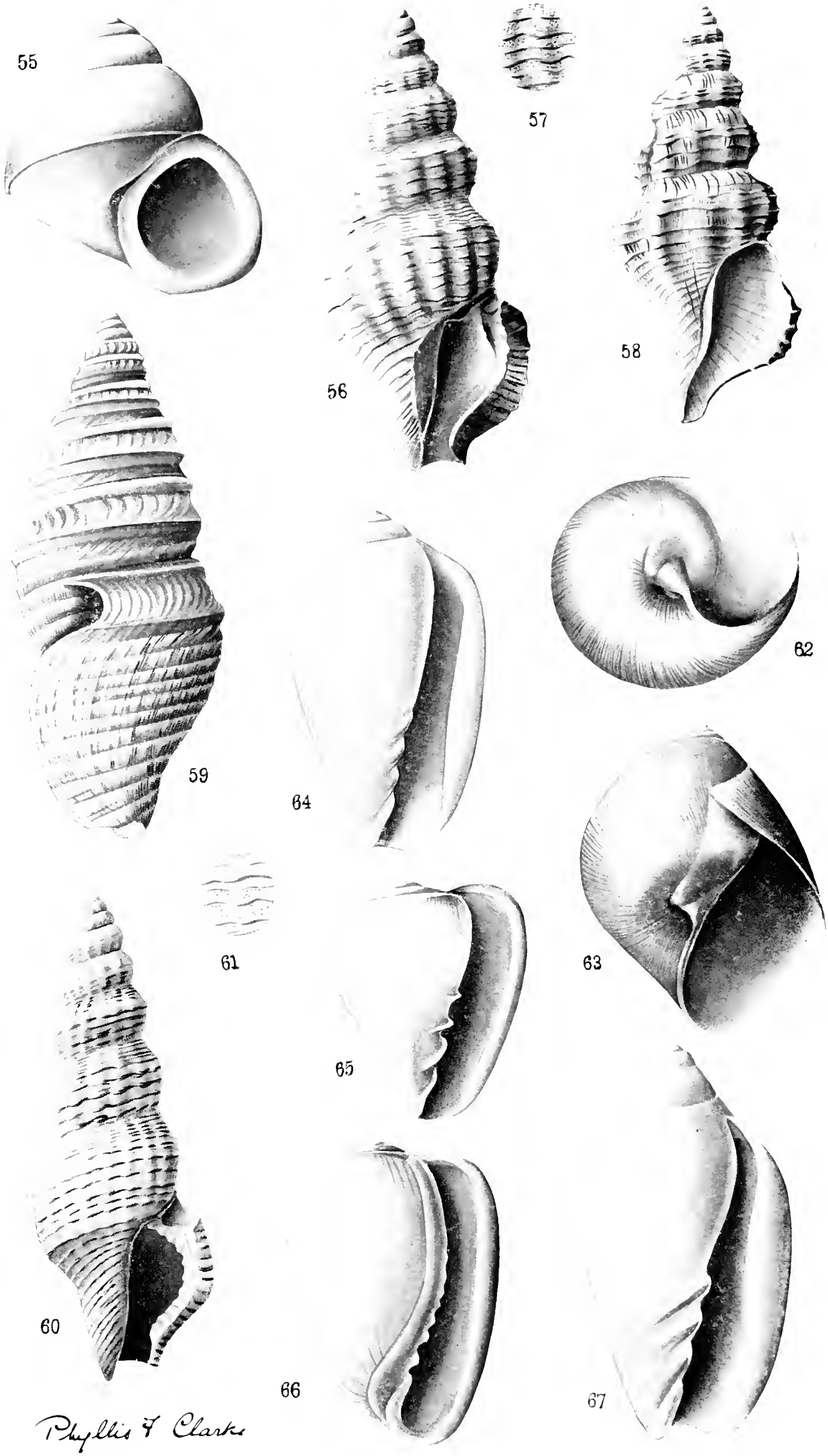

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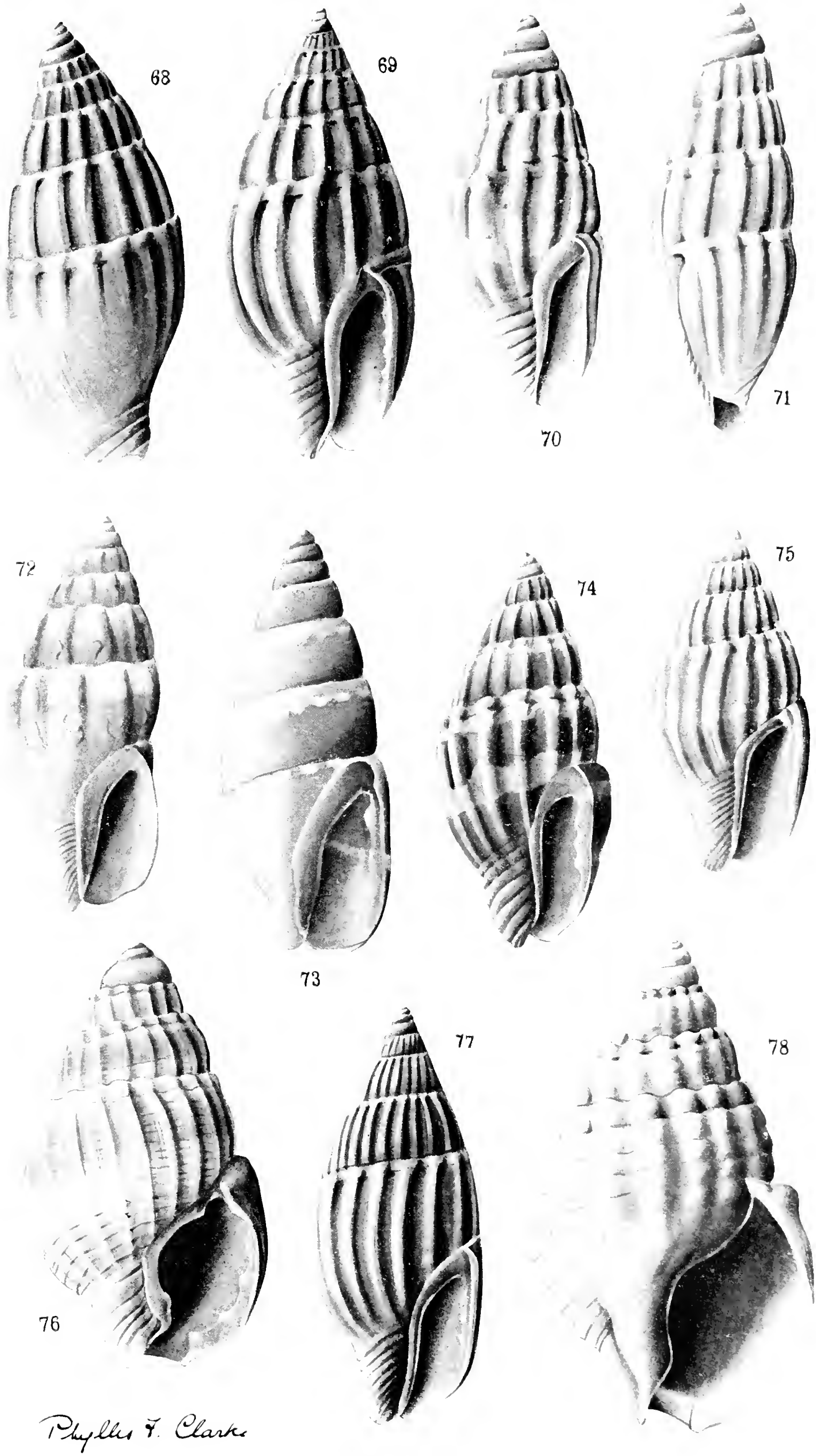

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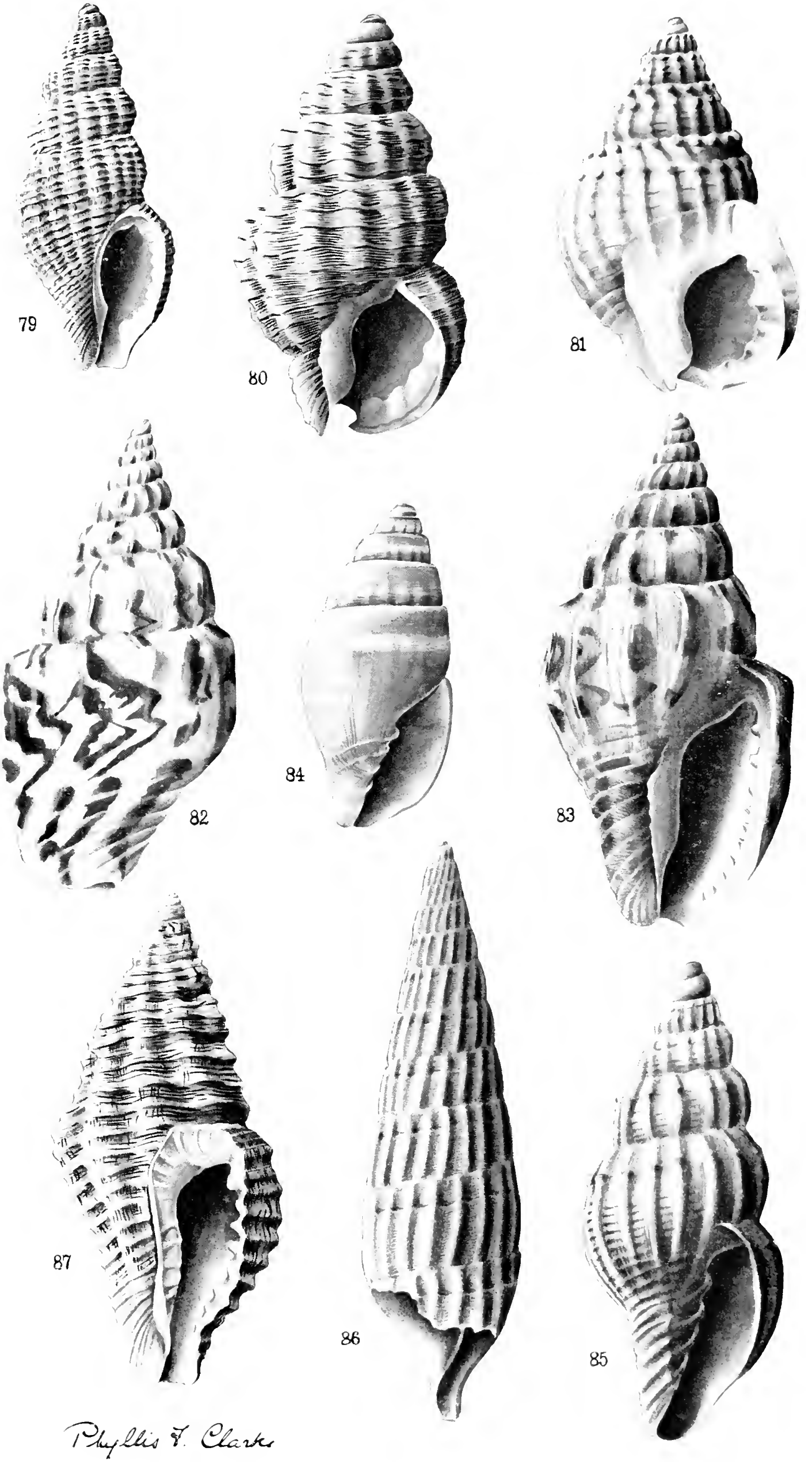

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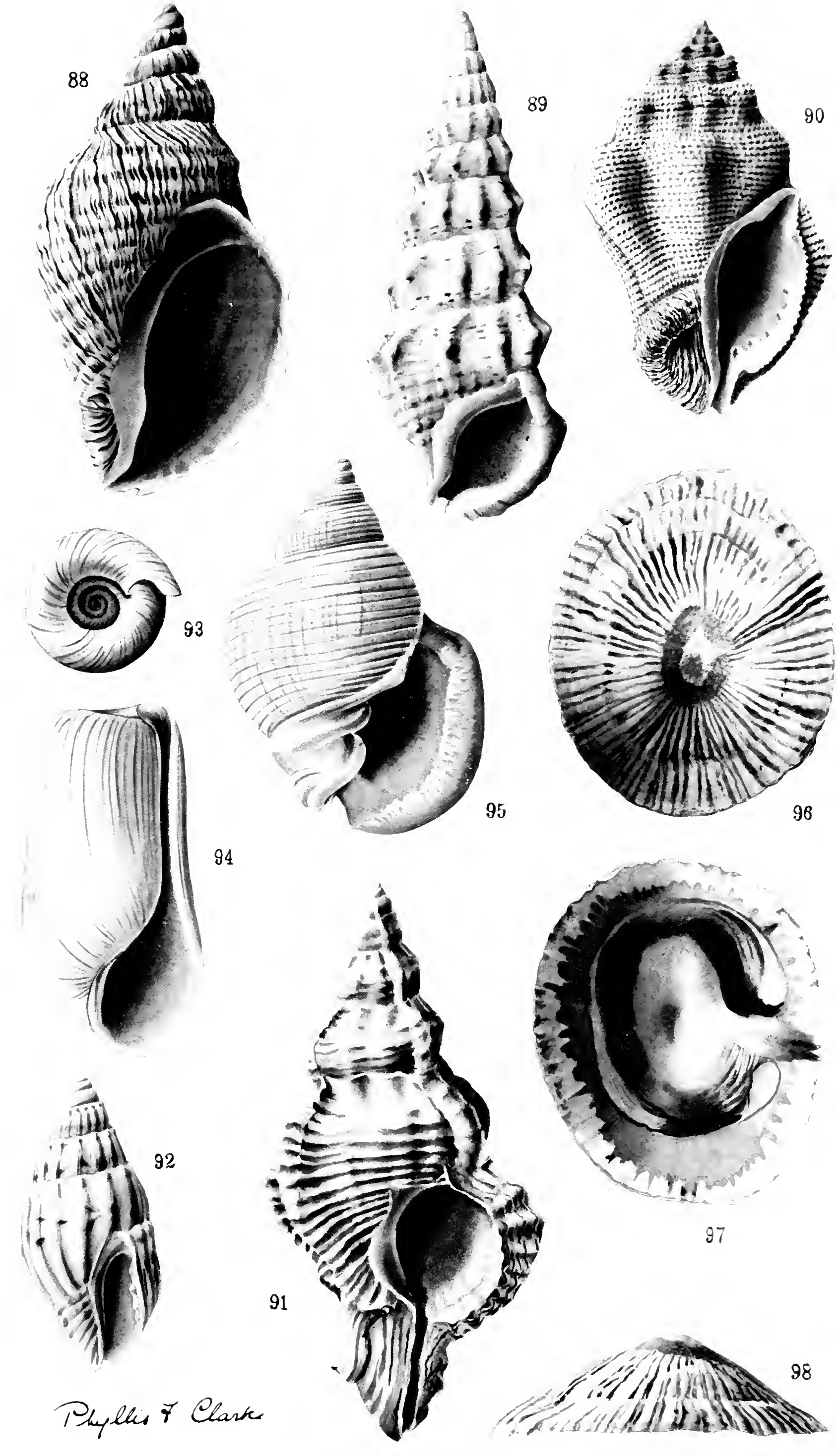

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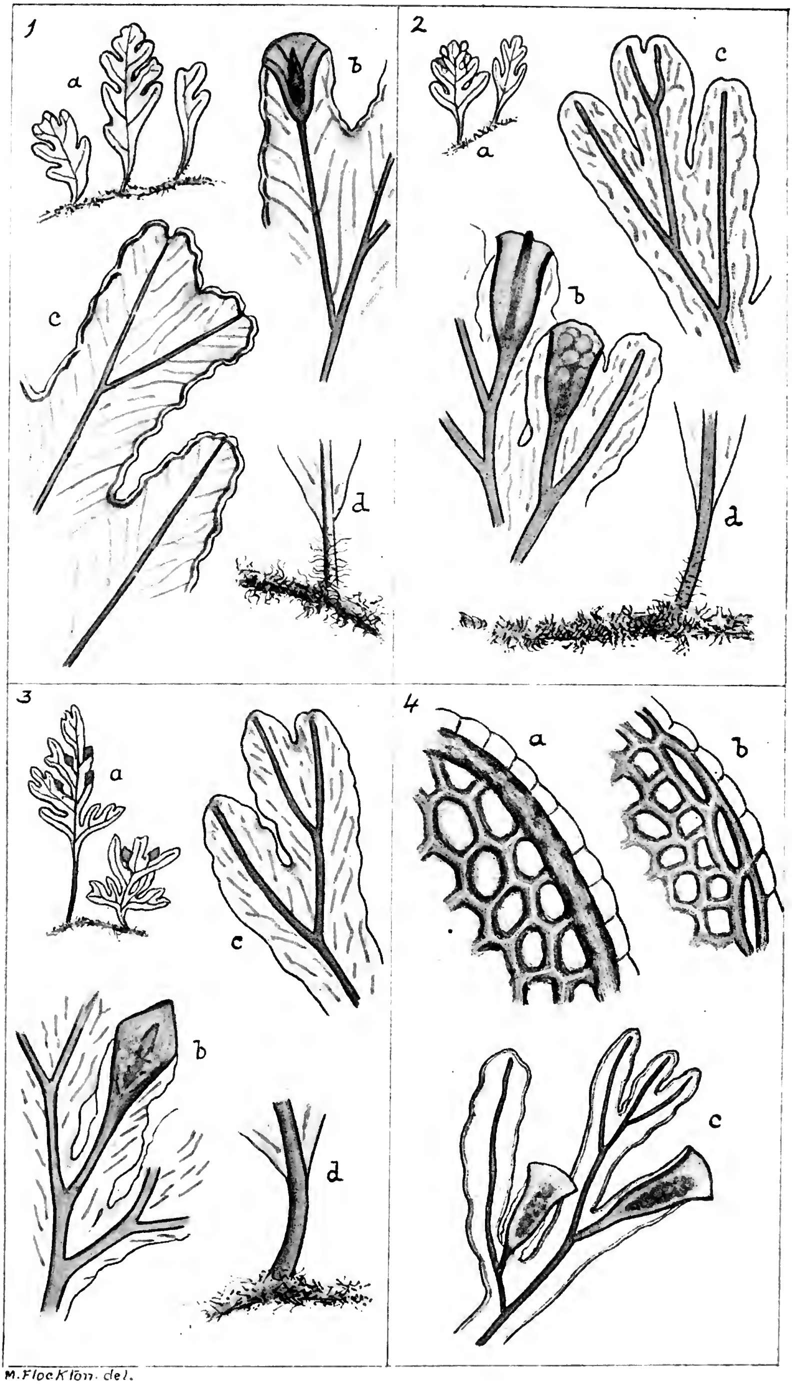

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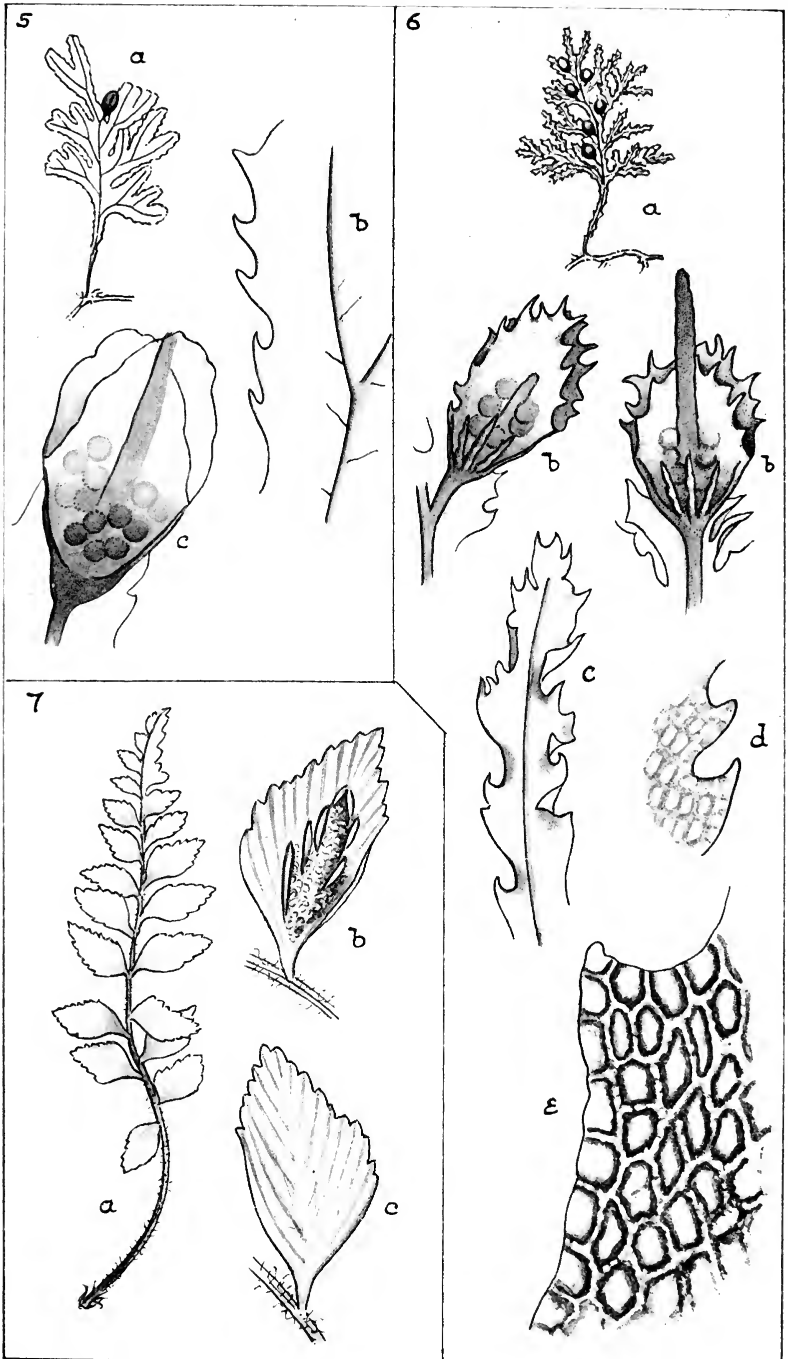
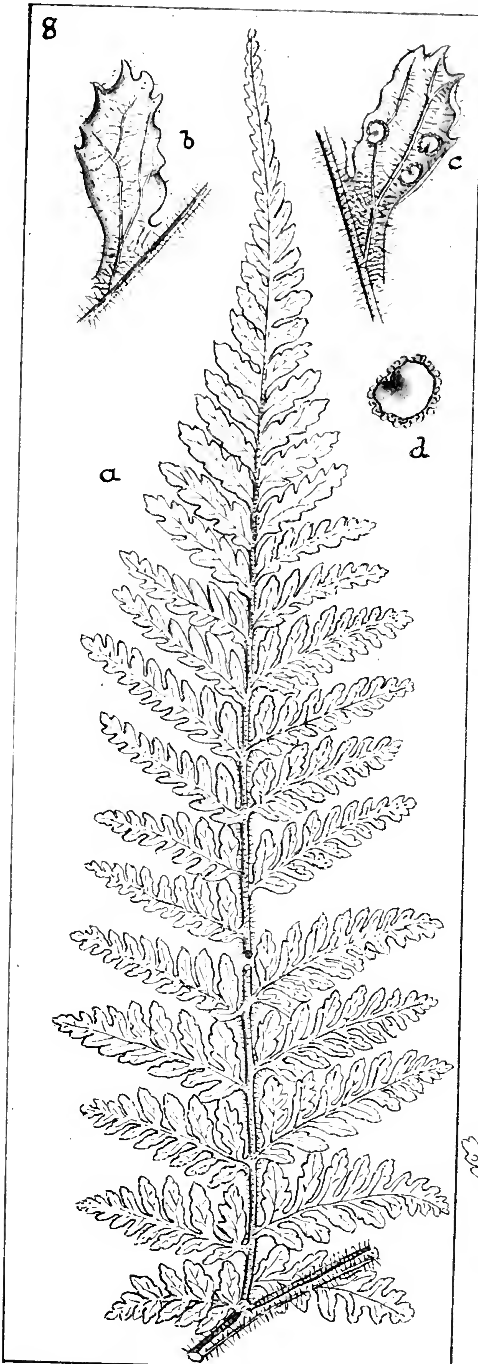
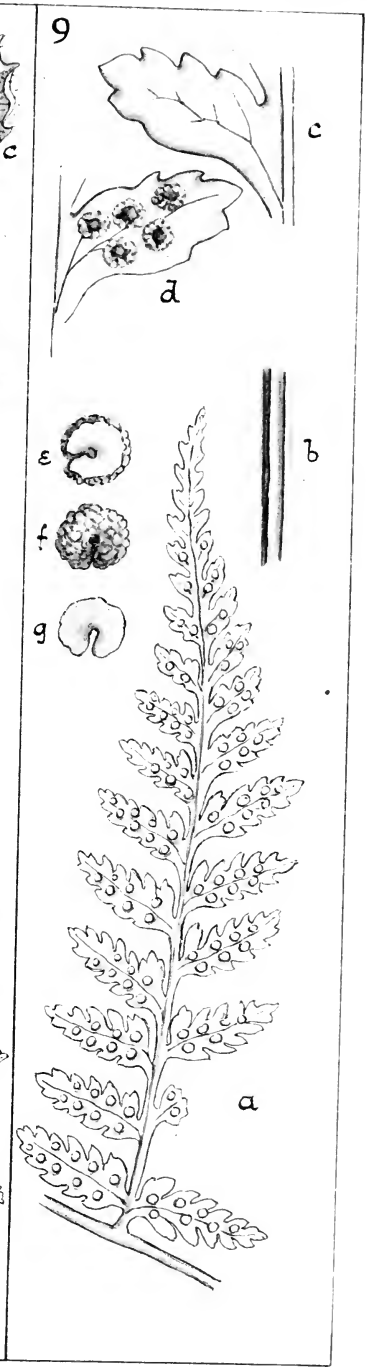
1. *Trichomanes Baileyanum*, n.sp. 2. *T. Majoræ*, n.sp. 3. *T. Walleri*, n.sp. 4*a*. *T. nanum* v. *australiense*. 4*b,c*. *T. Wildii*.



M. Flockton. del.

5. *Hymenophyllum Babindæ*, n.sp. 2. *H. Kerianum*, n.sp. 3. *Asplenium parvum*, n.sp.





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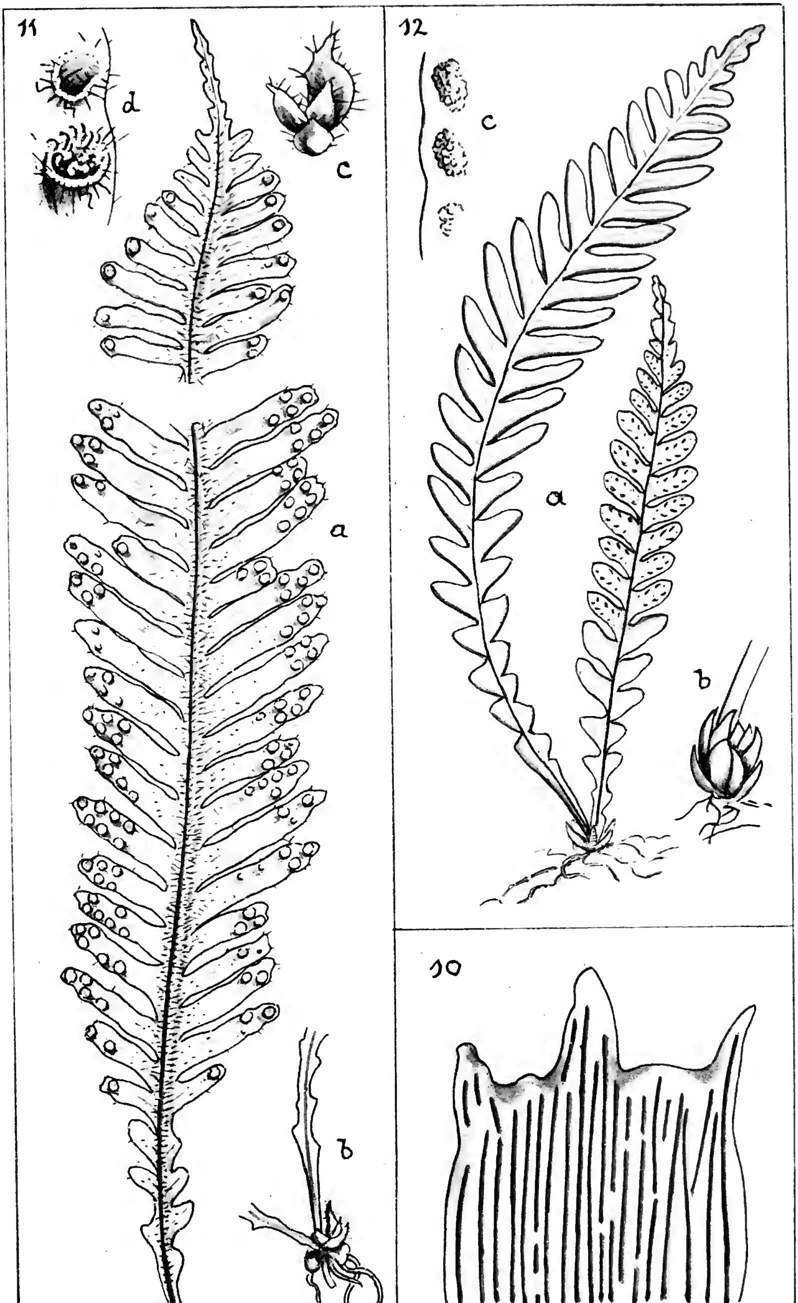
8. *Dryopteris albovillosa*, n.sp. 9. *Polystichum fragile*, n.sp.



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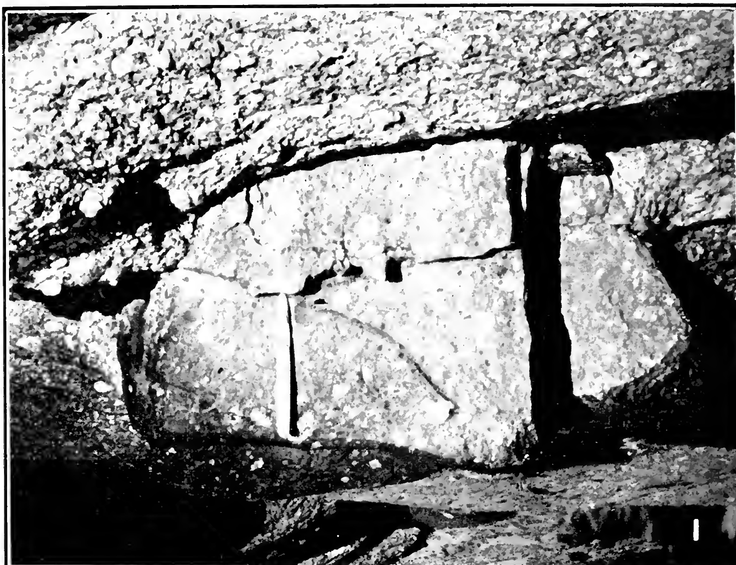
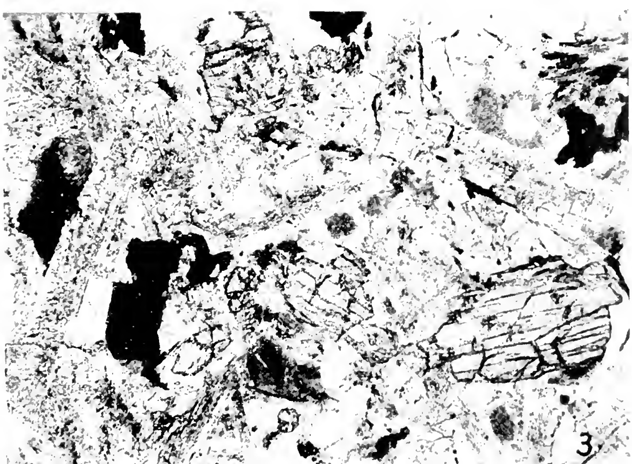
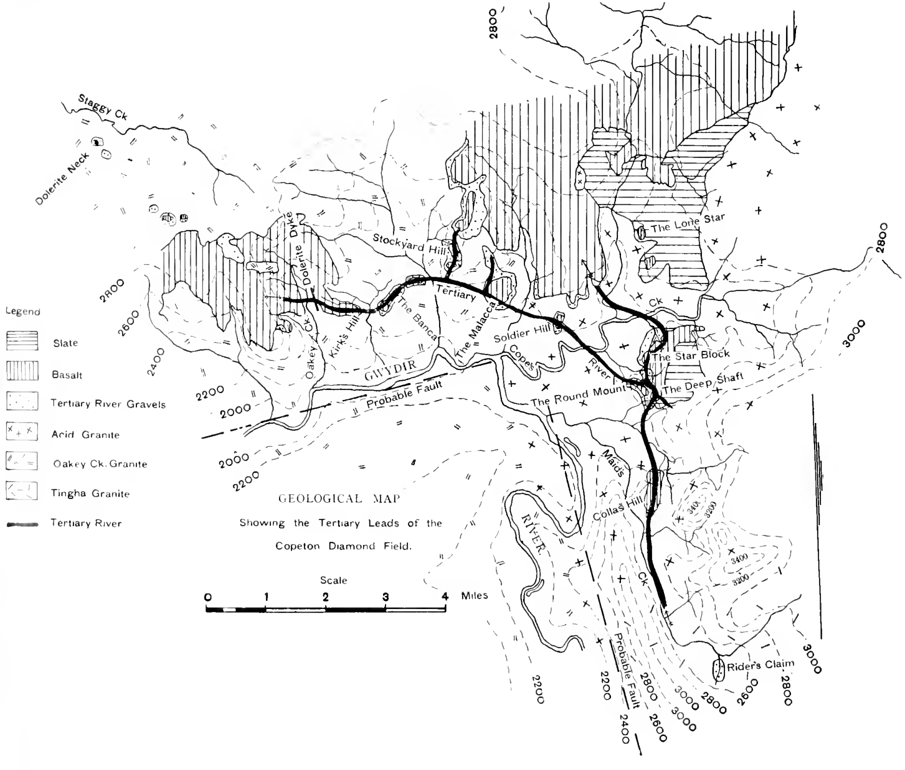
10. *Antrophyum reticulatum.* 11. *Polypodium Maideni*, n.sp. 12. *P. Gordoni*, n.sp.



1. Inclusion in Oakey Creek granite. 2. View of Copeton from Soldier Hill, looking east.

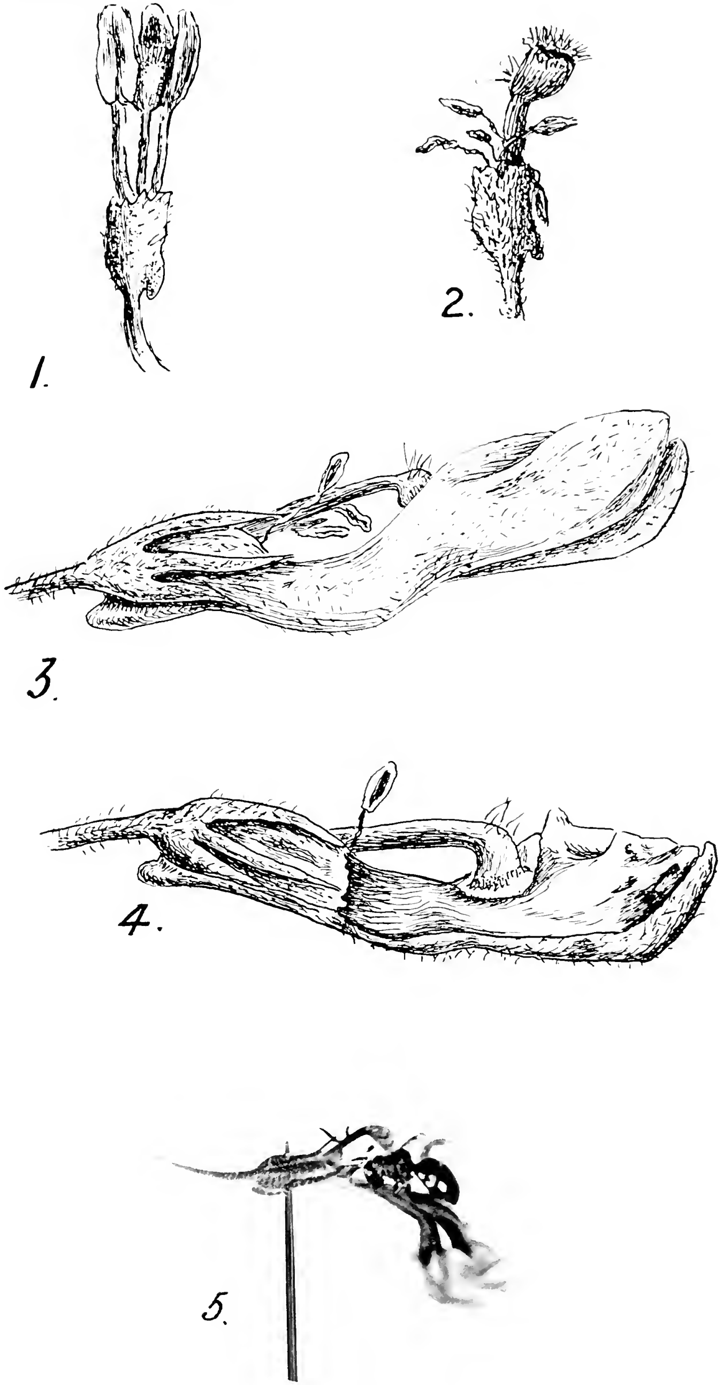


1. Mouth of tunnel, Oakey Creek. 2. Bed of Cope's Creek. 3. Oakey Creek dolerite.

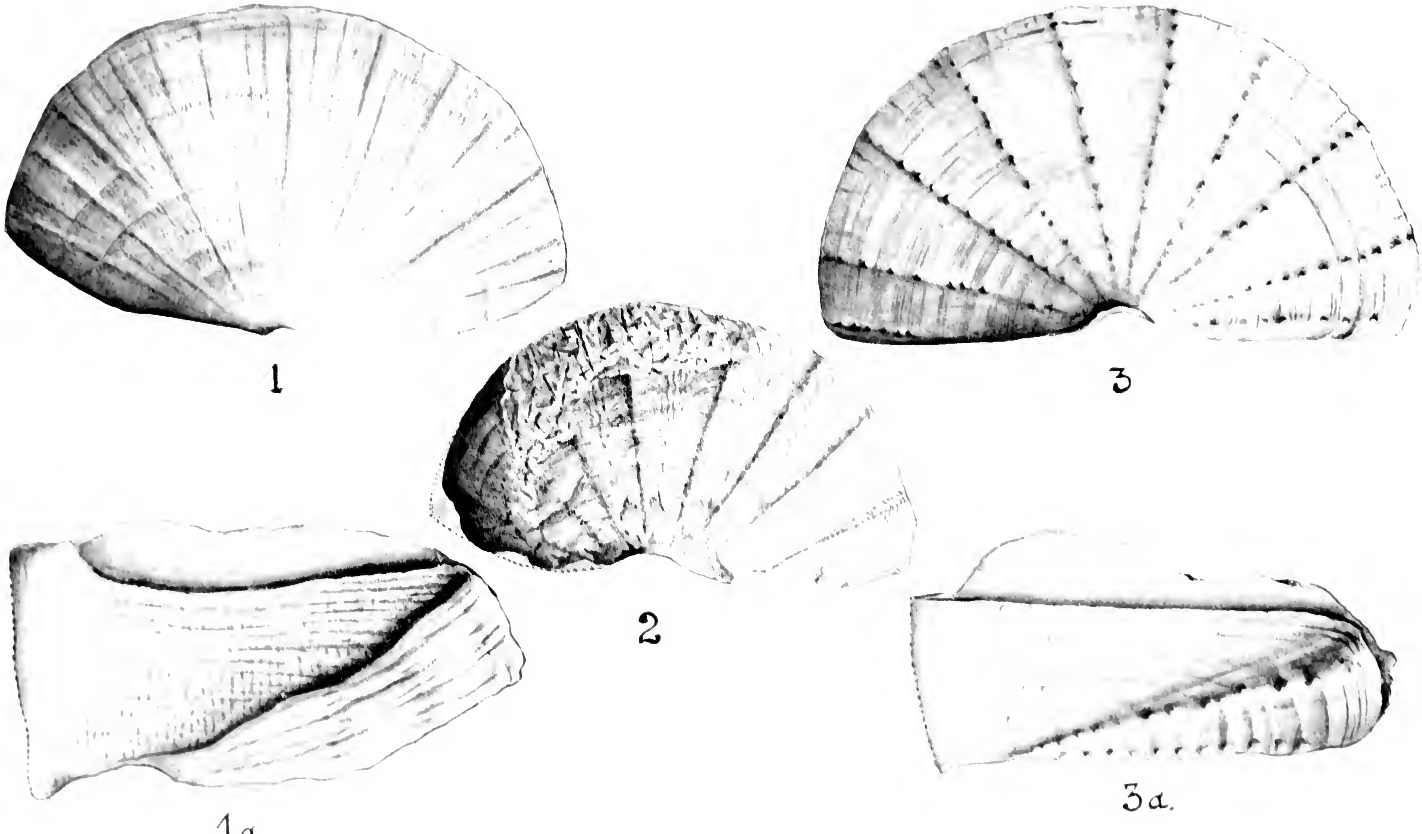


GEOLOGICAL MAP

Showing the Tertiary Leads of the Copeton Diamond Field.



Goodenia cycloptera R.Br.



1,1a. *Loricella magnifica*, n.sp. 2. *L. octoradiata*, n.sp. 3,3a. *L. atkinsoni*, n.sp.

Issued 17th July, 1914.

Vol. XXXIX.
Part I.

No. 153

THE

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OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES

FOR THE YEAR

1914

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Issued 25th September, 1914.

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PROCEEDINGS, 1914, PART 2.

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Note.—Plate xxviii. will be issued with the next Part.

Issued 24th November, 1914.

Vol. XXXIX.
Part 3. **No. 155**

THE PROCEEDINGS OF THE LINNEAN SOCIETY OF NEW SOUTH WALES

FOR THE YEAR

1914

PART III. (pp. 449-640)

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(Plates xxviii., and xxxiv.-lxxi.)

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Part 4.

No. 156

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OF THE

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OF

NEW SOUTH WALES

FOR THE YEAR

1914

PART IV. (pp. i.-viii., 641-878, i.-xxxviii.)

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(Plates lxxii.-xciv. : Note, Plate xci. is incorrectly lettered cxi.)

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