THE

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES

FOR THE YEAR

1916

Vol. XLI.

WITH FIFTY-NINE PLATES.

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CONTENTS OF PROCEEDINGS, 1916.

PART I. (No. 161).

(Issued 14th June, 1916).

PART II. (No. 162).

(Issued 13th September, 1916).

* Plate xx. was issued with Part iii.

PART II. *(Continued).*

PAGES

Correction in Dr. Turner's Paper (p.254).

Omit name and description of *Capua crypserythra*, n.sp., and substitute

CAPUA LEUCOSTACTA.

Capua leucostacta Meyr., Proc. Linn. Soc. N. S. Wales, 1910, p.202.

One ♀ example. Also from N.S.W.: Lawson.—Vic.: Beaconsfield.

Page 249, line 8—*for* six, *read* seven.—line 9, *for* 12, *read* 11.—line 22, *for* 7, *read* 6.

PART III. (No. 163).

(Issued 9th December, 1916).

PART IV. (No. 164).

(Issued 4th April, 1917).

PART IV. *(Continued).*

CORRIGENDA.

Page 17, line 23—for *Tecoma capense*, read *Tecoma capensis*.

Page 249, line 8—*for* six, *read* seven.—line 9, *for* 12, *read* 11.—line 22, *for* 7, *read* 6.

Page 254, lines 26-36—*omit* name and description of *Capua crypserythra*, n.sp., and substitute

Capua leucostacta.

Capua leucostacta Meyr., Proc. Linn. Soc. N. S. Wales, 1910, p.202.

One ♀ example. Also from N.S.W: Lawson.—Vic.: Beaconsfield.

Page 267, line 2—*for* Miss M. Hinder, *read* Miss E. M. Hinder.

Page 275, line 14—*for* Stenobiella, n.sp., *read* Stenobiella, n.g.

Page 498, line 22—for *Tragosia*, read *Auletta*.

Page 546, line 2—*for* palmate, *read* veins of a palmate.

Page 551, lines 7 and 10—*for* Fig.3, *read* Fig.4, and *vice versâ*.

Page 598, line 22—*for* American species, *read* American genus.

Page 633, line 9—for *Œ. Lamarkiana*, read *Œ. Lamarckiana*.

Page 637, line 25—for *Halicnemia* (s.str.), read *Paratimea* (g.n.).

Page 658, line 25—for *H. massalis*, read *H. coralloides*.

LIST OF NEW GENERIC NAMES PROPOSED IN THIS VOLUME(1916).

LIST OF PLATES.

PROCEEDINGS, 1916.

PROCEEDINGS
OF THE
LINNEAN SOCIETY
OF
NEW SOUTH WALES.

WEDNESDAY, MARCH 29TH, 1916.

The Forty-first Annual General Meeting, and the Ordinary Monthly Meeting, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 29th, 1916.

ANNUAL GENERAL MEETING.

Mr. A. G. Hamilton, President, in the Chair.

The Minutes of the preceding Annual General Meeting (March 31st, 1915) were read and confirmed.

The President delivered the Annual Address.

PRESIDENTIAL ADDRESS.

Bacon's familiar essay on "Adversity" concludes with this incontestable aphorism: "For prosperity doth best discover vice; but adversity doth best discover virtue." Twenty months ago, a lengthy period of unprecedented, material world-prosperity, largely due to Man's increased control of Nature, suddenly ended in discovering the calamitous condition of things which still confronts the world—Civilisation attacked from within, divided against itself, the solidarity of mankind rent in twain, Internationalism bankrupt. The case has been clearly and simply stated in a recent article by Emeritus Professor G. T. Ladd, of Yale University, in these words—"To-day, the German mind is at wide variance, is at desperate odds, with the human mind. It appears as either superhuman or below the human. It is not in accord with the standards supplied by the great majority of civilised and conspicuously thought-directed mankind."* Here is outlined the situation to be saved. If Civilisation is to continue and progress, it is unthinkable that it cannot be saved. What, except adversity, can be expected to discover the virtue required to save it? The ruinous expenditure in lives and treasure is impoverishing all the belligerent nations in varying degrees. The tide of adversity is steadily rising for all concerned in the war, though the full effect may not be fully realised until the heat of warfare has subsided. The possible failure of ambitious schemes, on one side, may enhance the general effect.

It might be expected, perhaps, that the recruiting-officer would be likely to look askance at most of the members of a Scientific Society. Nevertheless, ten of our limited number have responded to the call to arms. Some of them are "Anzacs"; others are on the way to destinations unknown to us; two have returned, one of them temporarily, while several are in training. It is befitting that we should have them in mind at this, our annual gathering. They are entitled to our warmest regard and good wishes, and to anything that we can do to show our appreciation of their readiness to serve the nation, and to strive for the triumph of the great issues at stake. Therefore, as a tribute of respect to them, I will ask Members to rise in their places while I read the list of names; and when I have concluded, to join with me in saying "All honour to our Soldier-Members!"

AUROUSSEAU, MARCEL, B.Sc., University of West Australia.

BRETNALL, REGINALD WHEELER, Australian Museum.

CARNE, WALTER MERVYN, Botanical Gardens, Sydney.

DAVID, Professor T. W. EDGEWORTH, C.M.G., D.Sc., F.R.S., University of Sydney.

FERGUSON, EUSTACE W., M.B., Ch.M., Department of Public Health.

FRY, DENE B., University student.

GOLDFINCH, GILBERT M., served at Gallipoli.

HENRY, MAX, M.R.C.V.S., on service abroad.

* "The Human Mind *versus* the German Mind." Hibbert Journal, January, 1916.

LASERON, CARL F., Technological Museum, Sydney: wounded at Gallipoli.

STOKES, EDWARD S., M.B., Ch.M., returned after service abroad: now P.M.O.

Sir Douglas Mawson is on the eve of leaving for England to enter upon military service. Dr. R. Broom, a Corresponding Member, has joined the Army Medical Service; but whether in South Africa or in Europe is not known to us.

If, as individuals, we are in need of further provocation to seriousness, we may surely find it in the departure of Professor David for the front with the Mining Battalion. We may well be impressed by his earnestness and self-sacrificing action in a great crisis; and be led to appreciate the example which he has set.

It was something more than a mere formality that, at a Special General Meeting held on 30th June, 1915, on the motion of the Hon. Treasurer, it was heartily and unanimously resolved "That the Annual Subscriptions of all Ordinary Members of the Society serving with the Australian Expeditionary Forces be remitted during their term of service."

Considering the unfavourable and depressing conditions entailed by the continuance of the war, the Society's progress during the past year may be regarded as satisfactory.

The full effect of the war on our exchange-relations with European Scientific Societies and Institutions is now realisable. For the Session 1914-15, the total number of donations and exchanges received amounts to 1028 additions to the library, as compared with 1166 for 1913-14 (five months of which were war-months), and 1285 for 1912-13, before the war. The significance of the shortage is, that our communications with over forty Societies, from which, under normal conditions, we hear at least once during the year, have been completely suspended. In some cases, we have received official notification that, in consequence of the disturbance of mails or other means of transmission, it has been deemed advisable to keep back despatches for the present.

The fortieth volume of the Proceedings for 1915 (896 pp., and

59 plates) has been completed in good time, and distributed, as far as circumstances permit. It contains thirty-six papers, on a wide range of subjects, read at the Meetings during the Session.

The recent decision of the Postal authorities that the annual volumes of the Society's Proceedings are not to be regarded as "books" within the meaning of the Postal regulations, and cannot be sent at book-rates per book-post, but are to be treated as "Printed Matter," and charged on a higher scale, on the technical ground that one Part of each volume contains a balance-sheet and report, means a substantial increase in postage on our publications for Societies, Institutions, and individuals within the Commonwealth, which cannot be delivered by messenger. The decision applies also to the publications of Australian Scientific Societies and Institutions generally, to University Calendars, and to the Annual Reports of Government Departments. Two examples will show that the cost is almost or quite quadrupled. The postage on single copies of the four Parts of last year's Proceedings, as "Printed Matter," was 1s. 3d.[one Part at 4½d., three Parts at 3½d. each]. Per Book-post, the amount would have been 4½d.[one Part at 1½d., three Parts at 1d. each]. We have recently received the last Calendar of the University of Melbourne, as Printed Matter charged 8d., whereas at book-rates the postage would have been 2d. The Annual Reports of mercantile Companies or Institutions are not volumes of 800-900 pages, with from 40-90 Plates illustrating objects of scientific interest only; so that the increase in cost falls most heavily on Scientific and Educational organisations. Considering that the balance-sheets and reports of Scientific Societies, like those of Educational, Charitable, and Government Institutions, are not records of profits made, and dividends payable: and often, as in our case, are largely concerned with the administration of trust-funds, this increase in the cost of sending scientific publications by mail—much higher than is charged on exactly similar publications containing balance-sheets, etc., which come to us per book-post at book-rates from other distant countries—seems rather like a tax on the diffusion of knowledge of scientific and educational value, and, as such, is objectionable. Two deputations of representatives of Scientific Societies and Institutions at different times since the new decision came into force, have waited on the Minister of the Department, but without result. In response to a request, Mr. J. E. West, Member for West Sydney in the House of Representatives, most kindly and courteously took some trouble to understand the Council's views on the subject, and was good enough to lay them before the Postal authorities. As matters stand at present, a new Postal Bill is in contemplation, which will provide for increases in certain rates, including book-postage; but as it is to be a measure for providing for a decreased revenue in war-time, we shall have to make the best of it. Nevertheless, we want to see the definition of "books" revised. Under existing circumstances, it does not seem to be a trivial protest to make, that while works of fiction, for example, can be sent by book-post, the publications of Australian Scientific Societies cannot, on what are really merely technical grounds.

Five Ordinary Members were elected during the year, two resignations were received, and we have lost, by death, one Ordinary Member, and two of our senior Corresponding Members.

Mr. William Allan, of Wingham, was born at Cheltenham, England, in 1820; and had resided on the Manning River uninterruptedly since 1851. He was elected to Membership on February 24th, 1886. Mr. Allan, throughout his long life, evinced a keen interest in Natural History, especially in Ornithology and Entomology; and it was largely through his unceasing efforts that the "Wingham Brush" was reserved for the preservation of the native flora and fauna. In his younger days, he came to know John Gould, and was in the habit of visiting him in London. He was very highly esteemed in the Manning River district, in which he had resided so long, for his kindly disposition, and for his readiness at all times to take a prominent share in promoting the interests of the district and the welfare of its inhabitants. Mr. Allan passed away on April 25th, 1915, in his 95th year.

Charles W. De Vis, M.A., Curator of the Queensland Museum for a number of years, died in Brisbane in April, 1915. Mr. De Vis, though somewhat later in the field than his colleague, in his official capacity, tried to do for the Queensland fauna, what Mr. Bailey did for the flora, but under more unmanageable and difficult conditions; for the zoological species far outnumber the botanical species, and the zoologist has no comprehensive, self-contained monograph like the Flora Australiensis to serve as a basis for his work. Both were pioneers in a local effort to provide, study, and record collections, illustrative of the fauna and flora of the same State and for State purposes; and they both encountered the usual preliminary difficulties, when such enterprises are in the early stages of development. Almost all Mr. De Vis' numerous papers on the vertebrates, fossil or recent, of Queensland and New Guinea, are to be found in the Proceedings of this Society (forty, contributed during the years 1882-95), in the Proceedings of the Royal Society of Queensland, in the Annual Reports on British New Guinea, 1889-97, published in Brisbane, or in the Annals of the Queensland Museum(1892-1911). By the aid of the "List of Contributors to the first Series of the Society's Proceedings" [21 titles listed; 19 others in Proceedings, 1886-1895]; of Dr. Shirley's "International Catalogue of Scientific Literature: Queensland Volume"(1889) [18 titles under Palæontology; 49 under Zoology]; and of the recently published "Index to Vols. i.-xxv. of the Proceedings of the Royal Society of Queensland"(1914), his numerous papers can be readily found. For reasons mentioned, circumstances did not permit of his issuing collected results, as his botanical colleague was able to do. Mr. De Vis was elected a Corresponding Member of the Society in July, 1882. He had retired from active work for some years before his decease, on account of advancing age. It is remarkable that Queensland should lose the two veterans, whose work was carried on concurrently for so many years, not only in the same year, but within so short a time as a few weeks of each other. From the absence of biographical details, this notice is necessarily short.

Frederick Manson Bailey, C.M.G., Colonial Botanist of Queensland, the Society's senior Corresponding Member, elected on 26th November, 1877, whose long and active life came to an end on 25th June, 1915, was widely known and esteemed throughout Australia for his benevolence and simple-mindedness, as well as for his zeal as a botanist. He came from England to South Australia with his family, in 1839, a boy of twelve. Later on he spent some time at the goldfields in Victoria; then returned to Adelaide for a time, in 1853, migrated to New Zealand, where he remained for some years; and finally, he came back to Australia in 1861, and settled in Queensland. For a time, he engaged in private business in Brisbane. In 1875, he accepted the position of botanist to a Board appointed to deal with the diseases of plants and animals; this was his first official connection with Australian botany. Later on, he took charge of the botanical section of the Queensland Museum, until, in 1881, he was promoted to the position of Colonial Botanist. He was then able to devote himself in earnest to systematic collecting, and to the study and revision, from personal knowledge, of the Queensland flora. This he carried out exhaustively during the rest of his life, so that, as his last illness was very brief, he died in harness, in his 89th year. Queensland had attained the status of a separate Colony in 1859, only about two years before Mr. Bailey arrived, and its total population was about 30,000. Hence he was practically an eyewitness of its evolution, and his botanical work developed with its expansion. The flora soon attracted his attention, but scientific enterprises in Queensland were in their infancy; and, until the Flora Australiensis (1863-78) was completed, his progress in doing effective work was somewhat retarded. His first contribution to a knowledge of the Queensland flora was a modest, private venture, entitled "Handbook to the Ferns of Queensland: with xxii. Plates illustrative of Genera," published in 1874. As this made its appearance before the last volume of the Flora Australiensis was ready, it was republished in a rearranged and extended form, in 1881, following the classification of Bentham, under a new name, "The Fern

World of Australia." In the meantime, during the years 1877-81, eight papers, one of them "On the Flora of Stradbroke Island," appeared in the Proceedings of this Society[Vols. ii.-vi.]; in addition to two written in collaboration with the late Rev. J. E. Tenison-Woods, one of them entitled "A Census of the Flora of Brisbane"; the other "On some of the Fungi of New South Wales and Queensland"[Vols. iv.-v.]. His first official publication seems to have been a booklet entitled "Inquiry for Seeds of Grasses and other Fodder-Plants; with a List of the Grasses of Queensland"[12mo., Brisbane, 1877]. In this, he gave some particulars respecting the Board appointed by Parliament to inquire into diseases of live stock and plants; and signed himself, at the end, "Botanist to the Board." Mr. Bailey distributed his numerous publications liberally, and they are well known. With the aid of the "List of Contributors" to the first ten Volumes of our Proceedings[10 entries]; Dr. Shirley's Queensland Bibliography[54 entries up to 1899]; and the recently issued Index to Vols. i.-xxv. of the Proceedings of the Royal Society of Queensland, there is no difficulty in following up his work. After 1899, his most important productions were The Queensland Flora, in six Parts(1899-1902); The Weeds and Suspected Poison Plants of Queensland(1906); and The Comprehensive[illustrated]Catalogue of Queensland Plants, both Indigenous and Naturalised(1912). These three are, in reality, the collected and summarised results of all his work, though, up to the last, he continued his series of "Contributions to the Flora of Queensland," appearing in the Queensland Agricultural Journal, giving the results of any supplementary information available.

It is difficult to estimate the total number of the additions to the Queensland flora which Mr. Bailey was enabled to make, from the way in which he tabulated his results. Thus, in his Second Census(1889), Baron von Mueller gives the following numbers:—Vasculares: Australia, 1,409 genera, 8,839 species: Queensland, 3,753 species(42·5 per cent.). Mr. Bailey, in the Comprehensive Catalogue, includes the vascular with the other Cryptogams, and gives his results thus—Phanerogams of Queensland, 1,222 genera, 4,259 species with 437 varieties; naturalised species, 307. Cryptogams, 818 genera, 3,606 species with 283 varieties. From this it will be seen, that the species of Phanerogams alone outnumber the species of Vasculares given in the Baron's table by more than 500—a very substantial increase.

In his Presidential Address to the Royal Society of Queensland in July, 1891, entitled "Concise History of Australian Botany," Mr. Bailey gave an account of his early travels in search of Queensland plants, as well as of the collectors, who, from time to time, sent him material. He also makes some interesting references to his father, John Bailey, Colonial Botanist of South Australia, from whom he inherited his botanical tastes; and he explains how it was that, from the comparative poverty of the native flora of the Adelaide district, his father's energy naturally found more scope in horticulture than in botany, though he did not altogether neglect the native plants.

The "Handbook of Ferns," Mr. Bailey's earliest publication, was published in 1874. His last effort was the latest of the series entitled "Contributions to the Flora of Queensland," contained in Part 4 of Vol. iii., N.S. of the Queensland Agricultural Journal for April, 1915; so that his published work covers a period of more than forty years; but this embodies the results of fifty-four years' experience under conditions that were slowly altering. He enlisted the co-operation of specialists in some of the groups of Cryptogams, so that he was able to catalogue and furnish descriptions, and in many cases illustrations, of all the known Queensland plants, in an accessible form convenient for reference. By unwavering zeal, and unflagging industry, he completed the task he set himself, and he did it well. His memory deserves to be held in kindly remembrance, not only in Queensland, but by all who are interested in the progress of Australian botany. We have heard with satisfaction, that Mr. J. F. Bailey, who for a long time assisted his father, has been appointed to succeed him.

The decease of Mr. J. R. Garland, in February, 1915, some time after the arrangements for the elections to fill vacancies in the Council for the Session, 1915-16 had been made, brought about an extraordinary vacancy, which was subsequently filled by the appointment of Mr. A. F. Basset Hull, who, in accordance with the provisions of Rule xv., governing such appointments, retires at this Meeting, but is eligible for re-election. From the foundation of the Society continuously up to the time of Mr. Garland's death, the Council had always included in its number one, and, for a great part of the period, two members of the legal profession interested in Science, who were most helpful in guiding the deliberations of the Council in matters submitted by, or to be referred to, the Society's Solicitors, or on obscure points which presented themselves unexpectedly, in connection with the administration of trusts. The appointment of Mr. Hull has restored the succession of such helpful members of Council.

As abstracts of the papers read during the year have been communicated to Members, and the papers themselves have been published, it is not necessary to refer to them in detail in offering a record of the Society's research-staff for the past year, as follows:—

Dr. R. Greig-Smith, Macleay Bacteriologist to the Society, continued his investigation of problems involved in the study of Soil-Fertility, and Nos. xiii., and xiv., of his series of papers on this subject were read during the year, and will be found in the last Part of the Proceedings. The first of these treats of the toxicity of soils; the second, of the stimulative action of chloroform retained by the soil. In addition, a third paper, in Part i., is descriptive of a new levangum-forming bacterium, which has been isolated and studied,

Dr. J. M. Petrie, Linnean Macleay Fellow in Biochemistry, completed two papers, one on the identification of the alkaloid of Native Tobacco, which will be read at the second Meeting of the coming Session; and the other, the third part of his study of hydrocyanic acid in plants. Other problems in hand are the statement of the results of the analyses of the inorganic constituents of plants; the photographic effects of the latex of *Euphorbia peplus;* the chemistry of the native Duboisias; and the alkaloids of *Solandra lævis.*

Mr. E. F. Hallmann, Linnean Macleay Fellow in Zoology, in continuation of his study of the Monaxonid Sponges, almost completed the examination of the *Axinellidæ*. A preliminary study of the Sponges brought back by the Australasian Antarctic Expedition received attention.

Mr. W. N. Benson, Linnean Macleay Fellow in Geology, continued his work on the geology and petrology of the Great Serpentine-Belt; and two papers, Parts iv., and v., of the series, dealing with the dolerites, spilites, and keratophyres of the Nundle district; and with the geology of the Tamworth district, were read during the year; and have appeared in Parts i. and iii. of the Proceedings for the year. The preparation of No. vi., treating of the intermediate region between the Nundle and Tamworth districts, and also a preliminary study of the Currabubula and Werris Creek areas were taken in hand, and some progress attained; but were subsequently suspended for special reasons. In August last, as a concession allowed during wartime, the Council granted Mr. Benson three months' leave of absence, afterwards extended up to the end of his term of appointment, in order to relieve Professor David of some of his University work, at first for national organisation at home, and later for military service abroad. The Council felt that the Society should cheerfully accept a share of the inconvenience and of the results of the disturbance of normal conditions arising in connection with the war. Mr. Benson will retire from his Fellowship at the end of his term, in order to continue the work which he has undertaken, during Professor David's absence. During his two years' connection with the Society as Fellow, Mr. Benson has carried out his work with both ability and zeal, and has amply justified his appointment. Throughout his work, he has had the great advantage of being in close touch with Professor David, whose experience and advice have always been freely available, both in the field, as well as in the laboratory. He has well advanced the subject he took in hand; and we hope that, when circumstances permit, he may be able to continue and complete the important and promising work, which he has so well begun.

Mr. R. J. Tillyard, Linnean Macleay Fellow in Zoology, has completed his first year's work. Four papers have been submitted, two of which, on the rectal gills in the larvæ of Anisopterid Dragonflies, and the first of a series devoted to the study of Australian Neuroptera, were read during the year; and will be found in Parts ii., and iii., of the Proceedings for the year. The second and third of the series will be communicated at the first and third Meetings of the new Session.

For the third time, in October, 1915, the Council was able to offer four Fellowships, the full number. Five applications were received; and I have now the pleasure of making the first public announcement of the Council's reappointment of Dr. J. M. Petrie, Mr. E. F. Hallmann, and Mr. R. J. Tillyard to Linnean Macleay Fellowships in Biochemistry and Zoology; and of the appointment of Mr. H. S. Halcro Wardlaw, B.Sc., to a Linnean Macleay Fellowship in Physiology, for one year from 1st proximo; and, on behalf of the Society, of wishing for them favourable opportunities for carrying out their important work, with a very satisfactory measure of success.

In joining the Society's research-staff, Mr. Wardlaw does so with an excellent record, both as a student and as a Research Scholar of the University of Sydney. On graduating, in 1913, he obtained First Class Honours in Chemistry and Physiology, and was awarded the University Medal for Physiology. In the same year, he was appointed to a Science Research Scholarship, which he has held for two years, during which period a series of investigations were completed, the results of which are embodied in five papers, of which four have been communicated to the Royal Society of New South Wales; and one, on "The Temperature of Echidna," is to be found in our Proceedings for last year. A sixth paper is ready, and will be published in London. Mr. Wardlaw, as a Linnean Macleay Fellow, will continue and extend his work on the physiology of the secretion of milk and on problems which arise in connection therewith. As this is the first time a physiologist has been appointed to a Fellowship, we look forward with pleasurable expectation to a more prominent place of this branch of science in the Society's Proceedings than has hitherto been possible.

The names of one Society and two Institutions—the National Academy of Sciences at Washington, the Zoological Museum at Tring, England, and the Instituto Oswaldo Cruz at Rio de Janeiro—have been added to the Society's Exchange-list during the year. The addition of their valuable publications to the library is very welcome.

Three portraits of workers identified in some way with the fauna or flora of Australia were presented during the year, and are now on view—one of Professor Herdman of Liverpool University, the gift of Mr. C. Hedley; the second of the late Rev. Dr. Woolls, well known to, and highly venerated by, the older botanical members of the Society, for some years a contributor to our Proceedings, for which the Society is indebted to the Trustees of the Australian Museum; and the third, of the late Alexander Walker Scott, formerly of Ash Island, author of "Australian Lepidoptera," and an active member of the Entomological Society of New South Wales, a donation from the Secretary. It is very gratifying to have the Society's collection of portraits added to in this interesting and very welcome manner.

Dr. E. Mjöberg, of Stockholm, has been good enough to send to the Society reprints of eleven papers published in the Handlinger[Bd. lii., 1913-15] or in the Arkiv för Zoologi[Bd. ix., 1915] of the Royal Swedish Academy—a first instalment of a series entitled "Results of Dr. E. Mjöberg's Swedish Scientific Expeditions to Australia, 1910-13." Six authors have co-operated in the production of these papers, which deal with the Mammals, Reptiles, Batrachia, certain groups of Hymenoptera [Fam. *Stephanidæ*, *Ichneumonidæ*, *Braconidæ*, and *Formicidæ*], and some Mesozoic plants. A number of species are described as new, and many notes on geographical distribution and on other matters are given. When completed, the series promises to be a very important contribution to a knowledge of the fauna of the outlying parts of Australia in which the collecting was done.

I am sure that I shall voice the sentiments of this Meeting in offering to two of our Members, who have given of their best at Gallipoli, sincere sympathy in their bereavement.

We have heard, with pleasure, during the year, of the appointments of two of our Members, both Members of the Council, also, to important positions in the Department of Mines—Mr. Cambage to succeed Mr. Pittman as Under Secretary; and Mr. J. E. Carne to the position of Government Geologist. On behalf of the Society, I would like to offer them our hearty congratulations on their promotion, and our best wishes for success in their new undertakings.

To Mr. J. H. Maiden, also, I would offer our cordial felicitations on his election to the Royal Society of London.

A noteworthy feature of late years has been the foundation of large numbers of Societies all over the world, having for their object the protection and preservation of the Flora and Fauna, of natural beauty-spots, and places or buildings with historical associations.

In England, the Selborne Society is doing valuable work in fostering the tendency towards caring for plants and animals. America has its Audubon and other Societies, and, in Australia, there are the Wild Life Protection Society, the Gould League of Bird-lovers, and the Australian Forest League.

The only way in which effective protection can be brought about is by educating the people, and leading them to see that it is necessary; and it is this method which is adopted by all these Societies. It is recognised by most of us that, to be lasting, such education should begin as early as possible; and, for this reason, the Gould League of Bird-lovers seeks to enroll the school-children. In this respect, the League has received the greatest encouragement and assistance from the Educational authorities. In our own State and in Victoria, that assistance has been particularly generous, and the results are very encouraging. In many country schools, the wild birds come no longer under that name, for they are almost domesticated; they come and feed among the children at their lunches, and show little fear of those who, a few years ago, would have been their natural enemies.

A significant sign of the improvement in the public point of view in this matter, is the frequent discussions in the press, both daily and weekly, of the value or harmfulness of birds. We find nowadays, a great many people who will even say a good word for the once universally detested Crow. It is recognised that, black though he may be, he is by no means so black as he is painted. And it is beginning to be generally understood that, as Mr. W. W. Froggatt pointed out many years ago, a bird may be very destructive in one locality, and extremely useful in another. In the matter of official protection of birds, we are very far behindhand. The Act gives a long list of protected birds, under the scientific names. The police, who are charged with the administration of the Act, have not the necessary knowledge of the birds. The remedy would be an Act which listed the birds which might be shot, a suggestion which we also owe to Mr. Froggatt.

One method of encouraging the birds—the provision of nesting-boxes—does not meet with a great deal of success. Our native birds do not take to these. In both England and America, the providing of such boxes is much resorted to. There are many firms which make a specialty of manufacturing them, and the birds respond by using them freely. But here, we find that, as a rule, the only tenants are the sparrow and the starling. It may be that Australia's being so recently settled, the birds have not reached that stage of sophistication which would lead them to see the advantages of such shelter.

All this is a matter for congratulation to such Societies as ours. The plants and animals offer numberless, unsolved problems to the biologist, and their preservation is, therefore, a matter of grave concern. And, in Australia, it is of very great importance on account of the unique characters of the fauna and flora. We are offered numbers of biological problems for investigation, which from the nature of our fauna and flora, are of compelling interest. Yet it is a lamentable fact that not very much has been done by Australian naturalists towards the solution of these problems. This is all the more regrettable, because, as a consequence of the rapid spread of settlement, and the increasing requirements of civilisation, many of our plants and animals are fast moving towards the limbo of lost things where they will meet with the Dodo, and the Great Auk. The spread of the cities and the operations of land-vendors are rapidly destroying our highly specialised, local flora; and, with the plants, the animals also disappear. And with them will disappear the opportunity for research into their bionomics. In the vicinity of all our towns, the flora is becoming a cosmopolitan one, and the Australian element forms but a small portion of it. It behoves us, then, before it is too late, to get to work on the bionomics of our native plants and animals.

A very important problem among these is the pollination of Australian flowers by birds. Looking into this question, on the suggestion of Mr. J. J. Fletcher, I was surprised to discover how little definite information on the subject of bird-pollination was to be found. The fact that a given species of bird visits a flower, is often taken as evidence that the flower is pollinated by that bird, but as to the method by which it is done, no record is made. Schimper(3) quotes Belts' description of the pollination of Marcgravia, and goes on: "Since Belt's classical description, and the unfortunately very short communications of F. Müller, the knowledge of humming-bird flowers has not made any considerable progress, for the surmises of several botanists formed far away from the home of humming-birds cannot be considered as such. The share taken by humming-birds in causing the peculiarities of many American flowers, can be ascertained only by careful and critical investigations on the spot." These remarks apply equally well to pollination by birds in Australia.

One of the first questions arising is, Are bird-pollinated flowers specially adapted in any way? Certainly many of them do present special features. Hermann Müller(2) says that ornithophilous flowers present several types. Many of them possess large, brilliantly coloured flowers, very frequently scarlet, pouched in form, upright in position, and secreting a great abundance of honey. But Kerner(5) says that laterally directed flowers are visited solely by hovering visitors such as the owlet- and hawk-moths and humming-birds, which require no platform, and, therefore, none is provided. And he speaks of the absence of plates, ridges, fringes, pegs, or knobs in bird-pollinated flowers. From personal observation, I should think that a large number of them have pendent flowers, as in the Fuchsia and Abutilon. It is certain, too, that honey-eating birds will visit any type of flower that contains much nectar. Moseley(6) speculates whether the humming-birds of Juan Fernandez may not be the agents of pollination in the strawberries, cherries, peaches, and apples. It is certain that honey-eating birds will visit any flower, no matter what type, that contains much honey. Beal records the pollination of cherries and catmint, and red clover is recorded by another observer.

Still, there is no doubt but that the majority of bird-pollinated flowers are more or less tubular, are brilliant in colour, and contain much honey. Further investigation will result in other types being recognised, but the above is no doubt the commonest. It is remarkable how soon birds recognise suitable introduced plants. Our Australian honey-eaters regularly visit Hibiscus, Abutilon, *Tecoma capense*, and other species, *Bignonia venusta*, *B. radicans*, Pentstemon, Gladiolus, Honeysuckle, Cotyledon, Echeveria, and Agave, all eminently adapted to bird-visitors.

One fact that must not be lost sight of is, that flowers specially adapted for pollination by birds, are equally adapted for visits from hawk-moths, and other moths with long proboscees. Bates(4) relates how he, several times, shot a moth instead of a bird, and says that the manner of flight and poise before a flower are precisely like those actions in a humming-bird. Only after some days was he able to distinguish the bird from the moth. He records, also, that the natives, and many of the educated whites, believed the moth *was* a bird. The daylight and crepuscular hawk-moths do frequent the same flowers, and are as successful in pollinating them, as the birds. I have observed that *Clero-*

dendron tomentosum is visited by the Spinebill in the daytime, and by hawk-moths in the evening and at night. But while the day-flying moths visit the same flowers as the birds, the night-flying moths would not visit the red flowers, for even by strong moonlight, the red colour would be invisible. The close resemblance of the moth and the bird is a very interesting example of how similar environment brings about analogous structure, and similar habits in very different organisms. A more curious instance of this is the fact recorded in Knuth(8), that a bat, in Trinidad, pollinates the flowers of a tree, behaving so like a moth that it was mistaken for one. It has a brush-like tongue like a humming-bird.

The profession of pollinator seems, in the main, to be confined to a few families of birds. In America, the humming-birds (*Trochilidæ*) and sugar-birds (*Cœrebidæ*) are chiefly concerned. In Hawaii, the *Drepanididæ* (35 spp. in 17 genera) and *Meliphagidæ* (5 spp. in 2 genera) are the agents. In Australia, we have *Meliphagidæ* (72 spp. in 23 genera), and 7 species of brush-tongued Lorikeets. Africa has its Sunbirds (*Cinnyridæ*) and Flower-peckers (*Dicæidæ*). In New Zealand, are the *Meliphagidæ* and a few parrots.

But there is no doubt that other birds, at times, pollinate flowers. Whether they visit the flowers in search of insects, or nectar, is not quite apparent. Moseley(6) gives an account of *Artamus leucopygialis* being shot, and found to have the bases of their bills clogged with pollen, which, he thinks, they got in searching flowers for insects. But Mr. Musson, in a letter to Mr. Fletcher, records that numbers of *Artamus personatus*, and *A. superciliosus* visited the flowers of a Beefwood (*Grevillea robusta*) and fed on the nectar. When some starlings visited the tree, the wood-swallows left, and the starlings began to feed on the nectar in just the same way. I have also been informed by several observers that sparrows probe the flowers of the Coral-tree (*Erythrina*) in the same way that the honey-eaters do. It is probable that closer inquiry into the habits of our birds will result in the discovery that many of them, while not professional pollinators, yet do a good deal of that work as amateurs. Mr. North informs me that Black Cockatoos visit the heads of Banksia-flowers in search of honey, and, no doubt, often pollinate some of the flowers in doing so.

All the special pollinating birds have some peculiarities of structure, which fit them for the special work they have to do. The humming-birds are capable of poising on the wing before the flowers they frequent, their beaks are either long or short, slender, curved, and, in some cases, at least, specially adapted to pollen-carrying. In a paper by J. L. Hancock(**7**), he describes and figures the beak of a humming-bird, showing what he calls a "pollen repository"—a groove in the ventral surface of the bill, and grooves at the angle of the mouth, from the nostril on the upper side. He also describes feathers about the head apparently adapted for holding pollen. These have barbules with barbicels. The pollen-grains are held between two barbules, or the barbs spread apart, and hold pollen like a pair of forceps.

In a paper by Robert Ridgway(**9**), he describes the tongue of the humming-bird as follows: "The tongue of this species (and doubtless others have a similar conformation) presents, when recent, the appearance of two tubes laid side by side, united for half their length, but separate for the remainder. Their substance is transparent in the same degree as a good quill, which they much resemble. Each tube is formed by a lamina rolled up, yet not so as to bring the edges into actual contact, for there is a longitudinal fissure in the outer side running up considerably higher than the junction of the tubes; into this fissure, the point of a pin may be inserted and moved up and down. Near the tip, the outer edge of each lamina ceases to be convolute, but is spread out, and split at the margin into irregular fimbriæ which point backward like the vane of a feather. These are not barbs, however, but simply soft and flexible points, such as might be produced by snipping diagonally the edges of a strip of paper. I conjecture that the nectar of flowers is pumped up the tubes, and that minute insects are caught, when in the flowers, in these spoon-like tips, their minute limbs being perhaps entangled in the fimbriæ, when the tongue is retracted into the beak, and the insects swallowed by the ordinary process, as doubtless those are which are captured by the beak when in flight."

Prof. Beal(**11**) gives the results of the investigations of some students into bird-pollination by humming-birds. They visit flowers for at least two objects, for insects and for nectar. Pollen-grains have been found on the bills and on the heads of the birds. They were seen to frequent pelargoniums, fuchsias, trumpet-creeper, phloxes, verbenas, catmint, milkweed, tropœolums, honeysuckles, lilacs, morning-glories, cherries, and wild balsam.

In the latter, the anthers form a covering to the pistil. If the flowers are covered up, no seed is produced. Humming-birds visited all the open flowers. Every time one plunged his beak in, the head, a little above the beak, became dusted with pollen. Where the anthers were removed, the birds left pollen on the stigma. All the flowers in one cluster were visited twice in 15 minutes. *Impatiens fulva* is cross-fertilised mainly, if not entirely, by humming-birds.

Trelease, in a note supplementary to Prof. Beal's(**11**), says the Ruby-throat is often seen to get nectar from both glands at the base of the cotton flowers. It was constantly seen at the flowers of *Oenothera sinuata*, very often about those of the maypop (*Passiflora incarnata*), the white-flowered buckeye (*Aesculus parviflora*), the wild and cultivated morning-glories, yellow day-lily, white oleander, several sorts of pelargonium, lemon, fuchsia, larkspur, malaviscus, zinnia, sage-bush, osier-willow. One was seen at the flowers of gourd, and several times at flowers of *Lobelia cardinalis*, where they usually acted as the one spoken of in American Naturalist, 1879, p.431. Flowers of *Erythrina herbacea* were often visited, and they appear to be adapted for fertilisation by them like the Palosabre in Belt. According to Gould, to number all the flowers visited by them would be equivalent to repeating the names of half the plants of North America. The same author also gives an account(**11**) of the fertilisation of *Salvia splendens*. One of the flowers visited had the stigma closed. The lever of the connective was nearly an inch long.

In "The Fauna Hawaiiensis"(**10**), Perkins gives a long account of the pollination of endemic flowers by native birds belonging to the Families *Drepanididæ* and *Meliphagidæ*. The former contains thirty-five species in seventeen genera, and the latter five species in two very distinct genera. The birds of the first family vary from entirely honey-eating to entirely insect-eating, and the *Meliphagidæ* appear to be entirely honey-eating. All the *Drepanididæ* have the tubular tongue, which shows descent from a common ancestor; and the author considers that that ancestor was a honey-eater, but that, as insects became more common, the characters of some of the birds gradually altered. He states that nectar is absolutely necessary to the existence of five of the genera, and that these can be kept alive on nectar and sugar-cane juice. The nectar-feeding birds are characterised by a slender beak, as well as the tubular tongue. "All, or practically all, the plants visited by these birds for food had bell-shaped or tubular blossoms, in which nectar was more or less hard to reach. Of these tubular-flowered plants, there are several predominant genera, some of which are themselves restricted to the islands, and belong to various families, comprising hosts of peculiar species. Most striking of all are the arborescent Lobeliaceæ, not closely related to forms found in other countries. The multiplicity of these plants, and their isolation from foreign forms bears a striking resemblance to that of the Drepanid birds themselves, indicating likewise an extremely ancient occupation of the island." This seems to me to show that the flowers (Lobeliacea) and the birds developed in dependence upon each other, and the author holds the same view, for he says:—"How easily the extraordinary lengthening of the bill . . . . . may have taken place, side by side with the increasing length of the tubular flowers, is apparent from the fact that, even now, in some of the birds, there is individual variation in this respect. . . . A series of observations made on one of the most superb of the Lobelias showed that it could only be fertilised by these highly specialised birds." It is much to be regretted that Mr. Perkins does not give full particulars of these observations. Just as in many other cases, we have no information beyond the fact that the birds visit the flowers.

A note of interest is to be found in the method employed by the hunters in the old days for taking *Drepanis pacifica*—the Mamo—the bird from which the yellow feathers used in the ancient feather-work was procured. The hunter covered himself with the branches and leaves of a tubular-flowered plant, and held, between finger and thumb, one of the flowers. When the bird inserted its bill, he closed his finger and thumb together, and thus captured it. The birds and flowers of Hawaii offer a unique opportunity to a field-naturalist to enrich our knowledge of bird-pollination.

Scott Elliott has published two papers on bird-pollination in South Africa(**12**). He mentions *Protea incompta*, *P. mellifera*, *P. lepidocarpa*, *P. longifolia*, *P. grandiflora*, *P. cordata*, *P. scolymus*, *Leucospermum conocarpus*, and *L. nutans* as being fertilised by the birds *Promerops cafer* and *Nectarinia chalybea*.

Bertha Stoneman, in her bright little book on South African plants and their ways, mentions the pollination of Gladiolus and Loranthus by the Nectariniæ. But no details as to method are given.

A good deal of observational work has been done in New Zealand on pollination by birds. Darwin(**14**) quotes Potts(Trans. N.Z. Inst.) as follows: "In New Zealand, many specimens of the *Anthornis melanura* had their heads coloured with pollen from the flowers of an endemic species of Fuchsia." Wallace gives a list of Australian and New Zealand flowers pollinated by birds(**15**), and says, "The great extent to which insect and bird agency is necessary to flowers is well shown by the case of New Zealand. The entire country is comparatively poor in species of insects, especially in bees and butterflies, which are the chief flower-fertilisers; yet, according to the researches of local botanists, no less than one-fourth of all the flowering plants are incapable of self-fertilisation, and, therefore, wholly dependent on insect and bird agency for the continuance of the species."

Thomson(16) gives a good account of the pollination of the Glory-pea (*Clianthus puniceus*). The birds concerned are the Tui, and the Korimako. The calyx of the flower contains a large drop of honey. Birds, in inserting their beaks, push back the carina, and this retains its hold of the style for a considerable time, till the pressure becomes too great, when the latter is jerked forward by its own elasticity, and throws out the accumulated pollen on the intruder's head. Of *Fuchsia excorticata*, *F. Colensoi*, and *F. procumbens*, he says that each species is dimorphic. The larger forms are green and purple, with exserted anthers. Both forms are scentless, but contain much honey. They appear to be fertilised by Tuis and honey-birds. The flowers are pendulous, affording no resting-place for insects, and have so large a quantity of honey that any insects, except long-tongued forms, would be drowned. Kirk(17) says *F. excorticata* and another species which he does not name, are *trimorphic*, and that, in the latter species under cultivation, the mid- and short-styled forms are certainly self-fertilised. But in *F. excorticata*, "the entire work of fertilisation is effected by two forms only; the long-styled can exercise no influence on the fertilisation of other flowers; it is a female flower, and, therefore, must receive pollen from the mid- or short-styled form, or from both. It is, therefore, remarkable, that long-styled flowers produce fruit in greater profusion than the mid- or short-styled. In the absence of experiments, it would be rash to assert that the short- and mid-styled forms are incapable of fertilisation, but there can be no doubt that the application of pollen of either form to the stigma of the other would result in the formation of large numbers of seeds. . . . . . The short-styled form may occasionally be self-fertilised, as detached pollen falling from its stamens may come in contact with the sides of its stigma. Birds are the usual agents for the transfer of pollen from one plant to another. It is interesting to watch them poising on the wing and dexterously inserting their beaks into the slender tube of the flower." Thomson also enumerates, as bird-pollinated, the following—*Sophora tetraptera*, chiefly visited by honey-birds (another visitor will be mentioned later); *Metrosideros lucida*, probably fertilised by Tuis and honey-birds, which, in great numbers, frequent them; *M. hypericifolia*, sometimes visited by birds; *Loranthus colensoi*, scarlet flowers, no scent or honey, but this is probably developed at some period of growth, and it then attracts Tuis and honey-birds; *Phormium tenax* is chiefly fertilised by birds. Insects may visit the flowers, but they depend upon Tuis and honey-birds. Kakas and parakeets also aid sometimes.

Petrie(**18**) gives an account of the pollination of *Vitex lucens*. "There is no doubt pollination is effected exclusively by small birds. These constantly visit the flowers, hanging on the rigid leaf-stalk or flower-stalks, and insert their bills into the corolla-tube to suck the nectar. In sucking the sweet juice, the Tui may be seen grasping the flower in one foot and turning it round into a more convenient position. In passing from flower to flower, the birds cannot avoid bringing pollen from young flowers to older ones." In an earlier volume(**18**), he refers to the pollination of *Rhabdothamnus Solandri* as being effected by birds, and notes that the flowers are orange striped with red.

Kirk(**17**) quotes a description of Colenso's of the pollination of *Sophora tetraptera* by the New Zealand parrot (*Nestor meridionalis*) as follows:—"Close to the village, and even within its fence, were several large Kowhai trees; these were covered with their golden flowers, and mostly without leaves. . . . . . The parrots flocked screaming to the Sophora blossoms. It was a strange sight to see them; how deftly they managed to go out to the end of a long, lithe branch, preferring to walk parrot-fashion, and there swing backwards and forwards, lick out the honey with their big tongues *without injuring the young fruit*. . . . I found that all the fully expanded flowers had had the upper parts of calyces and the uppermost petal (vexillum) torn out; this the parrots had done to get at the honey. As the flowers are produced in large, thick bunches, some are necessarily twisted or turned upside down; still it is always that peculiar petal and that part of the calyx (though often in such cases underneath) which have been torn away. Through this, no injury was done to the young enclosed fruit, which would, in all probability, have been the case if any of the other petals had been bitten off."

Laing and Blackwell(19) refer to a number of plants already mentioned, and add *Knightia excelsa* as much visited by Tuis and bellbirds.

North's "Catalogue of the Nests and Eggs of Australian and Tasmanian Birds" gives a total of 67 species of honey-eaters and brush-tongued lories, but the author informs me that five species have been added to the honey-eaters since that section of his catalogue was completed. Add to these the Black Cockatoo, already referred to as visiting Banksia-heads, and we have 74 species, in 26 genera (though Matthews puts the Honey-eaters in 42 genera), all flower-frequenting in their habits. Both the Honey-eaters and the Lorikeets have their tongues markedly adapted to their nectar-feeding habits.

Von Mueller's "Second Census of Australian Plants" contains 8,581 species of flowering plants—a number which is now somewhat too small; but the records of new species are so scattered, that I have not attempted to arrive at the correct total. I have gone through the Census, and find that there are, at least, 649 species adapted to bird-pollination. This is no doubt under the real number; many of the plants are unknown to me; and I have also omitted the Styphelias, most of which are ornithophilous, because von Mueller has lumped several genera, such as Leucopogon, not ornithophilous, in that genus. But even so, this shows that about 7·4% of our flowering plants are ornithophilous. Of the 649 species mentioned, 385, or a good deal more than half, are Proteads, which are peculiarly adapted for bird-visitors.

Taking a smaller area, I am tolerably familiar with the plants and birds of the Mudgee district. In that district, there are 401 flowering plants, and of these 53 are ornithophilous, 14 being Proteads. Thus 13·2% of the flowering plants are adapted to birds. There are 194 species of birds, of which 23 are honey-feeders (13·3%), a rather curious coincidence. It can be seen, then, that the birds and flowers which are dependent on each other form a large percentage of the avifauna and the flora.

We hardly expect to find references to bird-pollination in Gould's "Birds of Australia." But we do find numerous allusions to the nectar-feeding habits of the honey-eaters; and he also repeatedly states that they eat pollen, giving instances of pollen being found in their stomachs.

The earliest reference, which I can find, to the pollination of Australian flowers by birds, is in an article on Eucalyptus by Dr. Woolls(**1**). Speaking of hybridisation in *E. tereticornis*, he says, "With regard to hybridisation in this genus, the flowers of which are probably fertilised before the operculum is cast off, Dr. Mueller does not think that it is impossible, but that all ordinary chances are against it. 'Still,' he continues, 'as Mr. W. S. Macleay remarked, parrots and other birds occasionally bite off the flower-buds, and may accidentally uncover a stigma, and remove the anthers; and, again, insects may then finish off their work, and carry pollen across from another species."

A correspondent, Mr. S. T. Turner, in a letter, mentions that, at the time of writing, parrots were very busy biting off the opercula of Eucalypt-buds.

I do not think that there is any foundation for the opinion that Eucalypt-flowers are fertilised in the bud. They are conspicuous flowers when open, scented, and contain a large amount of nectar, all of which would point to pollination by insects or birds.

I have not been able to trace any further allusion to bird-pollination in Australia until 1895, when a couple of short notes by myself were read at a Meeting of the Australasian Association for the Advancement of Science(**20**). These recorded the visits of Acanthorhynchus, and a species of Ptilotis to *Erythrina indica*, and of Acanthorhynchus to Telopea. In neither was the process described, but it was in a later paper(**21**). In Erythrina, the flowers are curved towards the left, and the bird sits on the right-hand-side, and inserts its beak into the other side. The pressure forces the stamens and style out, so that they brush on the side of the bird's neck, leaving a deposit of pollen. Should the bird then visit a flower in which the stigma is receptive, some pollen would undoubtedly reach it. I captured a bird while feeding, and found a considerable smear of pollen on the neck. As a rule, birds feeding on nectar allow a much closer approach, and it seems also as if they lost some of their fear of man; for when I held a blossom to the bird in my hand, it inserted its bill, and fed on the nectar. I have seen a note on honey-eating birds stating that they may become intoxicated with the honey, and even drop to the ground at times, but, unfortunately, I omitted to record the reference. There is no doubt, however, that some flowers produce nectar which is more or less intoxicating. That of *Banksia ericifolia* is so, and is apt to produce, a severe headache in some people. Although the birds were most assiduous in their attentions to the trees I had under observation, no fruits were produced. I carefully pollinated a large number of flowers, and found that the fruit developed till it was four inches in length, and as thick as a knitting needle, but at this stage it invariably dropped off. Hermann Müller(2) says that Darwin states, on the authority of MacArthur's Observations that, in New South Wales, Erythrina does not produce good fruit unless the flowers are shaken. But the late Mr. G. H. Cox told me that it bore seed freely at Mulgoa. And I have been told that it seeds plentifully on the Northern Rivers and in Queensland.

The Note on Telopea states: "The flowers produce very large quantities of nectar at certain stages, so that if a head is shaken, a shower of drops is thrown off. They are much visited by Acanthorhynchus and other honey-eating birds, yet they rarely produce fruits; but when a plant does, it usually develops a large number. In one instance, I observed a head which was much damaged by some larvæ, and this head afterwards developed several capsules." Later I was able to watch one of these birds at a head, which was in the nectar-bearing stage. I could not get close enough to see just where the pollen was deposited on the bird, but I marked the plant, and afterwards found eleven capsules on it.

Holtze(22) gives the following account of the pollination of *Grevillea chrysodendron*:—"The showy flowers of this species are closely packed into the form of a brush, and abound in nectar. Before maturity, the long pistil is curved, so that the stigmatic point is inserted between the anthers at its foot. At maturity, the pistil becomes erect, bearing on its head the pollen deposited there by the anthers. The tree is visited by a small bird for the nectar in the flowers, and the pollen is taken from tree to tree on its breast and head, which come into contact with the stigma in probing for the nectar. Cross-fertilisation, therefore, is facilitated, and the existence of the provision for the pollen being deposited naturally on each stigma would lead one to expect that, in the ancestral form, this was to insure fertilisation should the flower not receive pollen from elsewhere. However, in the species under notice, the flowers appear to be incapable of fertilisation with their own pollen." The writer makes the common mistake of supposing that the whole of the disc on the end of the style is stigmatic, but this is not so. The stigma is a minute, nipple-like point in the centre, and in no species of Protead have I ever seen pollen on this.

Dr. Shirley, in the same volume(23), has a paper on "Peculiarities of the Flowers of the Order Proteaceæ," in which he says, speaking of Grevillea: "The lowest have styles with a true stigmatic surface. The central ones have immature styles coated with pollen. The apical ones are still hooked in the perianths, and, where the style-end is adherent to the petals, are clothed round the line of attachment with a copious supply of honey. Parrots and honey-eaters frequent the plants at this and earlier stages, clinging below the flowers, and reaching to the apex of the inflorescence where most honey lies. In doing so, they brush the pollen from the central flowers on their feathers, and, visiting the next branch, attach the grains to the lower stigmas of the next inflorescence, thus fertilising them." He also notes the small proportion of fruits that are sometimes found: "That this apparatus often fails is seen in the few perfect fruits on Hakea and Macadamia bushes which have borne masses of blossoms, and by there being seldom a dozen fruits on a Banksia-cone, which carried a thousand perfect flowers."

With the assistance of some students, I investigated a bush of

Banksia ericifolia. We found that the average number of flowers on a head was 900. Then, taking all the heads more than one year old, we found that only 0·01 per cent. of the flowers had developed fruits. Usually one finds a large number of old cones without a single fruit, and then one with from twelve, up to twenty. In one instance, we found forty fruits on a single head. I attribute this to the fact that, when the birds find a head with plenty of nectar, they work over it again and again. In West Australia, I noticed that the Banksias about Perth bore comparatively few fruits, while those round about Albany fruited very freely. This arises, I think, from the fact that the honey-eaters are much more plentiful at the latter place, and perhaps also from the presence of Tarsipes, which is still found in that neighbourhood.

Mr. Musson and Mr. Carne have been good enough to supply me with some interesting observations on bird-pollination, but, unfortunately, I have mislaid their very accurate series of notes on the pollination of *Grevillea robusta*, illustrated with photographs. The notes showed that the flowers, at different stages, took up different positions, and that these changes were related to the habits of the birds in visiting the blossoms. I hope Messrs. Musson and Carne have copies of these notes, as they certainly should be published, and would form a notable addition to our knowledge of bird-pollination in Australia. In one of Mr. Musson's notes, he says the Silver-eyes come to the underside of the horizontal spike of flowers by swinging the body round to get at the nectar. He also mentions the bees, and a moth, apparently a species of Agrostis, frequenting the flowers. Another interesting observation was made at Lindfield. An Acacia, probably *A. suaveolens*, was infested with numbers of the Berry-scale (*Lecanium baccatum*), and these excreted large drops of honeydew. Two individuals of the tufted honey-eater, *Ptilotis auricomis*, were seen feeding on the drops of sweet fluid. None of the scales were damaged; the birds were undoubtedly after the honeydew. This is an interesting observation, as it shows that the Meliphagidæ will go to any sweet fluid they detect. It is tolerably certain, therefore, that they will visit nectar-bearing flowers which they cannot pollinate.

While on the subject of the Proteads, I may mention that, as long ago as 1882, Trelease(**24**) made out, from the examination of plants growing in the Botanic Garden in Cambridge, Mass., the structure and mode of pollination of *Hakea nodosa*, and of *Grevillea Thelemanniana*. He notes that both flowers are incapable of self-pollination, and that the Hakea is probably pollinated by birds or insects, and the Grevillea by birds. He also refers to Kerner's guess as to Dryandra being pollinated by kangaroos.

Mr. O. Sargent has published a paper, "Biological Notes on *Acacia celastrifolia*(**25**). This plant (which Bentham considers a variety of *A. myrtifolia*), when the racemes open, secretes from the gland on the phyllode at the base of the raceme, a drop of nectar, and continues to do so all through the time of flowering. The Silver-eyes feed upon this. "Careful examination of a flowering-branch shows it to be well adapted for bird-pollination. No hindrance is offered to the bird, as the saucer of nectar stands open beside the inflorescence; yet in sipping the sweet fluid the bird is sure to brush against the fluffy blossoms, and have its feathers dusted with pollen. The next flower brushed against will receive some of this pollen on its stigmas."

Mr. Sargent has also been good enough to send me a copy of his MS. of a paper entitled, "Fragments of Westralian Plant-Biology," which has been accepted for publication by a Botanical Journal. The first part of this paper is concerned with ornithophylly. He thinks it probable that the flowers suited for birds have been evolved from entomophilous flowers. The Honey-eaters are aggressive feeders; if the nectar is not easy to get at, they rip the flower open. In that way, the flowers which were best suited to birds may have persisted, and developed, while the others retrograded. He sets forth certain types of flowers as being suited for bird-pollination, beginning with simple open flowers like those of Nuytsia; the flowers are open, and grow in masses; and birds feeding on them, as they do, cannot fail to pollinate the stigmas. Anothor flower of this type is *Xanthorrhœa Preissii*, and he has frequently seen small birds drinking the nectar. My son has seen the New Holland Honey-eater feeding on *X. hastilis*, following the spiral of flowers round the spike. But as Mr. Sargent remarks, many insects also visit these. Indeed they are of a type visited by all sorts of insects.

The next type is *Loranthus linophyllus*, a tubular flower. It is visited by *Zosterops Gouldi*. Next comes Acacia, already referred to, and then Eucalyptus. Mr. Sargent estimates that *E. macrocarpa* has 1,400 stamens, and these form a band, one inch wide, and 5½ inches in circumference. The stigma is less than 1 mm. in diameter, so that the pollen-bearing surface was 3,000 times the area of the pollen-receiving surface. In the case of this species, he has not seen birds pollinating it, but has observed *E. redunca* and *E. calophylla* being visited by *Zosterops Gouldi*, and species of Glyciphila. From my knowledge of Eucalypt flower-structure, I should be more inclined to look upon the brush-tongued lories as, to use Mr. Sargent's phrase, the "official" pollinators.

In *Beaufortia sparsa*, he sees another type, more specialised for birds; and he has observed that the anthers rub against cheeks, foreheads, and throats. This type reaches further specialisation in *Calothamnus sanguineus*. In this, the anthers are arranged in bundles, so placed that they press against the heads of the birds (Glyciphila and Zosterops) visiting it. Other flowers mentioned as ornithophilous are *Astroloma divaricata* and *Blancoa canescens*. *Anigozanthos humilis* and *A. Manglesii*, he has not personally seen visited by birds, but his brothers have seen them at the former, and some friends have seen small birds at the latter. I may say that I have repeatedly seen Acanthorhynchus feeding on *A. Manglesii* in the King's Park in Perth, and I noted their black heads covered with yellow pollen.

Mr. Sargent names three of the Papilionaceæ as ornithophilous —*Templetonia retusa*, *Crotalaria Cunninghamii*, and *Clianthus Dampieri*.

His last type embraces the Proteaceæ, and he mentions *Adenanthos cuneata*, *Banksia attenuata*, *B. Menziesii*, *Dryandra floribunda*, and *D. carduacea*.

Miss Brewster lately read a paper(26) before this Society on bird-pollination in *Darwinia fascicularis*. The paper is now available to Members, so I need not quote from it. Miss Brewster has done an excellent piece of work, and left little, if anything, for others to glean, except to extend her observations to the other species of the genus.

A little book by Mr. C. Mudd(**27**) contains a good deal about pollination, some of it very extraordinary, too extraordinary to be taken seriously—as for example the pollination of Dryandra by kangaroos, said to have been observed on the Blue Mountains; and of an orchid by frogs.

In a paper by E. W. Berry(**28**), on "The Affinities and Distribution of the Lower Eocene Flora of South-Eastern North America, he gives a list of plants, among which are six Proteads in four genera – Palæodendron, Proteoides, Knightophyllum, and Banksia. He also mentions Banksia and Dryandra as being found in abundance in the European Tertiary, and that the family enjoyed a more or less cosmopolitan range in the Early Tertiary. The ancestors of the family, he thinks, probably entered the Australian Region during the Upper Cretaceous, before the country had become entirely separated from Asia, becoming adapted to the peculiar soils and climate of Australia: while the stock in the Northern Hemisphere appears to have been unable to stand the climatic changes, and thus became extinct. Von Ettingshausen, in his Memoir, republished by the Department of Mines, Sydney(**29**), described a number of Proteads from the Tertiary of Australia. Incidentally, I would like to place upon record my feeling that it is unsafe to identify plants from mere impressions of their leaves. The more plants I know, the more I find that leaves very similar occur in plants belonging to widely separated families, while, on the other hand, plants belonging to the same family, or even the same genus, may have leaves so utterly dissimilar, that I should hesitate, without having seen flowers or fruits, to think they were allied. The differing types of leaf in Banksia and Hakea are examples of this. But Mr. Deane expressed similar opinions from this Chair long ago, in much more convincing terms.

The point I wished to draw attention to is this: that the majority of recent Proteads are bird-pollinated, and specially adapted to that. Now were these old Proteads (and notwithstanding what I have said above, I believe that there were archaic Proteads) bird-pollinated, and if so, what were the birds concerned? If an inflorescence of a fossil Banksia is known, it might be easy to say whether it was likely to have been so pollinated. And, in that case, I should like to ask the palæontologists whether there are any Tertiary birds known, which would be likely to have been the ancestors of any of the three great groups of pollinators—Humming-birds, Sun-birds, and the Honey-eaters of Australia?

I have said enough to show that the bird-pollination of Australian flowers is a large and interesting problem awaiting solution in detail. Some of the questions that need answering are the following. Are the colours of the flowers adapted to attract birds? It is generally taken for granted that bird-pollinated flowers are of brilliant colours, mostly reds. But closer acquaintance with the habits of the birds leads one to think that the brilliant colours may not be necessary to attract them. Our honey-eaters seem to visit any flower that offers them a plentitude of honey. Again, are the tubular flowers specially adapted to birds with long bills like the Meliphagidæ? Here, I think the answer will incline towards the affirmative, but nevertheless the fact that they go to shallow flowers, like Eucalyptus and Xanthorrhœa, seems to point to the same conclusion—that the shapes of flowers do not matter greatly, if there is abundance of nectar. Are there any other factors that are significant—scent, for example? These questions can only be finally settled by long-continued observation of the birds and the flowers they frequent.

The next point (or perhaps it should be the first) to be settled is the actual method of pollination. Knuth(8) says:—"It must be the aim of research in pollination to make out the adaptation of all flowers and their pollinators, and this can only be approached if such investigations are systematically carried out, and in as many small and clearly demarcated areas as possible." Now the points regarding adaptation which have to be observed are many. The shape and colour of the corolla, the presence and amount of nectar, the scent, the length and position of the stamens and style, at various stages of anthesis, the time of maturation of anthers and stigma, and the relation of these stages to the changes of position in those organs. And, in the case of the birds, the presence of grooves on the beak as pollen-receptacles, the presence of modified feathers for the purpose of retaining pollen-grains, the position the bird takes on approaching the flower, and on what part of the body it receives and carries pollen; all these points must be made out before it can be said that we know how a flower is pollinated by birds.

To succeed in such an inquiry, the observer must have unlimited time and patience. He may have to sit motionless for a long period near the plant being investigated, till the birds gain confidence and approach the flowers; he must have keen sight and a good pair of field-glasses. He needs to camp out in a selected spot, and to be abroad at dawn, when the birds are beginning to feed; and, in addition, since the most precise information is necessary with regard to the bird's size, shape of head and beak, and their relation to the parts of the flower, and can only be seen in the bird in the hand, which is proverbially worth two in the bush, he must, repugnant as it may be to a bird-lover, be prepared to sacrifice the lives of some of the pollinators to settle these questions accurately. It is a big piece of work, but it is worth the trouble; and a few earnest investigators with sufficient time at their disposal would soon produce results which would be of far greater value than the vague statements to be found in most of the papers on bird-pollination. It is not that the interest and importance of the subject are unrecognised, but that favourable conditions for carrying out the necessary investigations have been wanting.

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Mr. J. H. Campbell, Hon. Treasurer, presented the balance sheet for the year 1915, 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 1914, £531 13s. 4d.; income, £1,164 8s. 8d.; expenditure, £912 8s. 10d.; transfer to Bookbinding account, £5 5s. 0d.; balance to 1916, £778 8s. 2d. Bacteriology Account, Income, £527 17s. 6d.; expenditure, £535 7s. 2d.; debit balance to 1916, £25 19s. 9d. Linnean Macleay Fellowships Account, Income, £2,027 15s. 3d.; expenditure, £1,598 17s. 0d. (including £97 2s. 0d. for publication of Fellows' contributions to the Proceedings); transfer to Capital account, £428 18s. 3d.

No valid nominations of other Candidates having been received, the President declared the following elections for the Current Session to be duly made:—President: Mr. A. G. Hamilton. Members of Council (to fill six vacancies):—Messrs. R. H. Cambage, F.L.S., J. H. Campbell, H. G. Chapman, M.D., B.Sc., J. B. Cleland, M.D., T. Storie Dixson, M.B., Ch.M., and A. F. Basset Hull. Auditor: Mr. F. H. Rayment, F.C.P.A.

On the motion of Dr. S. J. Johnston, a very cordial vote of thanks to the President, was carried by acclamation.

The Linnean Society of New South Wales.

GENERAL ACCOUNT.

Balance Sheet at 31st December, 1915.

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.	76	13	0
Income A/c, at 31st December, 1915 ..	778	8	2
	£20,555	1	2

Assets.	£	s	d
Society's Freehold	1.600	0	0
Investments:			
War Loan	500	0	0
N.S.W. Treasury Bills	4,000	0	0
Loans on Mortgage	13,600	0	0
	19,700	0	0
Cash:			
Commercial Banking Co. of Sydney, Ltd...	334	19	5
Government Savings Bank of N.S.W.	520	1	9
	£20,555	1	2

Examined and found correct. Securities produced.

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

J. H. CAMPBELL, Hon. Treasurer.

Sydney, 18th February, 1916.

INCOME ACCOUNT, year ended 31st December, 1915.

Dr.

	£	s	d	£	s	d
To Salaries and Wages..				465	0	0
,, Printing (Publications) ..	271	15	6			
,, Illustrations	78	6	5			
				350	1	11
,, Rates..	23	9	5			
,, Insurance	7	17	9			
				31	7	2
,, Postages, Telegrams, Advertising and Petties ..	31	10	0			
,, Printing (sundries), Stationery, etc.	7	3	0			
,, Maintenance Fee, Sir Wm. Macleay's Grave..	1	10	0			
,, Audit Fee (proportion of) ..	1	15	0			
,, Legal Costs	16	7	6			
,, Telephone..	4	4	4			
,, Bank Charges	1	9	11			
,, Library..	2	0	0			
				65	19	9
,, Bookbinding A/c.				5	5	0
,, Balance to 1916				778	8	2
				£1,696	2	0

Cr.

	£	s	d	£	s	d
By Balance from 1914				531	13	4
,, Subscriptions—						
1915	121	16	0			
Arrears	14	16	0			
In advance..	3	3	0			
				139	15	0
,, Entrance Fees				5	5	0
,, Interest on Investments				901	9	9
,, Sales (including 100 copies of Proceedings purchased by the Govt. of N.S.W.)..				101	18	11
,, Rent (Bacteriology A/c.)				16	0	0
				£1,696	2	0

BACTERIOLOGY ACCOUNT.

Balance Sheet at 31st December, 1915.

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.	25	19	9
	£13,925	19	9

Assets.	£	s	d
Investments:			
New South Wales Inscribed Stock	13,900	0	0
Income A/c at 31st Dec., 1915	25	19	9
	£13,925	19	9

INCOME ACCOUNT, year ended 31st December, 1915.

Dr.

	£	s	d
To Balance from 1914	18	10	1
„ Salary and Wages	440	0	0
„ Rent	16	0	0
„ Rates	9	0	7
„ Insurance	1	6	0
„ Gas	8	9	1
„ Apparatus and Chemicals	1	7	0
„ Journals and Printing	50	19	6
„ Bank Guarantee Fee	0	10	0
„ Audit Fee (proportion of)	1	15	0
„ Petty Cash	6	0	0
	£553	17	3

Cr.

	£	s	d	£	s	d
By Interest on Investments				521	4	2
„ Tuition Fees	20	0	0			
„ Less Bacteriologist's proportion	13	6	8			
				6	13	4
„ Balance to 1916				25	19	9
				£553	17	3

Examined and found correct. Securities produced.

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

Sydney, 18th February, 1916.

J. H. Campbell, Hon. Treasurer.

LINNEAN MACLEAY FELLOWSHIPS' ACCOUNT.

Balance Sheet at 31st December, 1915.

Liabilities.	£	s	d	Assets.	£	s	d
Capital: Amount bequeathed by Sir William Macleay, £35,000, less Probate Duty, £1,750	33,250	0	0	Investments:			
Balance of Income A/c capitalised in terms of bequest or available for such purpose—				War Loan	2,500	0	0
To 31st Dec., 1914.. £9,081 5 4				N.S.W. Inscribed $3\frac{3}{4}\%$ Stock . ..	7,715	0	0
At 31st Dec., 1915.. 428 18 3				Loans on Mortgage	32,450	0	0
	9,510	3	7	Cash:			
	£42,760	3	7	Savings Bank of N.S.W.	195	16	7
Commercial Banking Co.	100	13	0				
	£42,860	16	7		£42,860	16	7

Dr. INCOME ACCOUNT, year ended 31st December, 1915. Cr.

	£	s	d		£	s	d
To Salaries of Linnean Macleay Fellows	1,500	0	0	By Interest on Investments	2,027	15	3
" Cost of publishing Fellows' Papers..	97	2	0				
" Audit Fee (proportion of)..	1	15	0				
" Amount transferred to Capital A/c..	428	18	3				
	£2,027	15	3		£2,027	15	3

Examined and found correct. Securities produced.

F. H. Rayment, F.C.P.A., Auditor. J. H. Campbell, Hon. Treasurer.

Sydney, 18th February, 1916.

ORDINARY MONTHLY MEETING.

March 29th, 1916.

Mr. A. G. Hamilton, President, in the Chair.

The Donations and Exchanges received since the previous Monthly Meeting (24th November, 1915), amounting to 28 Vols., 231 Parts or Nos., 40 Bulletins, 9 Reports, and 25 Pamphlets, received from 89 Societies, etc., and four private donors, were laid upon the table.

STUDIES IN AUSTRALIAN NEUROPTERA.

No. ii. Descriptions of new Genera and Species of the Families *Osmylidæ*, *Myrmeleontidæ*, and *Ascalaphidæ*.

By R. J. Tillyard, M.A., B.Sc., F.L.S., F.E.S., Linnean Macleay Fellow of the Society in Zoology.

(Plates i.-vi., and three Text-figs.)

The material on which this paper is based is mainly drawn from my own collection, but has been gathered together by the kindness and energy of many correspondents rather than by myself. These larger Neuroptera are not generally to be taken in any numbers, as are the Odonata; and the gathering together of the material necessary for their study must be spread over a large number of years and carried on by a number of collectors. Particularly must this be so when, as in the case of the *Myrmeleontidæ*, the majority of species are not to be found in the well-watered coastal regions, but are confined to the more arid regions of the interior. Thus it would seem that Broken Hill, N.S.W., with a rainfall of less than ten inches, is particularly rich in these insects, and the largest number of new species must be credited to the energy of Mr. O. B. Lower, F.E.S., my valued correspondent in this locality. Almost equally rich is the dry, sandy region of Western Australia, and even the coastal portion of that State possesses a large number of fine species. From Mr. W. B. Alexander, F.E.S., Keeper of Biology in the W.A. Museum, Perth, I have received, for study, a small collection of Neuroptera containing some fine species; the types of the new species of this collection are in the West Australian Museum, and the descriptions are included in this paper. Other small collections of *Neuroptera* have been sent to me by Mr. G. F. Berthoud, of Waroona, W.A., Mr. G. A. Waterhouse, B.E., B.Sc., F.E.S., of Sydney, Mr. E. Allen, of Emerald, Q., Dr. A. J. Turner, F.E.S., of Sherwood, Brisbane, Q., and Mr. Rowland E. Turner, of London,(from Yallingup, W.A.). To all of these, I offer my sincere thanks for the valuable specimens received, without which my collection would still be a very poor one indeed.

In this paper, eighteen species are proposed as new. One of these belongs to the family *Osmylidæ*, one to the *Ascalaphidæ*, and the remaining seventeen to the *Myrmeleontidæ*. This latter family offers considerable difficulty to the Australian systematist, chiefly because of the paucity of literature, the inaccessibility of the types of the species already described (mostly by Walker, Gerstaecker, and Banks), and also partly because of the close resemblance between many of the forms. I desire, therefore, to express my thanks to my friend, Mr. Esben Petersen, of Silkeborg, Denmark, for giving me his valuable opinion on a number of the forms described in this paper, and also for his excellent generic table, recently published in these Proceedings (1915, Vol. xl., Part I, pp.56-57), which I found of the greatest help, particularly in assigning positions to a number of new genera.

Four genera are proposed as new. No attempt has been made to break up the complex genera *Glenoleon*, *Formicaleon*, or *Acanthaclisis*, though *Alloformicaleon* Esb.-Pet., has been accepted as a valid genus. A new division of the subfamily *Dendroleontinæ* into three tribes has been proposed, based on venational and phylogenetic considerations.

The following is a list of the genera and species dealt with in this paper:—

Family OSMYLIDÆ.

EUPORISMUS, n.g. (Type, *E. albatrox*, n.sp.)

1. *Euporismus albatrox*, n.sp.

Family MYRMELEONTIDÆ.

Subfamily DENDROLEONTINÆ.

Tribe **Protoplectrini**, trib.nov.

2. *Protoplectron longitudinale*, n.sp.
3. *Protoplectron eremiæ*, n.sp.

Tribe **Dendroleontini**, trib.nov.

4. *Periclystus aureolatus*, n.sp.
5. *Dendroleon lambda*, n.sp.
6. *Dendroleon dumigani*, n.sp.
7. *Glenoleon bertnoudi*, n.sp.
8. *Glenoleon aurora*, n.sp.
9. *Glenoleon roseipennis*, n.sp.

Tribe **Distoleontini**, trib.nov.

10. *Gymnocnemia maculata*, n.sp.

BRACHYLEON, n.g. [Type, *B. darwini* (Banks)].

11. *Brachyleon darwini* (Banks).

STENOLEON, n.g. (Type, *S. fieldi*, n.sp.).

12. *Stenoleon fieldi*, n.sp.

XANTHOLEON, n.g. (Type, *X. helmsi*, n.sp.).

13. *Xantholeon helmsi*, n.sp.
14. *Alloformicaleon hyalinus*, n.sp.
15. *Alloformicaleon waterhousei*, n.sp.
16. *Distoleon nigrosignatus*, n.sp.

Subfamily MYRMELEONTINÆ.

17. *Myrmeleon loweri*, n.sp.
18. *Acanthaclisis peterseni*, n.sp.

Family ASCALAPHIDÆ.

Subfamily PROTASCALAPHINÆ.

19. *Stilbopteryx dromedaria*, n.sp.

Family OSMYLIDÆ.

EUPORISMUS, n.g.

Allied to *Porismus*, from which it differs as follows: wings longer, narrower in proportion, with the tips not broadly rounded but somewhat pointed, slightly falcate. Colour-pattern black and white. Rs close to and parallel with R (in *Porismus*, Rs diverges from R for about two-fifths of the wing-length, and then converges towards it apically). Branches of Rs very numerous, closely arranged, almost straight, and nearly parallel (in *Porismus* they are fewer, wider apart, and less regular). Towards apex of wing, a set of cross-veins forms a distinct, curved line running across the wing from M to pterostigma, separating off an internal "disc" from a distinct apical portion, which carries only closely parallel, longitudinal veins (cf. *Psychopsis*); in *Porismus*, this line is absent. Four anal veins present, as in *Porismus*, but 2A and 3A stand further from the posterior border, and the cross-veins arising from them are longer and more numerous than in *Porismus*.

Genotype, *Euporismus albatrox*, n sp.

This genus may be placed as intermediate between *Porismus* and *Oedosmylus*; for, while it resembles the former in the strong branching of Cu, and in the dense wing-pigmentation, it approaches the latter in the shape of the wings, and in the possession of the apical line of cross-veins.

It is interesting to note that a fossil insect-wing, closely resembling the hind-wing of *E. albatrox*, has recently been discovered in sandstone-rock at Goodna, near Ipswich, Q This rock is supposed to have come from a Tertiary deposit (?Eocene) overlying the Trias-Jura rocks of the Ipswich Coal-Measures.

1. EUPORISMUS ALBATROX, n.sp. (Pl i., fig.1).

Total length 16·5, abdomen 9·5, forewing 30, hindwing 28mm.

Head very small, 2·5 mm. wide; *eyes* dark olive-brown; the three *ocelli* large, black, the median one very distinctly double; *epicranium* black, *antennæ* 11 mm., slender, black, basal joint twice as long and thick as the second; *labrum* and *mouth-parts* shiny brown.

Thorax: *prothorax* 1·7 mm., elongate, slender, orange-brown. *Pterothorax* orange brown, marked with black in the sutures, especially along the middle line; wing-bases blackish. Legs black, fore- and middle-legs short, hind-legs long.

Abdomen short, of medium width, dark grey above, marked with numerous, orange-brown spots; underside orange-brown, especially at apex.

Wings: *venation* very close and abundant. Costal border of forewing strongly arched near base; costal space wide near base, gradually tapering towards pterostigma. All four wings strongly curved towards tips, which end in a slight point; the posterior margin being very slightly hollowed out towards the tip, the wings have a slightly falcate appearance. *Colouration:* forewing richly mottled with black and white, the former colour due to pigment, the latter to a very close arrangement of numerous, parallel, white veins. Costal space irregularly blotched with black patches, separated by hyaline spaces crossed by white veins. In the pterostigmatic region, and extending nearly to tip of wing, is a large, subtriangular, white patch, the curved wing-border forming its base, while its apex is directed posteriad and forms an angle a little greater than a right-angle. On this patch, two small black spots interrupt the white wing-border. The rest of the wing is very irregularly and heavily marked with black. Hindwing nearly all hyaline in its basal half; then follows a large, irregular, black blotch right across the wing before the level of the pterostigma, but somewhat interrupted between M and Cu distally; beyond this, covering the pterostigma and all the apical part of the wing except the extreme tip, is a whitish patch, larger and more irregular than the corresponding patch in the forewing. [In the dead insect, the black wing-pigment fades gradually to a dark, semi-transparent brownish, as in *Porismus strigatus*].

Hab.—Head of Condamine River, near Killarney, Q. Very rare. Mr. E. J. Dumigan captured, in January, 1914, four specimens sitting on the large rocks of the river-bed.

Type in Coll. Tillyard. (E. J. Dumigan; January 8th, 1914). Of the remaining three, one has been placed in Mr. Esben Petersen's collection, another in that of Mr Nathan Banks, and the third remains in my collection.

Family MYRMELEONTIDÆ.

Subfamily DENDROLEONTINÆ.

This subfamily was formed by N. Banks to include all those genera in which there is only a single cross-vein in the radial space of the hindwing, before the origin of the radial sector. As this character is based essentially on the archaic position of Rs, viz., originating from R close to the wing-base, it seems to me an excellent character for the main subdivision of the family, and marks off the large complex of forms included in the *Dendroleontinæ* (to which the great majority of our Australian species belong) as definitely more archaic than the *Myrmeleontinæ*, in which the radial sector of the hindwing has progressed much further along R.

In subdividing the mass of forms in the *Dendroleontinæ*, it seems to me that too much stress has been laid on the presence or absence of tibial spines. In the dichotomous tables so far published by Banks and Petersen, this character is used for effecting the main dichotomy, and only later are venational characters brought into play. Now, I would urge an alteration of this procedure for two reasons: firstly, because it seems probable that some forms, at least, that lack spurs (if not all) did originally possess them,* and are really closely related to those forms (e.g., *Glenoleon*) which possess very short spurs, but which, on the present method of dichotomy, are driven right to the other end of the table; and secondly, because the wing-venation, particularly of the forewing, offers us more important and better understood characters, and a far better chance of making natural divisions. I would propose that, in no case, should the absence, or (if present) the size of the spurs be used for divisions greater than of generic value, since we cannot ignore the strong probability of convergent reductions of these organs in widely separated groups.

Turning, then, to the venation of the forewing, we can select, without hesitation, as a natural group, those peculiar genera in which Cu_2 runs parallel with $Cu_1 + M_2$ for a considerable distance. This is clearly an archaic character, carried over without change from *Nymphid*-ancestors. These genera form a distinct tribe, which I propose to name *Protoplectrini*. This tribe is represented

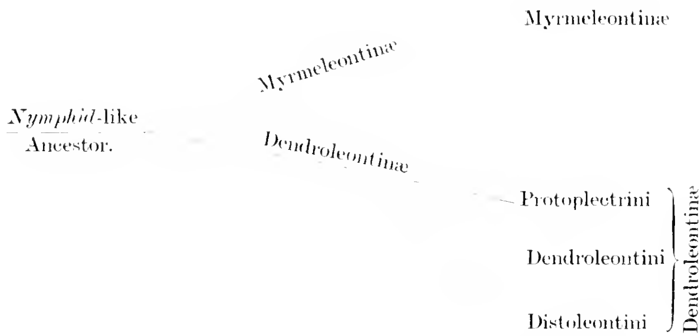
* The presence of these spurs almost universally in the Neuroptera, Trichoptera, Lepidoptera, and Mecoptera is a fact that cannot be ignored in our attempts at classification.

in Australia by the two genera, *Protoplectron* and *Pseudoformicaleon*, two genera which may be compared respectively with *Acanthaclisis* and *Myrmeleon* in the subfamily *Myrmeleontinæ*. The African genus *Creagis* would also appear to belong to this ancient group.

It appears that the position of the cubital fork has remained fixed, throughout the evolutionary development of the subfamily, at a point about one-fourth of the wing-length from the base. This is, therefore, a satisfactory *fixed level* from which we can observe the evolution of the radial sector in the forewing. This, as might be expected, has followed the same lines as in the hindwing, *i.e.*, gradual removal of its point of origin on R, from a point close to the base of the wing to a position further and further distad. Thus, just as the *Dendroleontinæ* are, as a whole, more archaic than the *Myrmeleontinæ*, on account of the position of the origin of Rs in the *hindwing*, so we may now select, from amongst the *Dendroleontinæ* themselves, those more archaic genera in which the same holds good for the *forewing*. This tribe, to which I give the name *Dendroleontini*, includes, then, all genera in which Cu_2 does not run parallel with $Cu_1 + M_2$, and having the origin of Rs in the forewing *before* the level of the cubital fork. This tribe contains a large number of genera, of which the Australian representatives are *Dendroleon*, *Glenoleon*, *Froggattisca* (an asthenic offshoot of *Glenoleon*), *Periclystus*, and *Chrysoleon*.

Finally, we may group together those genera in which the origin of Rs, in the forewing, has become shifted to a level either exactly above, or distad from, that of the cubital fork, as the tribe *Distoleontini*. The connecting-link with the *Dendroleontini* is not wanting, since the genus *Gymnocnemia* has the origin of Rs *exactly above* the cubital fork. But as, in other respects, this genus appears to belong rather to the *Distoleontini* than the *Dendroleontini*, it seems advisable to include it here rather than to separate it out as an intermediate tribe. The *Dendroleontini*, then, also contain a large number of genera, of which the Australian representatives are *Gymnocnemia*, *Brachyleon*, n.g., *Stenoleon*, n.g., *Xantholeon*, n.g., *Macronemurus*, *Formicaleon*, *Allo-*

formicaleon, and *Distoleon*. The phylogeny of these three tribes may be exhibited thus:—



In this diagram, I have not attempted to show the ramifications of the subfamily *Myrmeleontinæ*, whose headquarters lie quite outside Australia.

Tribe **Protoplectrini**.

In forewing, Cu runs parallel with $Cu_1 + M_2$ for some distance.

Genus Protoplectron Gerst.

2. Protoplectron longitudinale, n.sp. (Pl. ii., fig.5).

Total length 30, abdomen 23·5, forewing 41·5 × 10·5 wide, hindwing 39·5 × 9 mm. wide.

Head: *epicranium* blackish, with two, small, brown spots on occipital ridge near eyes; *eyes* black, touched with grey above; *antennæ* 9 mm., greyish-brown, ringed with black; *face* and *mouth-parts* pale, shiny orange-brown.

Thorax: *prothorax* short, 3·5 × 2·5 mm., downy, grey, with two, longitudinal, dorsal, blackish stripes. *Prothorax* grey, downy, with darker markings, a small but distinct, white spot close to base of each forewing; underside with soft, pale grey hairs. *Legs* rather short, stout: femora brown, with black stripes, and long, soft, grey hairs, also a few, stiffer, black hairs; tibiæ similarly marked, with several, large, stiff, black hairs; first joint of tarsi very long, 2nd-4th short, 5th long, all blackish, claws brown; tibial spines long, reaching to end of first tarsal joint.

Abdomen fairly stout, uniformly shiny dark grey, with pale grey, downy hairs.

Wings: neuration grey-brown, Sc speckled. In forewing, along R up to pterostigma is a series of very narrow, blackish markings encroaching slightly into subcostal space; pterostigma blackish, covering 7-8 veinlets, all but three of them forked distally. Along $Cu_1 + M_2$ runs a thick, somewhat sinuous, longitudinal, black band, continued distally across M_1 to tip of wing. Hindwing without markings, pterostigma weakly indicated by a brownish patch.

Hab.—Western Australia; also Broken Hill, N.S.W. (O. Lower).

Type in Coll. West Australian Museum. Label "H. 22," indicating that it was collected by Mr. G. H. Hardy, now of the Tasmanian Museum, Hobart. No date or locality-label.

The Broken Hill specimen was unfortunately badly damaged in the post: only a small piece of the thorax, and the two wings of the right side, hanging by a thread, remain.

This rare species superficially resembles the commoner *Distoleon nigrosignatus*, from which, however, it can be distinguished at sight by the fact that the longitudinal, black mark is single and continuous, whereas, in *D. nigrosignatus*, it is broken into two parts. The venations of the two species are, of course, quite distinct. It is somewhat remarkable that there should be, in a small collection of Western Australian forms, representatives of three genera (*Protoplectron*, *Distoleon*, *Glenoleon*) having this unique development of a longitudinal, black line in the forewing, while, in a fourth (*Dendroleon*), there is also a considerable development of black pigment.

3. PROTOPLECTRON EREMIÆ, n.sp. (Pl. ii., fig.4).

Total length 19, abdomen 13, forewing 24·5, hindwing 23mm.

Head: *epicranium* grey, with black markings behind and a touch of brown in front; *eyes* dark grey; *antennæ* 6mm., greyish; *face* orange-brown, *mouth-parts* blackish.

Thorax grey-brown with blackish markings; on prothorax, two, parallel, longitudinal, blackish bands. *Legs* greyish, very short and thick, hairy.

Abdomen grey-black, smooth above, sides with numerous, fine, grey hairs; a fine, transverse, brown line at apex of segments 4-8.

Wings rather narrow and pointed. Venation of forewing speckled black and white, likewise Sc in hindwing, rest of venation of that wing blackish. In forewing, the pterostigma has a strongly-marked, black, proximal patch; in hindwing, only a very slight touch of black along R. Hindwing hyaline, forewing much marked with small, blackish spots and patches, especially along R, $Cu_1 + M_2$ and the branch of Rs next but one above M_2; many cross-veins and dichotomous forkings also touched with black.

Hab.—Broken Hill, N.S.W. A single specimen taken by Mr. O. Lower; November 11th, 1902.

Type in Coll. Tillyard. Unique.

Closely allied to *Pr. venustum* Gerst., from which it can be at once distinguished by its shorter wings, shorter and stouter abdomen, and by the lack of the strikingly beautiful effect of the pattern of the forewing, from which Gerstaecker's species received its name. *Pr. eremica* is possibly a dwarfed, inland species geminate with *P. venustum*, which appears to be confined to the coastal strip and eastern river-valleys.

Tribe **Dendroleontini.**

In forewing, Cu_2 bends sharply away from $Cu_1 + M_2$. Rs arises at a level proximal to that of the cubital fork.

Genus Periclystus Gerst.

4. Periclystus aureolatus, n.sp. (Pl. ii., fig.3).

Total length about 19 (tip of abdomen bent under), forewing 26·5 by 7·5 wide, hindwing 24·5 × 5mm.

Head orange-brown, except for a black area between the eyes, isolating two orange spots, one at base of each antenna; *eyes* black, shining; *antennæ* short, 3 mm., brownish at base, shading to reddish at tips.

Thorax orange-brown above, with black marks in the suture, and touches of black near the wing-bases; underside shining black, with small, but conspicuous, orange-brown spots. *Legs:* fore and middle moderate, hind very long, black, spotted with orange as follows base and apex of femora, base of tibiæ and a small spot about 1 mm. distad from it; basal joint of tarsus orange, second brownish, third blackish, fourth brownish, fifth orange-brown, blackish distally, claws brownish; tibial spurs as long as first two tarsal joints.

Abdomen (somewhat shrivelled and bent) fairly slender, banded transversely with alternate orange and black, the black predominating distally, the orange being reduced to small spots; tip broadly truncate, orange, with short, black, hairy appendages.

Wings: posterior border of forewing twice angulated, once near middle of wing, very obtusely (*middle posterior angle*) and once more distally (*angle of the falcate border*); the part of the border between this angle and the apex (*falcate border*) is very slightly hollowed out, so that the wing is slightly falcate. In the hindwing, there is only one posterior angle, the border between it and the apex being irregularly waved.

Costa pale brownish, all other veins whitish. Forewing beautifully marked with numerous, irregular spots, some semi-transparent orange, some dark brown or black, and others dark brown with golden centres: base slightly saffroned for about 3 mm. These spots are arranged as follows—along Sc and R, *nine* spots, three, small, basal ones, then a larger, blackish, sub-rectangular one 6 mm. from base; 3 mm. further on, a similar but slightly smaller spot; 2 mm. further on, a slightly larger spot, dark brown with orange-gold centre; 2·5 mm. further on, a similar but narrower spot; a similar but more rounded spot surrounding the radial brace; between these two last, a small rectangular spot with golden centre. All these spots just touch Sc from below, but they lie, on the whole, well below R. Pterostigma marked by an opaque, whitish, oval area surrounding a small dark brown spot, also a somewhat concentric, blackish spot between this and the last of the row of radial spots. Between R and Rs near apex, there are two, small, dark, squarish spots, with orange-gold centres. Along $Cu_1 + M_2$, touching M_1 from below, are four, orange-gold spots touched posteriorly with brown, followed by a dark brown spot, above which, slightly proximad, lies a small, brown spot. In the cubital space, there are four, elongated, narrow, blackish spots. At the apex of the wing, is a large, irregular, transparent, orange blotch: a smaller blotch runs in from the wing-border between this and the pterostigma, and below it is a small, squarish, brown spot with a pale orange centre-point. From the apex towards the angle of the falcate border, lie four, transparent, orange blotches, with three, irregularly placed, brownish spots lying proximad to them. Along posterior margin of wing, a large, irregular, trapezoidal, orange blotch occupies the middle, posterior angle, and is touched above by black; half-way between this and the wing-base, is a smaller, oval spot of the same colour.

The hindwing shows very few markings, all distally placed, and of a uniform brown, except for three, minute spots along Sc + R. A large, reniform spot overlies R and Rs at level of the angle of the falcate border, which itself is filled with a larger and more irregular blotch. Pterostigma whitish, opaque, with two, small spots near it. A rounded spot at apex, and two, elongated marks on the falcate border complete the markings.

Hab.—Cunderdin, W.A. A unique specimen, apparently a male, but the abdomen is somewhat shrivelled.

Type in Coll. West Australian Museum, Perth. Museum label No.6972; no date.

This very beautiful insect is at once distinguished from the other two species of the genus by its small size, and by the beautiful and bizarre effect of its colouration, which suggests a stained-glass window in old gold. It appears to be more closely related to *P. laceratus* Gerst., than to the better known *P. circuiter* Walker, owing to a closer similarity in the scheme of wing-markings. From both these species, it differs in having the forewing much less falcate.

Genus DENDROLEON Brauer.

5. DENDROLEON LAMBDA, n.sp. (Pl. iii., fig.7).

Total length (abdomen broken off) about 20 mm., forewing 21, hindwing 19·5 mm.

Head small, *epicranium* grey-brown, with a pale line in front between the eyes; *eyes* black; *antennæ* 5 mm., brownish, ending in a large, black, subtriangular knob; *labrum* and *mouth-parts* rich brown.

Thorax greyish-brown. *Legs* with blackish femora, tibiæ brown tipped with black, tarsi brown; tibial spurs curved, reaching to middle of second tarsal joint.

Abdomen [broken off at 3rd segment] appears to have been dull grey with fulvous blotches.

Wings: venation dark brown. Forewings with beautiful black or dark brown markings as follows - an elongated basal patch along costal space, crossing Sc and R and reaching M_1 distally; across wing, obliquely near middle, there runs an irregular mark resembling the Greek λ (lambda), but with its apex somewhat blurred and swollen; on the pterostigmatic area is a large, elongated, triangular blotch, followed distally by a slender, longitudinal mark for about 2 mm.; from posterior border, below pterostigma, there runs obliquely upwards towards the tip, across the ends of M_2 and M_1, a dark band, bent in the middle, about 4 mm. long. Small spots and specks shade the bases of many of the cross-veins. Hindwings with irregular blotchings between Sc and R in basal half; about two-thirds of the way along the wing, an irregular patch covers both Sc and R, while a small patch lies on the pterostigma; on the posterior margin, just below the end of Cu_1+M_2, lies a fainter, smoky patch.

Hab.—Harvey, W.A. January, 1912. Unique.

Type in Coll. West Australian Museum. Museum No.6601.

This very beautiful little insect is very distinct from all others of the genus, and is easily recognised by its small size, and the peculiar "lambda-mark" on the forewings.

6. Dendroleon dumigani, n.sp. (Pl. iii., fig.6).

Total length 21, abdomen 15, forewing 28·5, hindwing 27·5 mm.

Head: *eyes* grey-brown; *epicranium* black, a transverse, grey-brown band above antennæ; these latter 6 mm., brown, with paler rings; tips elongate-oval, flat, concave above, black; a brown spot below base of each; *face* and *mouth-parts* dull testaceous

Thorax: *prothorax* long and narrow, slightly wider behind, dull brown with paler, longitudinal markings. *Pterothorax* broader, similarly coloured and marked; underside pale testaceous. *Legs* very long and slender; forelegs black, basal and apical fourths of tibia testaceous:* middle and hindlegs testaceous, the femora strongly tipped with black, the tibiæ slightly so; tarsal joints mostly black.

Abdomen slender, dull grey-brown; 1 and base of 2 testaceous, 3-8 with a basal, testaceous mark projecting apically into a sharp point.

Wings: *venation* brown, Sc and R speckled with whitish. *Forewing* with a narrow, black mark on pterostigma, several blackish specks along posterior margin, and veinlets towards apex mostly clouded with brown. *Hindwing* with a diffuse patch of dark brown just above posterior margin, two-thirds of the distance along the wing from base, a touch of brown proximad to pterostigma, and another distad from and just below it. Veinlets of *pterostigma* in both wings whitish. In forewing, only three cross-veins in radial space, the third being whitish. Origin of Rs about two cells' width proximad from level of cubital fork; the oblique vein placed far beyond the fork (3-4 cells distant).

Hab.—Linville, Q. (Brisbane River Valley). A single specimen, apparently a male, taken on February 22nd, 1915, by Mr. E. J. Dumigan, to whom I dedicate the species

Type in Coll. Tillyard.

Easily distinguished from *D. longipennis* Esb.-Pet.,(New South Wales), by its larger, broader, and less pointed wings, less marked with black or brown. In *D. longipennis*, also, the difference in level between the origin of Rs and the cubital fork is greater.

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* I have used this word throughout as indicating a dull, pale yellowish-brown, *i.e.*, earthenware-colour (Lat. *testaceus*). It has sometimes been used to indicate a dull brick-red, *i.e.*, tile-colour. The Latin word admits of both meanings.

Genus GLENOLEON Banks.

7. GLENOLEON BERTHOUDI, n.sp. (Pl. iii., fig 8).

Total length 21, abdomen 13, forewing 29·5, hindwing 26 mm.

Head: *eyes* blackish; *occiput* brownish, with three, black spots, and an irregular, transverse, black line above; from the middle of this, a short, median line runs up on to the occipital ridge, and is flanked on either side by a transverse, black bar; rest of *epicranium* shiny black; *antennæ* 6 mm.; face straw-coloured, *mouth-parts* pale, spotted with brown.

Thorax: *prothorax* fairly wide, dull grey-black with brownish markings. *Pterothorax* greyish-black, with numerous, brownish markings; in particular, a fine, mid-longitudinal line, a pair of curved bands on mesonotum, and a pair of oblique stripes on metanotum. *Legs:* fore- and middle-legs with dull brown femora tipped with black, tibiæ brown, with three, black patches, tarsi blackish; hindlegs with brown femur, pale brownish tibia just tipped with black, tarsus pale at base, brown beyond.

Abdomen greyish-black, with numerous, small, brown markings on segments 3-8.

Wings rather long and pointed, *venation* brownish. *Pterostigma* blackish in forewing, covering only 4-5 veinlets, but the black is continued obliquely inwards on to Rs; in hindwing, the pterostigma is small, opaque, and whitish, covering 3-4 veinlets, and touched with black proximally. In forewing, Sc and R, and the space between, are speckled with black; in the median space, from base almost to tip, there runs a conspicuous, black, longitudinal streak, which turns upwards at about two-thirds of its length to run obliquely parallel to, and beneath, the black, pterostigmatic patch, and ending 3 mm. from tip; the bent portion of the streak is brownish. On posterior border of forewing are two, small, oblique patches; one at about one-third from the base slants upwards and outwards, blackish; the other, more distally placed, is pale brown, and runs upwards and inwards: around these, and also near apex, are many brown specks on cross-veins. In hindwing, a large, round, dark brown blotch occupies the region of M_1 and M_2 at about two-thirds of the wing-length from base; there is also a small, black mark on the radial brace.

Hab.—Waroona, W.A. Taken by Mr. G. F. Berthoud, to whom I dedicate the species, on February 23rd, 1911. Unique.

Type in Coll. Tillyard.

8. GLENOLEON AURORA, n.sp. (Pl. iv., fig.9).

♂. Total length 19, abdomen 10·5, forewing 24, hindwing 21·5 mm.

Head: *eyes* olive-grey; *epicranium* reddish-brown, with three, small, black spots on occiput; in front, a transverse band of shining black, passing between the eyes and enclosing bases of antennæ; these latter 4·5 mm., brownish, tipped with blackish; *face* and *mouth-parts* yellowish-brown.

Thorax dull reddish-brown, marked with dark grey. *Legs:* femora orange-brown tipped with dark grey, tibiæ and tarsi greyish-brown.

Abdomen alternately banded, very irregularly, with orange-brown and dark grey; on the orange-brown portion of 3-6 are some blackish spots or lines.

Wings with a delicate, pinkish sheen on the nearly hyaline membrane; *venation* of forewing blackish along costa, speckled pink and black on Sc, R, and Rs, the rest brownish specked with black. In hindwing, costa paler and veins less speckled. *Pterostigma* in both wings distinct, about 1·5 mm., mostly pink, but touched proximally with brown. Hindwing with a small, brown blotch at distal end of M_1 and Cu_1.

♀. Differs from ♂ in having less black on epicranium, the wings less speckled, somewhat pinker, and without the brown blotch on the hindwing. Wings considerably wider, less pointed, and altogether larger than in ♂.

Hab.—Broken Hill, N.S.W. Several specimens taken by Mr. O. Lower, in 1900 and 1902.

Types, ♂♀, in Coll. Tillyard;(♂, December 4th, 1900; ♀, November 10th, 1902; Broken Hill; O. Lower).

This species and the succeeding one are very distinct from all other species of the genus by the beautiful, pink sheen of the wings, and by their peculiar facies, which comes closest to that of *G. annulicornis* Esb.-Pet. The sexual dimorphism, which is more or less noticeable in all species of this genus, is, in *G. aurora* (and probably also in *G. roseipennis*) extremely marked.

9. Glenoleon roseipennis, n.sp.

♀. Unique. Closely allied to the preceding, but differing from it by its much greater size, duller colouration, very large head, and roseate pterostigma.

Total length 19, abdomen 10, forewing 33, hindwing 30 mm.

Head very large, 3·6 mm. wide, dull greyish-brown

Thorax greyish, touched with brown on sides and on notum.

Abdomen with alternating, fairly regular bands of orange-brown and blackish, [much faded].

Wings much as in *G. aurora*, more rounded at tips, costa brownish. Sc, R, and Rs very little speckled with black; the wing-membrane lightly washed with rose-pink in places. *Pterostigma* of forewing 1·8 mm., rich orange-pink, surrounded by rose-pink, which extends to tip of wing; of hindwing, 1·3 mm., orange-pink, with less rose-pink beneath it, and very little towards wing-tip. No brown blotch on hindwing.

Hab.—Winton, Q. A unique ♀, taken by Mr. R. L. Higgins, in 1912.

Type in Coll. Tillyard.

Tribe **Distoleontini.**

In forewing, Cu_2 bends sharply away from $Cu_1 + M_2$ Rs arises at a level distal from that of the cubital fork (in *Gymnocnemia*, exactly above it).

Genus Gymnocnemia Schneider.

10. Gymnocnemia maculata, n.sp. (Pl. iv., fig.11).

Total length 16·5, abdomen 10, forewing 23, hindwing 19·5 mm.

Head: *eyes* olive-grey; *epicranium* dull yellowish-brown, with a fine ψ-mark in black on the occiput; two, black, transverse lines run, one on either side of the top of this mark in front; a black, shiny patch between bases of antennæ, which are 5 mm. long, dark brown, with blackish tips; *face* yellowish-brown, shiny; *mandibles* and *maxillary palps* blackish.

Thorax: *prothorax* yellowish-brown, with a broad, longitudinal, median, dorsal, grey-brown stripe, divided down the middle by a fine, pale line. *Pterothorax* pale straw-colour, with a similar, median, dorsal stripe, and a greyish-black mark on each side just above the wing-bases. *Legs* dull brown; femora with a blackish, apical spot, tibiæ with three, black spots, tarsi partly blackish.

Abdomen rather short, grey-black with dull, brownish markings, in the form of an irregular patch covering most of each segment, on either side of the median line, and isolating a median, longitudinal band of greyish-black, which is divided, as in the thorax, by a fine, pale, median, longitudinal line; sutures greyish-black.

Wings mostly hyaline, well-pointed; *venation* brownish. R, Rs, and $Cu_1 + M_2$ speckled with black. *Pterostigma* strongly marked as a pale brown area bordered proximally with black; total length about 2 mm., covering some seven veinlets, some of these being branched In forewing, the origin of Rs and of some of the cross-veins from R to Rs strongly blackened: a short, oblique, dark brown mark runs upwards from near end of M_2 (below level of pterostigma) through five cells, ending just beneath the Banksian line, which is well-marked; a somewhat similar mark overlies the ends of Cu_2 and A_1 on the posterior border. In the hindwing, there is an irregular, dark brown blotch below R and Rs, just before pterostigma, a smaller blotch at distal end of hypostigmatic space, and a rather large, irregular splash of dark brown above the posterior border, at the level of the radial brace.

Hab.—Broken Hill, N.S.W. Four specimens taken by Mr. O. Lower (undated).

Type in Coll. Tillyard.

Genus BRACHYLEON, n.g.

In forewing, Rs arises about one cell distad from level of cubital fork; the oblique vein lies directly under origin of Rs. No Banksian line present. M_1 and $Cu_1 + M_2$ in forewing unite before the wing-margin. In forewing, 1A is a straight line to wing-border. In hindwing, there is no distinct Cu_2: Cu_1 is straight, not arched concavely to posterior border. Five cross-veins before origin of Rs in forewing. Hindwing narrower, and slightly longer than forewing, very pointed.

Legs short; tarsus with first joint moderately long, 2nd-4th very short, fifth long; spurs present, nearly as long as first two joints of tarsus.

Abdomen short.

Genotype, *Brachyleon darwini* (Banks).

This genus may be placed next to *Gymnocnemia* on account of the position of the origin of Rs in forewing, but differs strongly from it in possessing spurs, and in lacking the Banksian line. It differs from *Macronemurus* Costa, in its short abdomen, and short legs, with long, stiff hairs.

11. Brachyleon darwini Banks. (Pl. iv., fig.10).

Macronemurus darwini Banks, Proc. Acad. Nat. Sci. Philadelphia, 1914, p.619 (issued 1915).

Head dark brown above; two, pale spots on occiput near *eyes*, which are very dark brown; *antennæ* fulvous at base [the rest missing]; *face* brownish, shading to fulvous on labrum; *mouth-parts* fulvous.

Thorax: *prothorax* pale brown, with two, broad, longitudinal stripes of darker brown. *Pterothorax* and *legs* shiny brown.

Abdomen short, slender, rich brown without any markings.

Wings *venation* brown; in forewings, Sc, Rs, M, and Cu speckled. Costal cross-veins very numerous, especially in forewing. *Pterostigma* in forewing clouded with brown, in hindwing clear. Apical cross-veins in all wings marked with brown specks. In all wings, an irregular, brown streak runs obliquely up from near the end of M_1 to near apex; this streak is longer and more diffuse in hindwing than in forewing. In hindwing, Cu_1 is dark, M pale. Only five branches of Rs before radial brace.

Hab.—Darwin, N.T One specimen, taken on April 6th, 1913, by Mr. G. F. Hill, Government Entomologist.

Type in Coll. Banks.

Genus Stenoleon, n.g.

Wings excessively narrow, pointed; in forewing, Rs arises well beyond brace of cubital fork, and is somewhat bent at the origin of its first descending branch; 5-6 cross-veins in radial space in forewing; oblique vein lying about under level of origin of Rs. No Banksian line present. Costal space very narrow in forewing, but widened near base in hindwing by the upward arching of C.

Legs moderately long; first and fifth tarsal joints about equal; 2nd-4th very short; spurs present, short, about as long as first tarsal joint. Abdomen slender, rather short.

Genotype, *St. fieldi*, n.sp.

This genus, which appears to have no near allies except, perhaps, the African *Nemoleon*, is a highly reduced offshoot from the main *Distoleontine* stock, easily distinguished from all other Australian genera known to me by the combination of characters given above.

12. Stenoleon fieldi, n.sp. (Pl. v., fig. 13).

Total length 19·5, abdomen 13·5, forewing 20·5 by 4 wide, hindwing 19 by 3 mm. wide.

Head: *epicranium* dull brownish; *antennæ* evidently long [tips lost], dark brown, strongly marked with pale rings; bases of antennæ, whole of face, and mouth-parts testaceous.

Thorax: *prothorax* subcylindrical, the anterior third marked off by a transverse groove; grey-brown, with a paler, median, longitudinal line, and two, parallel, lateral bands. *Pterothorax* grey-brown with paler markings; underside grey. *Legs:* coxæ, trochanters, and bases of femora pale testaceous; femora blackish, tibiæ brown, with a black spot one-third from base and another at apex; tarsi with first joint pale brown, 2-4 dark, 5 pale, with black apical third.

Abdomen narrow, cylindrical, dull grey, with transverse, ochreous lines on apices of segments 3-8.

Wings: *venation* mostly whitish, costa grey in both wings, also Cu in hindwing. Sc speckled. A conspicuous, dark spot proximal to pterostigma in both wings. Forewing much spotted with brown, as follows—on two or three of the cross-veins in the cubital space, also at the origin of Rs, on the third and fifth cross-veins beyond it, and on the radial brace; on the 4th-6th cross-veins in median space, and on the first four cross-veins in the cubital space. A larger blotch above the posterior margin just before half-way, crossing Cu_2 and running up to M_2; near apex, several, small, cloudy patches. In hindwing, a cloudy patch over ends of M and Cu_1, extending as a faint smokiness almost to apex.

Hab.—Tennant's Creek, Central Australia. Taken in November, 1906, by Mr. J. F. Field, to whom I dedicate the species.

Type in Coll. Tillyard. Unique.

A very distinct and peculiar little species.

Genus XANTHOLEON, n.g.

Insect of very slender build. In forewing, Rs arises about two cells' width distad from level of cubital fork, and is rather irregular in form; oblique vein close to the fork (within one cell's distance). No Banksian line present. The cells below $Cu_1 + M_2$ in forewing, and below Cu_1 in hindwing, are very regularly arranged, and separated into oblique rows by numerous, parallel sectors descending from the main vein. Hindwing slightly longer than forewing Antennæ long and slender, with weak, elongated club. Legs of median length, slender; tarsi with first joint a little longer than fifth, 2nd-4th very short; spurs present, longer than first tarsal joint Abdomen slender.

Genotype, *X helmsi*, n.sp.

A very distinct and clearly marked-off genus, whose affinities appear to be somewhat doubtful In the delicacy of its structure, it appears to hold about the same relationship to *Distoleon* that *Froggattisca* does to *Glenoleon*.

13. XANTHOLEON HELMSI, n.sp. (Pl. v., fig.12).

Total length 24·5, abdomen 17·5, forewing 29, hindwing 30mm.

Head pale yellowish all over, except for the black eyes. *Antennæ* yellowish, slender, 7 mm. long.

Thorax pale yellowish; *legs* straw-colour with a dark patch at apex of femur, another near base of tibia, a third at apex of same; tarsal joints brownish apically, claws dark.

Abdomen rather short, slender; 1 yellowish, 2 pale brown, 3 yellowish at base, shading to dull brown; the rest dull brownish touched with pale brown on apices of 7-9.

Wings with very pale, straw-coloured venation, abundantly speckled with brownish, especially along R, M, and Cu. *Pterostigma* large in all four wings, 2 mm., pale straw-coloured, covering about 8 cross-veins, and touched with brown at the inner angle. Four cross-veins in radial space of forewing; 5-6 descending branches of Rs before radial brace.

Hab.—Sydney, N.S.W. Two specimens, collected in October, 1909, by the late Mr. Helms, to whom I dedicate the species.

Type in Coll. Tillyard; cotype in Coll. Petersen.

This delicate and almost ghost-like species is quite distinct from any other *Myrmeleonid* known to me.

Genus ALLOFORMICALEON Esb.-Pet.

Differs from *Formicaleon* Brauer, by the absence of the Banksian line.

14 ALLOFORMICALEON HYALINUS, n.sp. (Pl. vi., fig.16).

Total length 22, abdomen 16, forewing 25·5, hindwing 24mm.

Head dark grey above, a pale, transverse line across occiput; *antennæ* long, 6·5 mm., slender, black, strongly clubbed; *face* blackish, *orbits* edged with pale cream, *genæ* and *labium* yellowish.

Thorax: *prothorax* short, dull greyish above, yellowish beneath. *Pterothorax* dull greyish-brown above, mottled with paler grey; underside grey, with some yellow markings. *Legs* greyish; hind femora very pale at bases, touched with black in middle and at apex; hind tibiæ pale, with a touch of black at apex.

Abdomen slender, subcylindrical, uniform grey-black; appendages touched with straw-colour.

Wings: *venation* blackish, Sc speckled in both wings; wings quite hyaline except for a slight touch of black basally on pterostigma of forewing; the veinlets of the pterostigma whitish. In forewing, only five branches of Rs before radial brace. Oblique veins very clearly marked, very close to cubital fork (less than one cell's length distant). In forewing, 1A black, forming a straight line to wing-border. Cross-veins in cubital space of forewing fairly numerous and close.

Hab.—Stradbroke Island, Q. Two specimens, bred in November, 1915, from large larvæ, which do not form pits, but hide in loose soil at the bases of trees.

Type in Coll. Tillyard (bred November, 1915).

This species superficially resembles *Myrmeleon uniseriatus* Gerst., in colour and facies, but has narrower and less pointed wings. Its nearest ally is *Alloformicaleon australis* Esb.-Pet., (Sydney), from which it can be at once distinguished by its smaller size, shorter wings, the hindwing not being as long as the fore, and by the completely different, and much darker colour-scheme.

15. ALLOFORMICALEON WATERHOUSEI, n.sp. (Pl. v., fig.14).

Total length 19·5, abdomen 13, forewing 25, hindwing 24 mm.

Closely allied to the preceding species, but distinguished as follows. On all four wings, a black mark on the stigma, and a smaller mark at same level on M_1 (this mark is a mere speck in hindwing): in forewing, a larger, oblique, black streak arises from just before middle of posterior border, and runs up across Cu_2 to bend parallel to $Cu_1 + M_2$ at one cell's distance below it. In forewing, 1A speckled, not quite a straight line; cross-veins in the cubital space of forewing very few and wide apart; also $Cu_1 + M_2$ arches up more strongly than in *A. hyalinus*. *Antennæ* bordered by a pale line in front of bases; *face* pale straw-colour. Hind *femora* black, except for the very pale bases. *Abdomen* somewhat stouter than in *A. hyalinus*, similarly coloured, but with pale, transverse lines across apices of segments 2-8.

Hab.—Woodford, Blue Mountains, N.S.W.(2,000 feet). Three specimens taken in February, 1909, by Mr. G. A. Waterhouse, to whom I dedicate the species. A single specimen, somewhat more heavily marked on wings, bred from a larva indistinguishable from that of *A. hyalinus*, on November 5th, 1915, from Stradbroke Island, Q.

Type in Coll. Tillyard (Woodford; G. A. Waterhouse; February 12th, 1909)

Genus DISTOLEON Banks.

16. DISTOLEON NIGROSIGNATUS, n.sp. (Pl. vi., fig. 17).

Total length, ♂ 25, ♀ 26; forewing, ♂ 30, ♀ 32; hindwing, ♂ 29, ♀ 32 mm

Head dark grey above, with a small, oval, brownish spot on occiput near each eye; a black band just in front of, and between, bases of *antennæ*, which are 8 mm. long, grey ringed with black, bases slightly brownish; *face* pale brownish.

Thorax downy, greyish, a touch of brown at wing-bases. *Legs* rather short, hairy, coxæ of forelegs brownish; femora grey, tibiæ and tarsi pale brownish with blackish markings.

Abdomen uniformly dull greyish.

Wings very long and narrow; veins mostly greyish; Sc speckled with black, Rs and Cu also blackish. *Pterostigma* in forewing greyish-white, with a black, basal patch covering about nine veinlets, five of which are forked; in hindwing, pterostigma is only a slight darkening on 5-6 veinlets. Forewing marked with long, black stripes as follows—a straight stripe running parallel to, and below Rs distally, slightly waved as it crosses each branch of Rs; a long and slightly curved stripe along the main stem of Cu to the fork, where it is thickened, and thence along $Cu_1 + M_2$, gradually tapering to a fine streak, and finally bending slightly up to cross M_1, and to run wavily for 3 mm. up across two branches of Rs; also a short, curved stripe placed concavely to the posterior border, about midway along the wing, arising from the end of Cu_2, and arching up towards the middle of $Cu_1 + M_2$. In hindwing, only a slight, double smudge of brown placed distally on M and Cu_1 and also on two branches of Rs above them; also a touch or two of black near apex. All the above marks are very complete and definite in ♀, but, in ♂, they are narrower, paler, and more or less reduced.

Hab.—Perth, W.A., and suburbs. Several specimens, taken by Mr. W. B. Alexander, Keeper of Biology in W.A. Museum, in February-March, 1913. A single ♀ from Broken Hill, taken by Mr. O. Lower (undated).

Types: ♂ in Coll. Tillyard (Cottesloe, W.A., February 18th, 1913; W. B. Alexander; Museum No.6726); ♀ in Coll. W. A. Museum (Subiaco, W.A.; March 12th, 1913; W. B. Alexander: Museum No.6898).

The Broken Hill ♀ differs from the Western Australian specimens in having a row of black spots along the posterior margin of the forewing, at the ends of the cross-veins descending from 1A.

This very distinct and handsome species appears to be quite common around Perth. Its superficial resemblance to *Protoplectron longitudinale*, n sp., has been already noted.

Subfamily MYRMELEONTINÆ.

Genus Myrmeleon Linn.

17. Myrmeleon loweri, n.sp. (Pl. vi., fig.15).

Total length 29, abdomen 21, forewing 29, hindwing 26 mm.

Head 3 mm. wide; *eyes* pale grey; *epicranium* grey, a small, yellowish patch just in front of *antennæ*, which are 4 mm. long, with tips in the form of a flattened club; *face* chiefly dark grey, *genæ* and *labrum* dull orange-yellow, *labium* yellowish.

Thorax pale powdery-grey, anterior lobe and base of prothorax lemon-yellow, as are also the wing-bases and the latero-posterior edges of the mesonotum; sutures of pterothorax dark. *Legs* short, dull orange, a patch of black distally on femora, a greyish tinge on tibiæ: tibial spurs, distal spines of the tarsal joints, and claws black.

Abdomen fairly long and slender, powdery-grey; two, small, yellow spots at base of 1; suture between 1 and 2 blackish, a trace of two, fine, yellow spots apically on 3, the same spots larger and more distinct on 5-7 and on sides of 8: 9 touched with yellow, blunt, hairy at tip.

Wings with pale yellow *venation*; bases strongly yellowish: about 34 costal cross-veins before pterostigma in both wings. *Pterostigma*, in forewing, distinct, pale brownish, covering 7-8 veinlets, some of which are branched; in hindwing, fainter, covering only the lower portions of four veinlets. Before origin of Rs, in radial space, seven cross-veins in fore, five in hindwing. In both wings, five branches of Rs before radial brace.

Hab.—Broken Hill, N.S.W., collected by Mr. O. Lower, to whom I dedicate the species. Bourke, N.S.W., collected by the late Mr. Helms. Fairly common

Type in Coll. Tillyard (Broken Hill, undated, O. Lower).

A very distinct and striking species

Genus ACANTHACLISIS Ramb.

18. ACANTHACLISIS PETERSENI, n.sp. (Pl. i., fig.2).

Total length 45, abdomen 31, forewing 66·5, hindwing 62·5mm.

Head: *eyes* brown: *occiput* greyish black; *antennæ* 10 mm., black, very slightly clubbed: *epicranium* and *face* dark grey, hairy: *labrum* and *mouth-parts* rich brown, *labium* fulvous.

Thorax: *prothorax* short, tapering towards head, grey-black above, brown on sides. *Pterothorax* brownish, with grey shading, and long, soft, grey hairs: underside covered with thick, pale grey hairs. *Legs* short; femora brown: those of forelegs very hairy: tibiæ brown, those of fore and middle-legs touched with black on basal half: tarsi very short, 1-4 blackish, 5 pale, with deep apex and claws.

Abdomen cylindrical, with close-set, small, black hairs, 1-2 and apex with longer hairs: colour black, with irregular, brown patches on either side of middle line on segment 3 (very slight) and segments 4-7.

Wings wide, fairly well pointed; *venation*, in general, brown, C, Sc, and R tinged with orange: $Cu_1 + M_2$ in forewing strongly marked with black A pale ochreous area on *pterostigma* of all four wings. Forewings strongly speckled all over, due to all the veins being irregularly marked with black. In radial space, before origin of Rs, eight cross-veins in fore, six in hindwing. In forewing, Cu_2 diverges very strongly from $Cu_1 + M_2$: the oblique vein is black, 3-4 cells' length distad from the cubital fork. Cubital space in forewing wide, triangular, with four, single cells, then two together, then three at widest part, and, finally, three single cells at distal end.

Hab.—Cooktown, North Queensland. Taken by myself, January, 1908.

Type in Coll. Tillyard. Unique.

This magnificent insect is clearly very closely allied to *A. fulva* Esb.-Pet., from which it differs by its smaller size (*A. fulva*, forewing 72 mm., total length 55 mm.) and darker colouration, as well as by having four cross-veins in the radial space. In *A. fulva*, the antennæ are pale yellowish-brown, the head, prothorax, and mesothorax yellowish-red. The legs in *A. fulva* have the tibiæ differently marked: the abdomen is brown, with paler apex: the apices of the segments darkened.

The differences separating *A. peterseni* from *A. fulva* appear to be of the same order as those separating *A fundatus* from *A. subtendens*. In both cases, we appear to be dealing with a pair of geminate species, but, in the case of *A. peterseni* and *fulva*, as the type of each is a unique specimen, we cannot yet say what the *constant* differences between them may be.

Family ASCALAPHIDÆ.

Subfamily PROTASCALAPHINÆ.

Genus Stilbopteryx Newman.

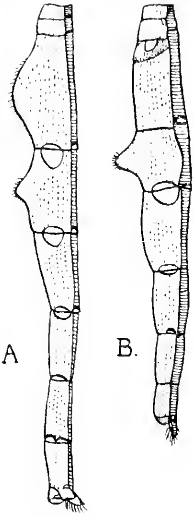
19. Stilbopteryx dromedaria, n.sp. (Text-figs.1-3).

♂. Total length 61, abdomen 47, forewing 48 by 9 wide, hindwing 44 by 8 mm. wide.

Head: *epicranium* black, with thick, black hair: *antennæ* black, *without yellowish rings*, tips strongly knobbed, black; *eyes* brown, *frons* black, *clypeus* and *labrum* bright golden-yellow, *genæ* and *labium* brown.

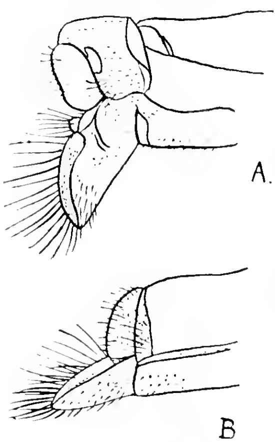
Thorax blackish above, with thick, soft, dark grey hairs; sides and underside thickly clothed with long, greyish-white hairs. *Legs* completely shining-black, except claws, which are dark reddish.

Abdomen very long (Text-fig., 1,A) black; 1-2 short; 3 very long, much swollen dorsally, with a convex hump carrying short hairs, and with a pair of large, rounded, latero-basal, golden-yellow spots, slightly overlapping on to 2, also a pair of small, apico-ventral spots of same colour, subtriangular; 4 long, swollen dorsally into a median tubercle, slightly bifid, and clothed with stiff, short hairs: a pair of large, round, latero-basal, golden-yellow spots slightly overlapping on to 3, the small, apico-ventral spots present, larger than in 3; 5 long, tapering towards apex, marked as in 4; 6 narrow-cylindrical, with latero-basal spots present, but smaller, and half operlapping on to 5; the small apico-ventral spots absent; a pair of small, semi-oval, golden-yellow spots laterally at apex of 6; 7-8 narrow, long, cylindrical, resembling 6, but without basal spots: 9 very short, blackish; *appendages* black at bases, golden apically, inferior shovel-shaped, hairy, as in Text-fig.2, A.



Text-fig.1.*

W i n g s with black venation except basal two-thirds of C, bases of anal veins, and many cross-veins, which are pale straw-colour. In forewing, a black, longitudinal band runs from base to pterostigma, enclosing Sc and R; the costal cross-veins towards pterostigma also outlined in black. *Pterostigma* with a straw spot covering five veinlets, and bordered basally with black; apex of wing beyond pterostigma strongly blackened, the basal border of this black patch oblique, nearly a straight line. In hindwing, the pattern is similar, but the longitudinal, black band fills the whole costal and subcostal spaces.



Text-fig.2.

♀. Total length 45, abdomen 30, forewing 50 by 10·5 wide, hindwing 46 by 8·5 mm. wide.

Differs from ♂ by the broader wings: the antennæ black, with

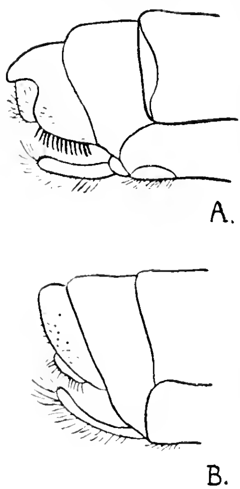
* For legends of Text-figs. 1-3, see p.69.

fine, yellow rings; the abdomen much shorter, more cylindrical, without any humps, the latero-basal spots less rounded, rather subtriangular, the apico-ventral spots distinct, larger than in ♂; the apex as in Text-fig.3,A. Prothorax of ♀ has a narrow, raised, transverse ridge, bright yellow.

Hab.—Waroona, W.A. A number of specimens taken by Mr. G. F. Berthoud, in January-February, 1913-1915. Also a single, fine ♀ taken at Yallingup, W.A., by Mr R. E. Turner, on January 7th, 1914.

Types, ♂♀, in Coll. Tillyard (Waroona, W.A.; G. F. Berthoud: ♂, January 6th, 1914: ♀, February 24th, 1914).

This fine species differs from *S. costalis* Newman (Eastern Australia) in the following points. In the ♂ of *S. costalis*, the wings are broader, and the black, longitudinal streak does not include the costal space, but only touches the bases of the costal cross-veins. Also, in all four wings of *S. costalis*, the basal border of the apical, black patch is irregular. The antennæ of *S. costalis* are longer, and ringed with yellow; the head, thorax, and segments 3-4 of abdomen much less hairy, the abdomen much shorter, stouter, and with *only a single hump*, placed dorsally on 4. The golden spots of the abdomen in *S. costalis* are confined to segments 5-7 laterally, 4-6 ventrally; the only, large, round spot is placed basally on segment 5. This pattern is shown in Text-fig.1, B. The appendages of *S. costalis* ♂ are black, and less complicated than those of *S. dromedaria* (*cf.* Text-fig.2, A and B).



Text-fig.3.

The females of the two species are less easy to separate, but *S. dromedaria* ♀ may be distinguished by the shorter antennæ, the black costal space of the hindwing, the straighter, inner edge of the black, apical patch, and by the different form of the apex of the abdomen (*cf.* Text-fig.2, A and B).

Text-fig. 1.—Lateral view of colour-pattern of abdomen in *Stilbopteryx*. A. *S. dromedaria*, n.sp., ♂. B. *S. costalis* Newman, ♂; (× 1·5).

Text-fig. 2.—Lateral view of anal appendages in males of *Stilbopteryx* (much enlarged). A. *S. dromedaria*, n.sp., ♂. B. *S. costalis* Newman, ♂; (× 6).

Text-fig. 3.—Lateral view of end of abdomen in female of *Stilbopteryx* (much enlarged). A. *S. dromedaria*, n.sp., ♀. B. *S. costalis* Newman, ♀; (× 6).

EXPLANATION OF PLATES I.-VI.

Plate i.

Fig. 1.—*Euporismus albatrox*, g.et sp.n.; (× 3).
Fig. 2.—*Acanthaclisis peterseni*, n.sp.; (× 1·3).

Plate ii.

Fig. 3.—*Periclystus aureolatus*, n.sp.; (× 3).
Fig. 4.—*Protoplectron eremiae*, n.sp.; (× 2·5).
Fig. 5.—*Protoplectron longitudinale*, n.sp.; (× 1·7).

Plate iii.

Fig. 6.—*Dendroleon dumigani*, n.sp.; (× 2·5).
Fig. 7.—*Dendroleon lambda*, n.sp., (× 3).
Fig. 8.—*Glenoleon berthoudi*, n.sp.; (× 2·5).

Plate iv.

Fig. 9.—*Glenoleon aurora*, n.sp.; (× 2·7).
Fig. 10.—*Brachyleon Darwini* (Banks); (× 2·5).
Fig. 11.—*Gymnocnemia maculata*, n.sp.; (× 2·8).

Plate v.

Fig. 12.—*Xantholeon helmsi*, g.et sp.n.; (× 2·8).
Fig. 13.—*Stenoleon fieldi*, g.et sp.n.; (× 2·8).
Fig. 14.—*Alloformicaleon waterhousei*, n.sp.; (× 3·3).

Plate vi.

Fig. 15.—*Myrmeleon loweri*, n.sp.; (× 2·5).
Fig. 16.—*Alloformicaleon hyalinus*, n.sp.; (× 2·5).
Fig. 17.—*Distoleon nigrosignatus*, n.sp.; (× 2·5).

N.B.—The figures are made from the type-specimens, but, where the setting of the specimen has been irregular, the wings have been orientated so as to conform to a single plan, and the abdomen straightened out where necessary.

A REVISION OF THE *STRATIOMYIDÆ* OF AUSTRALIA.

By Arthur White.

(Communicated by Dr. Eustace W. Ferguson.)

(Seven Text-figures.)

The *Stratiomyidæ* form one of the larger families of the Diptera, containing about one thousand species from all parts of the world. They are conspicuous flies, many of them possessing splendid metallic colouring, but, so far as the Australian species are concerned, they have been little studied. Most of those named up to the present time were described by Macquart (Diptères Exotiques, 1838-55); and Walker (List of Diptera in the British Museum, 1848-55; and Insecta Saundersiana, Diptera, 1850). One species was described by Erichson (Archiv f. Naturgesch., 1842), one by Bigot (Ann. Soc. Ent. de France, 1876), and, finally, some Tasmanian species by myself (Proc. Roy. Soc. Tasmania, 1914).

The present paper lists 30 species, belonging to 18 genera, all the species, with one doubtful exception, and 12 of the genera being peculiar to Australia. Most of the species are uncommon, and many more probably await discovery, particularly in the northern parts of the Continent.

In the preparation of the present paper, I have received great assistance from Mr. C. French, Junr., Government Entomologist of Victoria; Mr. W. W. Froggatt, Government Entomologist of New South Wales; Dr. E. W. Ferguson, of the Government Bureau of Microbiology, Sydney; Mr. A. M. Lea, of the Adelaide Museum; and Mr. F. P. Spry, of the National Museum, Melbourne, to all of whom I wish to tender my most cordial thanks.

The Australian *Stratiomyidæ* are divisible into six Subfamilies, which are distinguished as shown in the following Table.

Table of the Australian Subfamilies of Stratiomyidæ.

1. Abdomen with seven, visible segments; scutellar spines, if present, four or more in number; wings with either three or four, posterior veins .... BERINÆ.
   Abdomen with only five or six, visible segments .... 2.
2. Wings with four, posterior veins or traces of them .... 3.
   Wings with only three, posterior veins .... 6.
3. The four, posterior veins all arise from the discal cell .... 4.
   The fourth, posterior vein is separated from the discal cell, and arises from the second, basal cell .... 5.
4. Metallic species; scutellar spines, if present, four or more in number .... ANTISSINÆ.
   Non-metallic species; scutellar spines two in number ...... CLITELLARINÆ.
5. Antennæ with or without a short style, never with an arista.... .... STRATIOMYINÆ.
   Antennæ with a long, thread-like arista .... SARGINÆ.
6. Antennæ with a long, thread-like arista .... PACHYGASTRINÆ.

In dividing the genera of *Stratiomyidæ* into their respective subfamilies, some doubt may occasionally occur relative to the position of the posterior veins, because, in a few genera, the fourth posterior vein seems to arise from the exact junction of the discal cell and the second basal cell, and so might be considered to arise from either. In such cases, the relationship seems to be nearest to the *Clitellarinæ*, and such genera are usually considered as belonging to that subfamily, whilst only those in which the fourth posterior vein is distinctly separated from the discal cell, are placed in the *Stratiomyinæ* or *Sarginæ*.

Subfamily BERINÆ.

The species belonging to this subfamily are readily recognised by their narrow abdomen, with seven, visible segments; the scutellar spines, if present, are never less than four in number. The Berinæ occur all over Europe, North and South America, Australia and New Zealand. In all, about a dozen genera have been described. In Australia, five genera are known to occur.

Table of the Australian Genera of Berinæ.

1. Scutellum without spines .... 2.
   Scutellum with spines .... 3.
2. Wings with three, posterior veins .... CRYPTOBERIS, gen.nov.
   Wings with four, posterior veins .... METOPONIA Macq.

3. Antennæ thrice the length of the head........... XANTHOBERIS, gen.nov.
Antennæ about the same length as the head......................... 4.
4. Eyes hairy; thorax metallic; wings not banded............ ACTINA Meig.
Eyes bare; thorax not metallic; wings banded...NEOEXAIRETA Ost.-Sack.

Of the above genera, *Metoponia* is unknown to me; Kertesz places the species named by Macquart, *Xenomorpha australis*, in this genus: if this is correct, its position should be that given above.

1. CRYPTOBERIS, gen.nov. (Fig.1).

Non-metallic flies: scutellum without spines; eyes bare, joined in the male: antennæ a little longer than the head, third joint annulated, but without any style or arista; discal cell of wings almost pentagonal, with three, issuing veinlets: cubital vein forked.

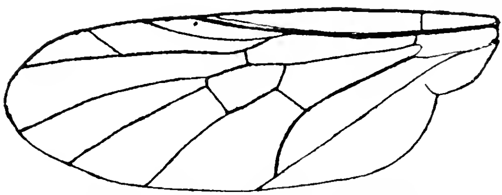


Fig.1—Wing of *Cryptoberis hebescens.*

Head short and not produced. Eyes bare, joined in the male. Antennæ set close together, situated towards the lower part of the head in profile, a little longer than the head; first joint about twice the length of the second, the third slightly swollen and annulated, nearly twice the length of the first two joints together. Thorax with small shoulder-tubercles; scutellum without spines. Abdomen long and slender, with seven, visible segments. The thorax, scutellum, and abdomen covered with short, *depressed* pubescence. Legs simple, slender. Wings without any distinct stigma; costal margin minutely bristly, cubital vein forked; discal cell almost pentagonal, with three, issuing veinlets (posterior veins); anal cell closed at some distance above the wing-margin.

This genus seems to be most nearly allied to the North American genus *Chiromyza*, from which it is distinguished by the forked, cubital vein. It also agrees with the European and North American genus *Allognosta* in having the scutellum unarmed, and in possessing only three, posterior veins, but differs from that genus in the very different form of the discal cell. From the Australian genus *Metoponia*, it is distinguished by possessing three, instead of four, posterior veins.

CRYPTOBERIS HEBESCENS, sp.nov. (Fig.1).

Antennæ, thorax, scutellum, and abdomen dark brown; legs entirely yellow; wings tinged with brown. Length, ♂, 7·5 mm.

Hab.—New South Wales (Sydney).

Male.—Face brown, receding. Eyes bare, joined for a long distance, the front being reduced to a very small patch at the vertex, and a small, frontal triangle directly adjoining the antennæ. Antennæ a little longer than the head, first joint about twice the length of second, the third swollen and annulated, and nearly twice the length of the first two joints together. Thorax, scutellum, and abdomen dark brown, the whole covered with short, white, depressed pubescence; sides of abdomen with a little longer, white pubescence; genitalia prominent, yellow-brown. Legs with femora and tibiæ clear yellow; tarsi yellow, a little browned towards the tips. Wings tinged with brown.

This species is known only from a single specimen, which was taken by Dr. Ferguson at Sydney, on November 12, 1914; it occurred settled on the wall of a building.

2. METOPONIA Macq.

Non-metallic flies; scutellum without spines. Antennæ inserted towards base of head; first joint a little elongated, second short, third annulated with eight divisions. Wings with four, posterior veins, all arising from the discal cell, first, second, and fourth complete, third incomplete; cubital vein forked.

This genus is unknown to me, the above characters being taken from Macquart's description of the genus, and from his figure and description of *Xenomorpha australis*, which Kertesz, in his Catalogue, ascribes to this genus.

Table of the Australian Species of Metoponia.

1. Thorax and abdomen black; legs black .... *rubriceps* Macq.
2. Thorax and abdomen testaceous; legs red.................. *australis* Macq.

Metoponia rubriceps Macq.

Described by Macquart as having the head red, thorax dull black; abdomen shining black; legs black. Length, ♀, 6 mm.

Hab.—"Tasmania."

Metoponia australis Macq.

Syn., *Xenomorpha australis* Macq.

Described by Macquart as having the thorax and abdomen testaceous, the former, in the male, with a curved, black stripe on each side; antennæ and legs red; posterior tibiæ bowed in the male. Length, ♂♀, 7-8 mm.

Hab.—"Australia."

3. Xanthoberis, gen.nov. (Fig.2).

Antennæ thrice the length of the head, first two joints short, and of almost equal length, third about four times the length of the first and second together, consisting of four segments of almost equal length, and a shorter style; scutellum with four, marginal spines; abdomen long and slender, with the posterior femora slightly swollen; neuration of wings as in *Neoexaireta.*

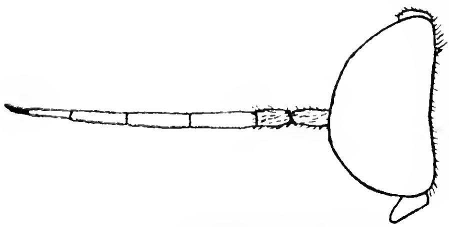


Fig.2.—Head of *Xanthoberis siliacea*, ♀.

Head short, and not produced. Eyes(♀) bare and separated. Antennæ set close together, and situated about the middle of the head in profile, about thrice the length of the head, first two joints short, and of almost equal length, third about four times the length of the first and second together, consisting of four segments and a style, the first segment being the longest, and distinctly longer than the first two antennal joints together, the second, third, and fourth segments of nearly equal length, the style about one-half the length of either of these segments. Thorax narrow: scutellum with four, slender, marginal spines. Abdomen long and unusually slender. Legs long and slender, posterior femora slightly swollen. Wings with the venation of *Neoexaireta spinigera:* cubital vein forked and much curved: discal cell with four, issuing veinlets, first, second, and fourth complete, third incomplete; anal cell closed bluntly at some distance above the wing-margin.

This genus is proposed for a New South Wales species, represented by a single specimen in the collection of the Adelaide Museum. The form of the antennæ distinguishes it from any other genus of the *Berinæ*.

XANTHOBERIS SILIACEA, sp.nov. (Fig.2).

Front black: antennæ brown, with the base yellow: thorax, scutellum, and scutellar spines light yellow-brown: abdomen light yellow-brown, with apex black; legs yellow: wings hyaline, with a dark brown stigma. Length, ♀, 9 mm.

Hab.—New South Wales (Dorrigo).

Female.—Face and portion of front adjoining base of antennæ covered with silvery hairs. Front black. Proboscis orange. Antennæ brown above, except the short, first and second joints, and a portion of first segment of third joint, which are yellow: beneath, the antennæ are yellow for nearly two-thirds of their length, the remainder light brown, with the style black. Thorax and scutellum light yellow-brown, with an orange tinge: scutellar spines yellow. Abdomen with first five segments light yellow-brown, sixth, seventh, and genitalia brownish-black. Legs with anterior and middle pairs entirely yellow: posterior femora bright yellow-brown, with base pale yellow; posterior tibiæ yellow-brown; posterior tarsi yellow. Wings hyaline, with a dark brown stigma.

This species is known from only a single specimen, labelled "Dorrigo, N. S. Wales," in the Adelaide Museum. It may be recognised without difficulty by its slender shape, four-spined scutellum, long antennæ, and uniform, light yellow-brown colouration.

4. Actina Meig.

Slender flies, with a metallic-green thorax, six-spined scutellum, and orange or brown abdomen; eyes hairy (♂) or sparsely hairy (♀), separated in both sexes; discal cell with four, issuing veinlets, first, second, and fourth complete, third incomplete; tibiæ in the male considerably inflated.

This genus occurs in Europe, North America, and Australia. In Australia, two species are known.

Table of Australian Species of Actina.

1. Scutellar spines long, partly or altogether yellow; abdomen, in female, bright orange-brown, with black segmentations.... .... *incisuralis* Macq.
2. Scutellar spines short, entirely metallic-green; abdomen, in female, uniform blackish-brown.......................... *costata* White.

Actina incisuralis Macq.

Syn., *Beris incisuralis* Macq.; *Beris filipalpis* Macq.

Thorax emerald-green(♂), or bronze-green(♀); abdomen brown (♂), or bright orange-brown(♀), with black segmentations; scutellar spines yellow, with the base dark metallic-green; posterior femora black(♂), or orange, with the apical third or half black (♀); wings with a conspicuous, black stigma. Length, ♂ 7, ♀ 6 mm.

Hab.—New South Wales, Victoria, Tasmania, Queensland.

This is one of the commonest and most widely distributed of the Australian *Stratiomyidæ*. It usually occurs settled on low vegetation, but may sometimes be found on windows. It is subject to some variation, both as regards size, and colouring of the abdomen and legs.

Actina costata White.

Thorax emerald-green, and abdomen blackish-brown in both sexes; scutellar spines short, entirely dark metallic-green; hind femora black, with an orange band towards the apex (♂), or entirely yellow(♀); wings with the costal margin much more sinuated than in *A. incisuralis*, and with a smaller stigma. Length, ♂ 6, ♀ 4·5 mm.

Hab.—Tasmania.

This species frequents pools in the beds of mountain-streams; it seems to occur very sparingly.

5. NEOEXAIRETA Ost.-Sack.
(*Exaireta* Schin.)

Slender flies, with thorax non-metallic; eyes bare, separated in both sexes; scutellum with four spines; wings banded.

This genus contains only one Australian representative.

NEOEXAIRETA SPINIGERA Walk.

Syn., *Beris Servillei* Macq.

Thorax black; scutellar spines brown, with the base black; abdomen purple; posterior femora black, with the base white; wings with basal half hyaline, apical half dark brown, with a hyaline spot on the costal margin towards the tips. Length, 10 mm.

Hab.—New South Wales, Victoria, and Queensland.

This is a common species. It may be easily recognised by its banded wings.

Subfamily ANTISSINÆ.

This subfamily is nearly allied to the *Berinæ*, but is distinguished by possessing only five or six, instead of seven, visible, abdominal segments; the abdomen is always short and broad, and of bright metallic colouring; the wings have frequently the basal half of the costal margin inflated; the scutellar spines, if present, are four or more in number.

Four Australian genera are at present known.

Table of the Australian Genera of Antissinæ.

1. Abdomen very broad; metallic blue in colour........................ 2.
   Abdomen not very broad; not metallic blue in colour .... 3.
2. Scutellum with spines: costa of wings in male greatly inflated. .... LECOGASTER White.
   Scutellum without spines.............................. ANACANTHELLA Macq.
3. Scutellum with rudimentary spines.................................. 4.
4. Antennæ much shorter than head .... ANTISSA Walk.
   Antennæ about twice the length of head .... ANTISSELLA White.

6. Lecogaster White. (Fig.3).

When this genus was proposed, only the male was known; specimens of the females of two species are now, however, to hand. The eyes of the male are densely hairy, widely separated at vertex, but almost joined at base of antennæ; of the female, only sparsely pubescent, and well separated throughout. Antennæ about the same length as the head, third joint annulated, and provided with a blunt, in-turned style. Scutellum with, normally, six spines, but two of these may be difficult to distinguish. Abdomen short, but extremely broad. Wings with the basal half of the costal margin greatly inflated in the male, to a less extent in the female; cubital vein with a long fork; discal cell with four, issuing veinlets, the first, second, and fourth complete, the third incomplete.

The species belonging to this genus may be easily recognised by their extremely broad, metallic-blue abdomen, and spined scutellum. Two species are at present known.

Table of the Species of Lecogaster.

1. Wings hyaline; thorax blue; scutellum flat................ *cærulea* White.
2. Wings with a black spot on the middle of the costal margin; thorax black; scutellum much upraised............... *cyanea*, sp.nov.

Lecogaster cærulea White.

Thorax, scutellum, and abdomen bright metallic-blue; scutellum not upraised; antennæ and legs black; wings hyaline. Length, ♂, 8 mm.

Hab.—Victoria and Tasmania.

This species, though of somewhat wide distribution, seems to occur very sparingly. There are two specimens in the collection of the Melbourne Museum.

Lecogaster cyanea, sp.nov. (Fig.3).

Thorax black; abdomen bright metallic-blue: scutellum much upraised; femora and tibiæ black, with the knees and tarsi white; wings with a black spot occupying the apex of the first basal cell and reaching to the costal region. Length, ♀, 7 mm.

Hab.—New South Wales (Milson Island).

Female.—Face black, bearing white pubescence. Front black. Eyes with sparse but fairly long, white pubescence, rather more widely separated at vertex than at base of the antennæ. Antennæ brown, with apex black, first joint slightly longer than second, third twice the length of first and second together, annulated, and gradually tapering, the apex with a blunt, in-turned style. Thorax black, with two stripes of white pubescence in front, the whole dorsum bearing sparse, white pubescence, scutellum black, much upraised, with six, black, rather short, marginal spines, the whole fringed with white pubescence. Abdomen bright metallic-blue, with violet or green reflections, second and fourth segments bearing a white, pubescent, diagonal stripe on each side Legs with femora and tibiæ black, the knees white; tarsi white, with the extreme apex black. Wings hyaline, with a black spot occupying the apex of the first basal cell, and reaching to the costal margin; discal cell with four, issuing veinlets, first, second, and fourth reaching the wing-margin, third only about one-third the distance to the margin.

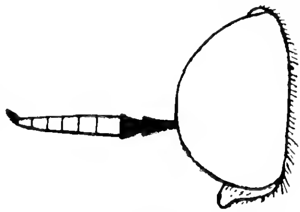


Fig. 3.
Head of *Lecogaster cyanea.*

This species bears a general resemblance to *L. cærulea*, but may be easily distinguished by the spotted wings, the upraised scutellum, the black instead of blue thorax, and the white instead of black tarsi.

This interesting species is known from two specimens (females), which were taken by Dr. Ferguson at Milson Island, Hawkesbury River, on October 31st, 1914.

7. Anacanthella, Macq.

This genus was proposed by Macquart for a South Australian species.

Scutellum without spines; abdomen short and broad, with five, visible segments; eyes of the male with short pubescence.

Anacanthella splendens Macq.

Thorax golden-green; abdomen shining, dark blue; antennæ black; legs fulvous, with tarsi black. Length, ♂, 5 mm.

Hab.—South Australia (Adelaide).

This species is unknown to me; it is not represented in the collection of the Adelaide Museum.

8. ANTISSA Walk.

This genus was proposed by Walker for a West Australian species. It is characterised as having the antennæ much shorter than the head, flagellum conical, with a short, thick style; thorax short, broad; scutellum with four, very small spines; abdomen round, much broader, but not longer, than the thorax.

ANTISSA CUPREA Walk.

Described as having the thorax and abdomen bright copper-colour, thickly clothed with short, hoary hairs; antennæ and legs black; wings brown, darkest on costal margin. Length, 6 mm.

Hab.—Western Australia.

9. ANTISSELLA White.

Antennæ nearly twice the length of head; eyes joined and hairy in the male, widely separated, and practically bare in female; scutellum unarmed or with rudimentary spines; wings with costal margin inflated in the male, barely inflated in the female.

This genus comes nearest to *Antissa*, but is distinguished by having the antennæ nearly twice the length of, instead of much shorter than, the head. It was proposed by me for Macquart's species, *Beris parvidentata*, which belongs to the *Antissinæ*, and not to the *Berinæ*.

ANTISSELLA PARVIDENTATA Macq.

Syn., *Beris parvidentata* Macq.

Thorax greenish-gold, and abdomen deep violet(♂); or thorax emerald-green, and abdomen ruddy bronze, with red, blue, and green reflections(♀); legs yellow. Length, ♂♀, 7·5 mm.

Hab.—New South Wales, Victoria, and Tasmania.

This species is widely distributed, and is more usually met with than any other species of the *Antissinæ*, but it can hardly be described as common; the female is more often found than the male.

Subfamily CLITELLARINÆ.

The wings in this subfamily possess four, posterior veins, which all arise from the discal cell, although the fourth may issue only from its extreme corner; the scutellum, in all known Australian species, possesses two spines.

Four, very distinct genera are known to occur in Australia, three of which are now described for the first time. Of the latter, *Ophiodesma* is fairly typical of the subfamily; *Elissoma* seems to show affinities with the *Stratiomyinæ*, and *Geranopus* with the *Sarginæ*. On the other hand, the two last-named genera, both by their venation and the form of the legs, seem to be related to one another.

Table of the Australian Genera of Clitellarinæ.

1. Thorax with a stout spine on each side; antennæ with a long, densely fringed style .... NEGRITOMYIA Bigot.
   Sides of thorax without spines; antennæ without a fringed style 2.
2. Antennæ with an arista. First joint of posterior tarsi longer than posterior tibiæ .... GERANOPUS, g.n.
   Antennæ without arista .... 3.
3. Antennæ very long and slender, about five times the length of head.. ELISSOMA, g.n.
   Antennæ not slender, about twice the length of head. OPHIODESMA, g.n.

10. NEGRITOMYIA Bigot. (Fig.4).

Thorax with a stout spine on each side; antennæ terminated by a very long, densely-fringed style.

Face barely projecting, but descending well below the eyes. Eyes hairy in both sexes, joined in the male, widely separated in female. Antennæ situated a little below the middle of head in profile, about twice the length of the head: first joint twice the length of second, which is closely approximated to the third; third consisting of a bare, cylindrical, basal portion, and a very long, densely fringed style, which is slightly longer than the

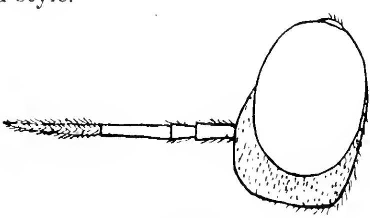


Fig.4.
Head of *Negritomyia albitarsis*, ♂.

basal portion, the total length, including the style, being about thrice the length of the first and second joints together. Thorax with a stout spine on each side, just before the base of the wings; scutellum with two spines. Abdomen longer than, and about equal in breadth to, the thorax. Legs rather long. Wings with the four, posterior veins complete, all arising from the discal cell.

This remarkable genus agrees with *Ephippium* in having a stout spine on each side of the thorax, but is distinguished from that genus by the very different antennæ. The form of the style bears some resemblance to that of *Hermetia*, but *Negritomyia* is distinguished from that genus by its thoracic spines.

NEGRITOMYIA ALBITARSIS Bigot. (Fig.4).

Syn., *Ephippium albitarsis* Bigot.

Face, thorax, scutellum, and abdomen black, scutellar spines light yellow-brown, with base black; tarsi yellow; wings brownish, with a dark cloud towards the tip. Length, ♂, 11 mm.

Hab.—Queensland (Mackay).

Male.—Face black, with silvery-white hairs at sides. Front, owing to the joined eyes, reduced to a small, frontal triangle and an ocellar tubercle, which are black, the former with silvery-white hairs above; vertex with long, black hairs. Eyes covered with dense, but short, white pubescence. Antennæ brownish-black, of the form described under the generic characters. Thorax black, with silvery-white pubescence, the spines at sides black and shining; scutellum black, bordered with white pubescence, and a few, long, black hairs, and bearing two, long, stout, diverging, marginal spines, which are yellow-brown with the base black, and which bear long, white and black hairs. Abdomen black, with white pubescence. Legs with femora and tibiæ black, the knees brown; tarsi yellow, brownish towards the tips. Wings brownish, the veins surrounding the anal cell strongly suffused with dark brown, and with a dark brown cloud occupying the greater part of the wing-tips.

The above description is taken from a specimen kindly sent to me by Mr. Froggatt.

11. GERANOPUS, gen.nov. (Figs.5 and 6).

Antennæ with third joint consisting of four, closely united segments, produced terminally into a long, thickened arista; eyes bare in both sexes, joined in the male, widely separated in the female; scutellum with two spines; abdomen slightly broader than the thorax, with a constricted base; legs remarkably long, the first joint of posterior tarsi longer than the posterior tibiæ, wings with the four, posterior veins arising from the discal cell, and reaching to the wing-margin, or almost so.

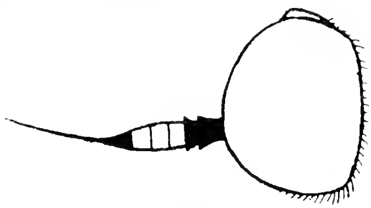


Fig.5.
Head of *Geranopus purpuratus*, ♀.

Head larger in male than in female, wider than the front part of the thorax, and excavated behind; face rounded. Eyes bare in both sexes, joined in the male, widely separated in female. Antennæ rather longer than the head, first joint twice the length of second, third twice the length of first and second together, composed of four, closely united segments, the fourth pointed, and produced terminally into a slightly thickened arista, which is about the same length as the rest of the antennæ. Thorax long and almost parallel-sided, the scutellum with two spines. Abdomen slightly broader than thorax, the base constricted. Legs remarkably long, first joint of posterior tarsi longer than the hind tibiæ. Wings with the costal vein extended considerably beyond the tip of the cubital; cubital vein forked; discal cell with four, issuing veinlets, although the fourth may sometimes issue only from the extreme corner; they are complete, and reach the wing-margin or almost so; anal cell closed at some distance from the wing-margin.

This genus bears some resemblance to the *Sarginæ*, but is separated from that subfamily on account of all the four, posterior veins arising from the discal cell, and because the arista is thickened, and not thread like. The genus of the *Clitellarinæ*, to which it seems to bear most resemblance, is the Mexican and Cuban genus *Chrysochlora*, but it is distinguished from that genus by the scutellum being armed, and by the third, antennal joint consisting of four, instead of six segments.

Geranopus may be easily distinguished from all the other Australian genera by the extremely long, posterior tarsi, the first joint of which is longer than the whole of the posterior tibiæ, in conjunction with the antennal arista.

This genus is proposed for a species which, up to the present, has been taken only in Victoria.

GERANOPUS PURPURATUS, sp.nov. (Figs.5 and 6).

Front, thorax, and scutellum black; scutellar spines, and margin of scutellum, between the spines, light brown; abdomen dark purple; femora black; tibiæ and first joint of tarsi white, with apices black; remaining tarsal joints black; wings light brown, with base and apex clear. Length, ♂, 11; ♀, 10-11 mm.

Hab.—Victoria.

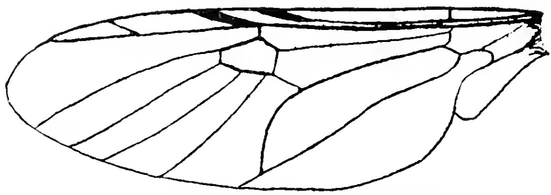


Fig.6.—Wing of *Geranopus purpuratus.*

Male. – Face and front black, the latter, owing to the joined eyes, being reduced to a small, triangular strip adjoining the vertex. Eyes bare, and, unlike the female, without any posterior rim. Thorax black, shining, minutely punctate, with fairly long, whitish pubescence at sides; scutellum black, with the two spines, and margin between the spines, light brown. Abdomen dark purple, minutely punctate, with white pubescence on sides. Legs with femora black; tibiæ and first joint of tarsi white, with apices black; remaining tarsal joints black. Wings light brown, with base and apex clear. Halteres pale yellow.

Female resembles the male, but the head is much smaller, the eyes widely separated, front broad and wrinkled longitudinally.

Specimens of the larva have been found under a log at Fern Tree Gully, by Mr. F. P. Spry, who succeeded in breeding a specimen. The pupa-case resembles that of *Pachygaster* very closely. The empty case consists of ten segments, the head, and apparently first segment, being missing; it is flat, black, and bears yellow bristles, second and third segments each with six dorsal bristles, fourth to ninth each with four dorsal bristles, tenth and eleventh each with two dorsal bristles; in addition, each segment bears a pair of lateral bristles on each side, and the last segment also a pair of unusually long, converging bristles.

G. purpuratus is, at present, known to occur only in Victoria, where several specimens have been obtained. One of these will be found in the collection of the Melbourne Museum.

12. ELISSOMA, gen.nov.

Slender, brightly coloured, but not metallic flies. Antennæ extremely long and slender, about five times the length of head; scutellum with two spines; abdomen twice as long as broad, narrow at the base, and broadening posteriorly, with a rounded apex; legs long and slender; wings large, cubital vein forked, fourth, posterior vein arising from the junction of the discal cell and second, basal cell.

Head slightly broader than the front of the thorax. Antennæ extremely long and slender, about five times the length of the head, first two joints short, first about twice the length of second, third about four and one-half times the length of first and second together; the three joints are of almost equal breadth, but the short, second joint is slightly the broadest; the third joint in its basal portion, for a length slightly exceeding the first and second joints together, is apparently without annulations, then come four or five, obscure, closely approximated annulations, after which the remainder of the third joint, amounting to about two-thirds of its complete length, is without annulations. Eyes bare, touching, in the male, at a point a short way above the antennæ. Vertex with an elevated, scutellar tubercle. Head connected with the thorax by a distinct neck. Thorax almost bare, narrower in front than at the base of the wings, and bearing distinct shoulder-tubercles. Scutellum with two spines. Abdomen nearly bare, about twice as long as broad, narrow at the base and broadening posteriorly, with a rounded apex. Legs long and slender, with the tarsi greatly lengthened. Wings large, veins distinct and not crowded anteriorly; cubital vein forked; four, posterior veins present, the fourth arising from the junction of the discal cell and the second basal cell.

This genus is proposed for a very remarkable, Victorian species, which apparently mimicks one of the Hymenoptera. It may be easily distinguished by the extremely long antennæ, variegated colouring, and greatly lengthened tarsi. It seems to come nearest to the Mexican genus *Compeprosopa* in the subfamily *Stratiomyinæ*; it bears no resemblance to any other Australian genus, although, in the venation and formation of the legs, it seems to show certain affinities to *Geranopus*.

Elissoma lauta, sp.nov.

Eyes carmine-red; back of head and front of thorax orange; dorsum of thorax black, with two, lengthened, triangular, white spots adjoining the scutellum; scutellum white, with two, small, white spines; abdomen with the first three segments and the outer margins of the remaining segments pale yellow, fourth segment black, with a pale yellow hind-margin, fifth and sixth black; femora black; anterior and middle tibiæ and tarsi yellow; posterior tibiæ and tarsi black; wings brown. Length, ♂, 11 mm.

Hab.—Victoria (Fern Tree Gully).

Male.—Face orange, receding. Eyes carmine-red, bare, occupying the greater part of the head, joined at a short distance above the base of the antennæ. Antennæ as described under the generic characters, first joint black, second orange, third black. Front orange, ocellar tubercle black. Back of head, neck, and front of thorax, including the shoulder-tubercles, orange; dorsum of thorax black, with two, lengthened, triangular, white spots, their bases resting against the scutellum, and their length about equal to that of the scutellum; scutellum white, with two, very small, white spines. Abdomen bare, the first three segments, and outer margins of the remaining segments, shining, pale yellow: fourth segment black, with a pale yellow hind-margin: fifth and sixth black; genitalia black: first three, abdominal segments with a few, yellow hairs at sides. Legs with all femora black, anterior and middle tibiæ and tarsi pale yellow, posterior tibiæ and tarsi black. Wings brown, the venation closely resembling that of *Geranopus purpuratus* (See Fig.6). Halteres purplish-white.

This interesting species may be easily recognised by its very variegated colouring, in conjunction with the extremely long antennæ. Two specimens are, at present, known. One of these is in the collection of the Melbourne Museum; the other was taken by Mr. F. P. Spry, at Fern Tree Gully, in December, 1913. In Mr. Spry's opinion, this species mimicks one of the *Braconidæ*.

13. Ophiodesma, gen.nov. (Fig.7).

Antennæ almost twice the length of head, first two segments short, the first being twice the length of second, third about six times the length of first and second together, composed of eight, closely united segments; scutellum with two, small spines; abdomen rounded, distinctly longer than broad; wings with four, posterior veins, which all issue from the discal cell; cubital vein forked.

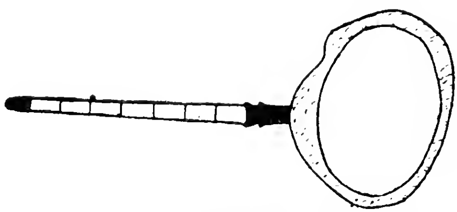


Fig.7.—Head of *Ophiodesma flavipalpis*, ♀.

Head rounded in front. Eyes in female (the only sex known) bare and separated, but not very widely. Antennæ situated about the middle of the head in profile, almost twice the length of head, first joint twice the length of second, which is exceptionally short, third flagelliform, about six times the length of first and second together, composed of eight, closely united segments, the last narrowed, and rather styliform in appearance. Thorax narrower anteriorly than posteriorly, with small shoulder-tubercles; scutellum with two, small spines. Abdomen distinctly longer than broad, rounded posteriorly. Wings with four, posterior veins, which all arise from the discal cell; cubital vein forked, and running directly from the discal cell to the costal margin, the anterior cross-vein being apparently wanting.

This genus is proposed for the species described by Macquart under the name of *Odontomyia flavipalpis.* It somewhat resembles *Odontomyia* in general appearance, but, as shown by the venation, it belongs to the *Clitellarinæ*, and not to the *Stratiomyinæ.* It is further distinguished from *Odontomyia* by the antennæ, which have the third joint composed of eight, instead of five or six, segments. It does not seem to resemble any of the described genera of the *Clitellarinæ.*

OPHIODESMA FLAVIPALPIS Macq. (Fig.7).

Syn., *Odontomyia flavipalpis* Macq.

Face, front, and antennæ black, front with a protuberance midway between vertex and antennæ. Thorax and scutellum deep black, with very short, scattered, depressed, yellowish pubescence; scutellar spines small, brown. Abdomen blue-black, minutely punctate. Legs with femora and tibiæ black, tarsi white, with tips darkened. Wings hyaline, with anterior veins and stigma dark brown. Length, ♀, 5-6 mm.

Hab.—New South Wales and Victoria.

This species is easily recognised by its general, black colouration, with white tarsi. It seems to occur fairly commonly both in New South Wales and Victoria.

Subfamily STRATIOMYINÆ.

In this subfamily, four, posterior veins are present, the first, second, and third arising from the discal cell, the fourth distinctly separated from it, and arising from the second, basal cell.

The antennæ are either with or without a style, but never with an arista.

The *Stratiomyinæ* are represented in Australia by the important genus *Odontomyia*, which is of world-wide distribution.

14. Odontomyia Meig.

(*Exochostoma* Macq.; *Opseogymnus* O.-Costa; *Psellidotus* Rond.; *Eulalia* Kert.)

Eyes either bare or hairy, practically touching in male, widely separated in female. Antennæ with the two, basal joints almost equally long, or, at the utmost, with the first joint twice the length of second; third joint with from four to six, closely united segments, of which the last two may form a terminal style. Scutellum with two spines. Abdomen almost quadrate in male, ovate in female. Wings with the anterior veins much crowded; cubital vein either forked or simple; four, posterior veins present, the first to third arising from the discal cell, the fourth from the second basal cell, but two of those from the discal cell are frequently abortive, and, as a rule, none reach the wing-margin.

Sixteen species have, so far, been described from Australia, but several of these cannot be considered as really distinct. *O. flavipalpis* Macq., I have placed in a new genus, *Ophiodesma*, in the subfamily *Clitellarinæ*. Of the remaining species, *O. stylata* Macq., and *O. ialemus* Walk., are identical with *O. amyris* Walk., and *O. hunteri* King. *O. rufifacies* Macq., and *O. carinata* Macq., are also apparently merely varieties of the same species. *O. annulipes* Macq., cannot be satisfactorily distinguished from *O. subdentata* Macq., and, until further evidence is obtainable, can be considered only as a variety of that species. *O. regis-georgii* Macq., was described from a specimen without a head, and, therefore, does not admit of identification; it should be deleted. The same applies to *O. picea* Walk., the type, in the British Museum, being in too bad condition for identification. *O. stricta* Erichs., cannot probably be identified from the description, and the locality of the type is unknown. The only other species that calls for mention is *Stratiomys badius* Walk.; this is probably an *Odontomyia*, but I have been unable to trace it.

Table of the Australian Species of Odontomyia.

1. Abdomen entirely black .... 2.
   Abdomen black, with green or yellow side-margins .... 3.
   Abdomen black, with three pairs of green or yellow side-spots. 5.
2. Legs entirely black .... *scutellata* Macq.
3. Femora black; tibiæ yellow, with a black ring......... *marginella* Macq.
   Femora and tibiæ yellow.......................... 4.
4. Face fulvous; scutellum with a yellow margin; cubital vein forked.......................... *amyris* Walk.
   Face black (♂) or yellow, with a black keel (♀), scutellum with a yellow margin.......................... *subdentata* Macq.
   Face and scutellum entirely black, cubital vein not forked...... .... *opertanea*, sp.nov.
5. Abdomen with three pairs of small, widely separated side-spots; antennæ with a long, thin style..................... *carinifacies* Macq.
   Abdomen with three pairs of side-spots, first and second pairs large, and usually confluent; antennæ with a very short, thick style .... *lateremaculata* Macq.

In using the above table, it should be borne in mind that the *face* is only that part of the head *below* the antennæ; the part above the antennæ is the *front*.

The species *O. subdentata* Macq., and *O. marginella* Macq., are unknown to me, and, for the particulars given, I depend on Macquart's descriptions.

Odontomyia scutellata Macq.

Thorax and abdomen black; scutellum brown, scutellar spines long, brown, with tips black; legs, including the tarsi, entirely black. Length, ♂, 12 mm.; ♀, 10 mm.

Hab.—Tasmania.

This is a scarce species. The male is remarkable for the fact that, in life, the eyes are a brilliant blue, which gives the insect a most splendid appearance.

Odontomyia amyris Walk.

Syn., *Odontomyia ialemus* Walk.; *O. stylata* Macq.; *O. rufifacies* Macq.; *O. carinata* Macq.; *O. hunteri* King.

Face entirely fulvous in both sexes. Front(♀) fulvous below, black above (in ♂, owing to the joined eyes, the front is reduced to a very small, black patch at the vertex). Thorax, in life, brilliant green, in dried specimens, black; scutellum black, with outer margin yellow, and with two, yellow spines Abdomen black with green or yellow side-margins, which vary greatly in size and shape. Legs entirely yellow, or, at the most, with the hind tarsi a little darkened. Wings with the cubital vein forked. Length, ♂♀, 9-11 mm.

Hab. Queensland, New South Wales, Victoria, Tasmania, South Australia, and Western Australia.

This is, by far, the commonest, Australian species of *Odontomyia*, and is very widely distributed. Much variation is shown in the extent of the green or yellow, abdominal side-margins, which may be narrow and almost straight, or broad and considerably bowed in the middle. The type of *O. amyris*, in the British Museum, is a small variety, with narrow side-margins; that of *O. ialemus* has the side-margins broad and bowed in the middle, but both belong to the same species. *O. hunteri* was apparently described from a rather rare variety, in which the green side-margins are reduced to large, basal spots. There is also considerable variation in the colouring of the front in the female; this has, normally, the upper two-thirds black, the lower third fulvous, but the fulvous portion may be reduced to a couple of spots directly above the antennæ; whilst, on the other hand, a variety from South Australia, which may represent a distinct species, has only the upper half black, and the lower half pale yellow. In any case, however, *O. amyris* may be distinguished by the entirely fulvous or yellow face, and the entirely yellow legs.

ODONTOMYIA SUBDENTATA Macq.

Face black(♂) or yellow with a black keel(♀); thorax black; scutellum black, with a yellow margin and two very small spines: abdomen black, with yellow side-margins: legs entirely yellow. Length, ♂♀, 6 mm.

This species was described by Macquart from "Australia."

O. annulipes Macq., according to Macquart's description, differs from *O. subdentata* only in the colouring of the tibiæ, which have a black ring,instead of being entirely yellow. The distinction is an unsatisfactory one, and it cannot be considered as distinct until more evidence is forthcoming.

Odontomyia marginella Macq.

Face, front, and antennæ black; abdomen black, with narrow, green side-margins; femora black; tibiæ yellow, with a black ring. Length, 5 mm.

Hab.—"Tasmania."

This species, which is unknown to me, should be distinguished, without difficulty, by its black femora.

Odontomyia opertanea, sp.nov.

Face in female entirely black; antennæ, front, thorax, and scutellum entirely black: scutellum with two, very short, brown spines; abdomen black, with narrow, yellow side-margins; legs entirely yellow: wings with the cubital vein not forked Length, ♀, 9 mm.

Hab.—Victoria (Healesville).

Female.—Face projecting forwards, entirely black. Front shining black, with a median furrow. Antennæ about the length of the head, black, first two joints of almost equal length, third nearly twice the length of first and second together, and terminated by a very short, blunt style. Thorax entirely black, beneath as well as above; scutellum entirely black, with two, very small, brown spines. Abdomen black, with narrow, yellow side-margins; lower surface bright yellow. Legs entirely bright yellow. Wings with the cubital vein short, and not forked; anterior veins suffused with brown.

This is the only known, Australian species of *Odontomyia* which has the cubital vein unforked; it is also distinguished from all the other, yellow-legged species by the wholly black scutellum, and by the black face of the female.

O. opertanea is known from only a single species, which was taken at Healesville, Victoria, by Mr. J. French, Junr., on November 7th, 1909.

Odontomyia carinifacies Macq.

Abdomen black, with three pairs of small, yellow, separated side-spots; antennæ with a long, thin style; face, in female, black, with a narrow, fulvous margin. (The male appears to be unknown). Length, ♀, 8 mm.

Hab.—Victoria and Tasmania.

This species seems to be generally scarce.

Odontomyia lateremaculata Macq.

Abdomen black, with three pairs of green or yellow side-spots, the first and second pairs large, and usually confluent; antennæ with a short, blunt style; face, in male, black, in female fulvous. Length, ♂, 12 mm.; ♀, 9 mm.

Hab.—Victoria and Tasmania.

This species is more often met with than *O. carinifacies*, but can hardly be described as common.

Subfamily SARGINÆ.

In this subfamily, four, posterior veins are present, the fourth being separated from the discal cell, and arising from the second, basal cell, as in the *Stratiomyinæ.* It is distinguished from the *Stratiomyinæ* by the long, thread-like, antennal arista.

Only two genera are, at present, known to occur in Australia: one of these, *Sargus*, a genus of almost world-wide distribution, is now recorded for the first time from the Australian region.

Table of the Australian Genera of Sarginæ.

1. Scutellum without spines; bright, metallic species.......... Sargus Fabr.
2. Scutellum with spines; black species............. Acanthasargus White.

15. Sargus Fabr.

(*Chrysonotus* Lw.; *Chrysochroma* Willist.; *Chrysonotomyia* Hunter; *Geosargus* Bezzi.)

Antennæ with a long arista, eyes bare, separated in both sexes; scutellum without spines; abdomen long and slender; wings large, fourth, posterior vein distinctly separated from the discal cell, and arising from the second, basal cell; colouring of thorax and abdomen metallic.

This genus is very widely distributed throughout the Palæarctic Region, Ceylon, the East Indies, North, Central, and South America, and the West Indies, but it has not previously been recorded from Australia. Those species in which the ocelli are equidistant, have been placed in a separate genus (*Chrysonotus*, *Chrysochroma*, or *Chrysonotomyia*), but it is doubtful if the distinction is more than a specific one. The name *Geosargus* has been proposed in lieu of *Sargus*, on account of a fancied preoccupation.

Sargus meridionalis, sp.nov.

Thorax metallic green; abdomen metallic golden-brown; legs yellow; wings with costal half brown, remainder hyaline. Length, ♂, 8 mm.

Hab.—New South Wales (Milson Island).

Male.—Eyes bare, almost joined on the middle of the front; anterior ocellus widely separated from the two, posterior ocelli, which are close together. Face shining brown. Front coppery-green, very narrow, posteriorly constricted in the middle by the approximated eyes. Thorax bright metallic-green, with brownish pubescence. Abdomen metallic-brown, with a golden tint, and bearing a little, similarly coloured pubescence. Legs entirely yellow. Wings with the costal half tinged with brown, remainder hyaline; stigma brown; the four, posterior veins are practically complete, though a little indistinct as they reach the wing-margin.

This striking species is, at present, known only from a single specimen, which was taken by Dr. Ferguson, at Milson Island, on January 30th, 1915.

16. Acanthasargus White.

Black or purple-black flies, with a two-spined scutellum.

When this genus was proposed, only the female was known; since then, however, several specimens of the male have been taken by Mr. Hardy and myself. The eyes are bare in both sexes, joined in the male, widely separated in the female. Antennæ with the first two joints of almost equal length, third about the same length as first and second together, thickened, annulated, and provided with a long, thread-like arista. Scutellum with two spines. Abdomen about the length of head and thorax together, constricted at base, and widening gradually towards apex. Legs short and slender. Wings with the discal cell small, four, posterior veins all incomplete and indistinct, fourth arising from the second, basal cell.

Of this genus, only one species has been described, but a second species, distinguished by the yellow, scutellar spines, is represented by a single specimen, in the collection of the Melbourne Museum.

ACANTHASARGUS PALUSTRIS White.

Thorax and scutellum dull black, the latter with two, long, black, marginal spines; abdomen purple-black; legs yellow, the posterior tibiæ frequently with a dark ring; tarsi yellow or brownish; wings tinged with brown, and with a brown stigma, which is distinct in the male, indistinct in the female. Length, ♂♀, 6 mm.

Hab.—Tasmania.

This species frequents rock-pools in the beds of mountain-streams. It occurred not uncommonly in the early summer of 1914, but is usually scarce. Specimens will be found in the collection of the Melbourne Museum.

Subfamily PACHYGASTRINÆ.

In this subfamily, the wings possess only three, posterior veins, which all arise from the discal cell: the antennæ bear a long, thread-like arista. The Australian species are small, black flies, with a short, ovate abdomen.

Table of the Australian Genera of Pachygastrinæ.

1. Scutellum rounded.. PACHYGASTER Meig.
2. Scutellum produced backwards in a spine-like prolongation...... .... LONCHEGASTER White.

17. PACHYGASTER Meig.

Eyes bare, touching in the male, widely separated in the female; antennæ short, third joint orbicular, with four, slight annulations, and a long, subterminal arista: scutellum rounded behind, without any sign of spines; abdomen very short, broader than long, and ovate.

This genus is widely distributed through North America, Europe, Asia, and New Guinea. No species has, so far, been described from Australia, but there is a specimen belonging to this genus in the collection of the Melbourne Museum.

18. Lonchegaster White.

This genus resembles *Pachygaster*, but is distinguished by the form of the scutellum, which rises from the thorax at an angle of about 45°, and is produced backwards centrally, in a thin, spine-like prolongation, this spine being about the same length as the rest of the scutellum.

Only one species is known.

Lonchegaster armata White.

Thorax and scutellum dull black; abdomen blue-black; legs pale yellow; wings hyaline, with anterior veins light brown, posterior veins very faint. Length, ♂♀, 3 mm.

Hab.—Tasmania.

Of this species, four specimens are known, all of which occurred on the windows of my house at Mangalore, Tasmania, during the summer of 1911-12. One of these specimens is now in the collection of the Melbourne Museum.

Species of doubtful position.

The three following species, *Beris quinquecella*, *Beris nitidithorax*, and *Beris fusciventris*, all described by Macquart from Tasmania, are unknown to me; they may belong either to the *Berinæ* or to the *Antissinæ*.

Addendum.

Mr. F. P. Spry has been good enough to send me two specimens of the undescribed species of *Acanthasargus* referred to previously (*antea*, p.96), so that I am now able to describe it.

ACANTHASARGUS GRACILIS, sp nov.

Face yellow above, black below: front and thorax black; scutellum black, with the two spines and margin between the spines yellow; abdomen purple-black, legs yellow; wings with a brownish cloud across the discal cell. Length, ♀, 6·5 mm.

Hab.—Victoria (Gippsland).

Female.—Head less produced than in *A. palustris*, with a yellow rim behind the eyes. Face with the upper part immediately adjoining the antennæ yellow, the remainder black. Antennæ black. Front black. Thorax deep black, minutely punctate: scutellum black, with the two spines, and margin between the spines, yellow. Abdomen purple-black, broader than in *A. palustris*, with a little, white pubescence at sides. Legs yellow, the tarsi a little brownish towards the tips. Wings with the four, posterior veins somewhat indistinct, but nearly reaching the wing-margin; stigma brown, and a slight brownish cloud covering the region of the discal cell.

This species bears a close resemblance to *A. palustris*, but may be distinguished without difficulty by the yellow, instead of black, scutellar spines. It seems to be generally scarce.

Systematic List of the Stratiomyidæ of Australia.

STRATIOMYIDÆ.

BERINÆ.

CRYPTOBERIS, gen.nov.
hebescens, sp.nov. ... ... New South Wales.

METOPONIA Macq.
rubriceps Macq. ... ... Tasmania.
australis Macq. ... ... "Australia."

XANTHOBERIS, gen.nov.
siliacea, sp.nov. ... ... New South Wales.

ACTINA Meig.
incisuralis Macq., (*filipalpis* Macq.) New South Wales, Victoria, Tasmania, Queensland.
costata White ... ... Tasmania.

NEOEXAIRETA Ost.-Sack.

spinigera Walk., (*servillei* Macq.) ... New South Wales, Victoria, Queensland.

ANTISSINÆ.

LECOGASTER White.

cœrulea White ... ... Tasmania.

cyanea, sp.nov. ... ... New South Wales.

ANACANTHELLA Macq.

splendens Macq. ... ... South Australia.

ANTISSA Walk.

cuprea Walk. ... .. Western Australia.

ANTISSELLA White.

parvidentata Macq. ... New South Wales, Victoria, Tasmania.

CLITELLARINÆ.

NEGRITOMYIA Bigot.

albitarsis Bigot. ... ... Queensland.

GERANOPUS, gen.nov.

purpuratus, sp.nov. ... Victoria.

ELISSOMA, gen.nov.

lauta, sp.nov. ... ... Victoria.

OPHIODESMA, gen.nov.

flavipalpis Macq. ... ... New South Wales, Victoria.

STRATIOMYINÆ.

ODONTOMYIA Meig., (*Exochostoma* Macq.: *Opseogymnus* O.-Costa; *Psellidotus* Rond.; *Eulalia* Kert.).

scutellata Macq. ... ... Tasmania.

amyris Walk., (*ialemus* Walk., *stylata* Macq., *rufifacies* Macq., *carinata* Macq., *hunteri* King.) Queensl'd, New South Wales, Victoria, South Australia, Tasmania, Western Australia.

subdentata Macq. ... ... "Australia."

opertanea, sp.nov. ... ... Victoria.

marginella Macq. ... ... Tasmania.

ODONTOMYIA, *contd.*

carinifacies Macq. ... ... Victoria, Tasmania.
lateremaculata Macq. ... Victoria, Tasmania.

SARGINÆ.

SARGUS Fabr., (*Chrysonotus* Lw.: *Chrysochroma* Willist.; *Chrysonotomyia* Hunter; *Geosargus* Bezzi.)

meridionalis, sp nov. ... New South Wales.

ACANTHASARGUS White.

palustris White ... ... Tasmania.
gracilis, sp.n. ... ... Victoria.

PACHYGASTRINÆ.

PACHYGASTER Meig.

sp. ... ... Victoria.

LONCHEGASTER White.

armata White ... ... Tasmania.

SPECIES DUBIÆ AUT INCERTÆ SEDIS.

ODONTOMYIA Meig.

annulipes Macq. ... ... Tasmania.

BERIS Latr.

quinquecella Macq.... ... Tasmania.
nitidithorax Macq.... ... Tasmania.
fusciventris Macq. ... ... Tasmania.

SPECIES EXPURGATÆ.

ODONTOMYIA Meig.

regis-georgii Macq.... ... "Australia."
picea Walk.... ... ... "Australia."
stricta Erichs. ... ... "Australia."

STRATYOMYS Geoffr.

badius Walk. ... ... "Australia."

ORDINARY MONTHLY MEETING.

April 26th, 1916.

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

Mr. Alfred L. Bennett, The Oaks, near Camden; Miss Margaret Deer, B.A., B.Sc., Cremorne, Sydney; Mr. William Welch, F.R.G.S., Mosman, Sydney; and Mr. Cyril T. White, Brisbane, were elected Ordinary Members of the Society.

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

The Donations and Exchanges received since the previous Monthly Meeting (29th March, 1916), amounting to 3 Vols., 96 Parts or Nos., 19 Bulletins, 4 Reports, and 9 Pamphlets, received from 37 Societies, etc., were laid upon the table.

NOTES AND EXHIBITS.

Mr. Fred Turner exhibited specimens of, and offered observations on, the following plants:—(1) *Sideroxylon arnhemicum* Benth. et Hook., Syn. *Achras arnhemica* F.v.M. The specimens were gathered in Northern Queensland by Mr. A H. Cooper, who forwarded them to the Honorable Dr. J. M. Creed, M.L.C., with a request that he should hand them to Mr. Turner for accurate botanical determination. Mr. Cooper says that the foliage of this tree has proved valuable feed for cattle and horses during the recent disastrous drought in the northern State. In fairly open country, this species of *Sideroxylon* grows into a very beautiful and umbrageous tree, and for its highly ornamental appearance alone is well worth extensively planting for shade about homesteads in the warmer parts of Australia — (2) *Loranthus longiflorus* Desr. This parasitic plant was growing on a lemon-tree at Lindfield, and was forwarded by Mr. Warwick Lloyd to the exhibitor for identification and report. Mr. Turner had not hitherto known this species of *Loranthus* to grow on any exotic tree or plant. In Mr. Fred Turner's paper "On Exotic Trees and Shrubs affected by Australian Loranths and Viscums" (the Society's Proceedings, 1895), only three species of the indigenous *Loranthaceæ* were recorded as growing on exotic vegetation, viz., *L. celastroides* Sieb., *L pendulus* Sieb., and *Viscum articulatum* Burm., the first two being much more common than the last.—(3) *Polygonum orientale* Linn., var. *pilosum* Meissn., Syn. *P. pilosum* Roxb. The specimen was forwarded by Mr. K. M. Niall, Buckunguy Station, Nyngan district, to the exhibitor for its botanical name. Mr. Turner has never hitherto known this species to occur west of the Blue Mountains, N.S.W. Mr. Niall says that "it grows four or five feet high, and that certain horses eat it greedily, whilst others will not look at it." This species is recorded in Turner's "Botanical Survey of North-East New South Wales."

Mr. T. Whitelegge exhibited a series of mounted slides illustrating the sexual generation of *Psilotum triquetrum*. The spores were grown on the living rhizomes of *Davallia pyxidata*, in a small Wardian case. The spores of *Psilotum*, although isosporous, are strictly diœcious. The male gametophyte consists of about eight cells. These are unequal in size, with clear, thin walls, enclosing very many extremely minute antherozooids. The cells are distinct, being only slightly adherent to each other, easily detached, and often float free when placed in water. The larger cells are equal to the diameter of the spore, the smaller to that of the nucleus. Spores destined to produce the female gametophyte contain an indefinite number of small cells. A single dome-shaped body emerges from the centre of the spore, and is about equal to its diameter. The structure consists of many irregular cells, apparently held together by gum; some project on the sides either near the summit or base; the latter, at its junction with the spore, exhibits a well defined ring of brown cells, encircling an opening leading from the interior of the spore into the hollow part of the dome. The projecting cells may represent the tips of the archegonia. Sections will be required to settle the question. Failing to secure ripe spores of *Tmesipteris*, old synangia were dissected. Traces of both male and female gametophytes were found, proving that the spores often germinate in the capsules. After this discovery, further examinations of the old synangia of *Psilotum* were made. Many contained self-germinated spores, and afforded a better supply of material for study than by cultivation.

Mr. Bassett Hull exhibited a mounted specimen of the Fluttering Petrel (*Cinathisma cyaneoleuca*) recently discovered by him near Ulladulla, N.S.W., and described as new ("Emu," Vol. xv., p.205, 1916).

Mr. North, by the permission of the Curator of the Australian Museum, exhibited a skin of the White Nutmeg, or Torres Strait Pigeon, (*Myristicivora spilorrhoa*) from Port Denison, Queensland, its hitherto known southern limit. Also a wing of a bird, forwarded to the Curator of the Australian Museum, for identification, by Mr. Ralph C. Blacket, of the Forestry Department, South Grafton, Clarence River, with a letter under date 26th March, 1916, from which the following extract is made:—"I did not myself see the whole bird, but the wing sent belonged to one of four birds seen at Urunga (at the mouth of the Bellingen River) all in one small tree. Two were shot, and one was eaten as a pigeon, but no one seems to have noticed this bird in the district before." Mr. North stated that, so far as he was aware, it was the first record of *Myristicivora spilorrhoa* G. B. Gray, being obtained in New South Wales.

Dr. J. B. Cleland exhibited a young plant of *Hakea leucoptera*, grown in Sydney, from seeds obtained at Overland Corner, Murray River, S.A. The leaves of the adult shrub are terete, pungent-pointed, and slightly hirsute. The cotyledons of the seedling resemble those of other Hakeas, being broad and rather wedge-shaped, about $\frac{3}{8}$ in. long by $\frac{3}{16}$ in. broad. *The first leaves to appear are broad linear-lanceolate*, about $1\frac{1}{2}$ in. long. A number of these appeared, representing a growth of about 2 inches, when they became narrower, and were then succeeded by terete leaves, like those of the adult but more slender. Occasionally later, some of these became furcate, a condition that was not noted on the adult shrub, though it might have been present occasionally. Still later, a second batch of lanceolate to linear-lanceolate leaves were developed, succeeded again by terete ones. After struggling for about 20 months against the adverse conditions of a Sydney soil, the seedling suddenly wilted and died. Other seeds were planted on November 9th, 1916, and one came up on November 24th. This has likewise developed at first narrow-lanceolate leaves, to be succeeded later by terete ones. So far, a second crop of flattened leaves has not developed, but, as their occurrence is probably partly dependent upon conditions of moisture, it may perhaps be expected later. In the Sydney district, there are four common terete-leaved Hakeas, none of which, in the seedling-stage, show any flattening of the initial leaves following the broad cotyledons. It was, therefore, a matter of considerable surprise to find that the seedling-leaves of a terete-leaved Hakea from the dry interior differed from those of similar-leaved Hakeas of the East Coast in being flattened. This occurrence would suggest a closer relationship of *H. leucoptera* to the broad-leaved Hakeas than to the terete-leaved Sydney species.

Dr. J. B. Cleland and Mr. E. Cheel exhibited specimens of the larger fungi collected by the former, at the beginning of April, between Byron Bay and Tweed Heads, in northern New South Wales. Late, heavy, monsoonal rain fell during the early part of the trip, causing a number of species of Lepiotes to flourish. *Lepiota dolichaula*, which has appeared in the Sydney district for the last two years, was abundant throughout the area visited, viz., Byron Bay to Murwillumbah, and thence to Tweed Heads, and for some distance north into Queensland. The caps of some of the plants must have been as large as tea-plates, and stood out like white saucers, or, in places, like isolated masses of snow on the hillsides. *L. subclypeolaria* was met with for the first time. The figure given in *Grevillea* (xix., Pl.180, fig.A) is a good representation, by which it can be easily recognised. The plants grew abundantly in fields in groups, from Byron Bay to Tweed Heads. The stems are rather short, the cap slightly striate, the whole plant soft to the touch and, a feature not mentioned in the original description, the flesh turns reddish when cut. The delicate, filmy *L. licmophora* was found in brush at Murwillumbah; also *L. felina*, or a species close to it, on the roots of a fern in a shade-house. The Lepiote figured as probably a dark form of *L. cristata* (Agric. Gaz. of N. S. Wales, Feb. 1916, Pl. iii., f.4) was also met with, growing amongst grass; its spores were 7 to $9 \times 4 \cdot 2\mu$ in size. The finding of this form at two such sundered districts as Sydney and Murwillumbah shows its constancy, and suggests that it is not a form of *L. cristata*, but a distinct species. Two other Lepiotes, at present unidentified, were also met with, viz., a delicate white one flecked with brown scales, and a golden one with an elongated cap. The typical, white-capped mushroom, *Psalliota campestris*, was seen at Byron Bay and Murwillumbah; at the latter place also *P.* sp. (gills remaining pallid, and not turning rich pink). The following were also noted:—*Coprinus micaceus* (Byron Bay, Murwillumbah), *Colus hirudinosus* (Byron Bay), *Panæolus ovatus* (Byron Bay), *Schizophyllum commune* (Murwillumbah), and *Cantharellus foliolum* (Murwillumbah).—They also exhibited specimens of a *Psalliota* common in the Sydney district, with a remarkably strong smell resembling that of iodoform, and which they have provisionally called *P. iodoformis*.

Mr. E. Cheel reported that, since recording the various forms of *Hardenbergia* (Proc. Linn. Soc. N.S.W., Vol. xl., 1915, p.722), specimens of *H. monophylla* Benth., var. *alba*, a trailing variety with pure white flowers, had been found in the Jamieson Valley by Mr. A. L. Bennett, this being a third locality, widely separated from the two previously known. He also exhibited a curious abnormal form of *Polysaccum pisocarpium* var. *crassipes* from Gladesville, having five distinct peridia consolidated on a foot-stalk, somewhat resembling a deformed hand.

Dr. H. G. Chapman communicated a note on the condition of a living specimen of a frog (*Hyla aurea*), received at the Physiological Laboratory of the University of Sydney, which appeared to be distended with fluid. The limbs were globular, with constrictions at the joints. The abdomen was swollen, and the flanks bulged outwards. A marked swelling was present beneath the lower jaw. The frog weighed 131 grms. On puncturing the skin and abdomen, the fluid escaped, and was collected. After draining for some minutes, the frog weighed 51 grms. Twenty-four hours afterwards, it weighed 41 grms. The fluid clotted in a few minutes after its removal from the frog. Its freezing-point was 0·488°C. The fluid was lying in the subcutaneous lymph-spaces, and in the peritoneal cavity.

OOCYSTIS AND *EREMOSPHÆRA.*

By G. I. Playfair, Science Research Scholar of the University of Sydney.

(Plates vii.-ix., and 28 Text-figs.)

During the past eight years, 1907-1915, a considerable number of gatherings of freshwater algæ, from Sydney and suburbs, and from the neighbourhood of Lismore, on the Richmond, have accumulated in my hands. In going through these samples on various occasions, I noted the presence of forms of *Oocystis* and *Eremosphæra* in such numbers and variety, that it seemed to me worth while to give a particular account of the two genera, as found in this country. To this end, I have made a thorough examination of my gatherings, to the number of 256, in 52 of which forms of *Oocystis* and *Eremosphæra* occur more or less plentifully. It is somewhat unfortunate that I had to work from preserved material, as, for this reason, the disposition of the cell-contents could not, in many cases, be recorded with certainty. This, however, may be discounted by the fact, that the chloroplasts are of the same character in almost all forms of *Oocystis* and *Eremosphæra*, and, for the rest, I had the advantage of a fair number of notes and figures made from the same material when it was just freshly gathered.

Samples.—The localities from which each form is reported are mentioned in the notes on the various species; the following list gives all the samples referred to in this paper, classified according to the *habitat* from which they were derived. The numbers refer to gatherings preserved in formalin, in the National Herbarium, Sydney.

Nos.49, 56, 59, 67, 79, 104, 105, 107, 118, 119, 124, 135, 138, 139, 140, 148, 149, 159, 163, 164, 171, 174, 185, 240, from swampy grass-lands, periodically dry, where rainwater collects: 23, 45, 57, 60, 70, 74, 84, 88, 91, 92, 95, 106, 114, 128, 146, from pond-edges and weeds in pools; 112 from weeds in creek-pools; 4, 13, 58, 93, from Sphagnum-bog. Plankton: 63, 65, 100, filter-screens, Sydney Water-supply; 136, from several gallons of lake-water passed through filter-papers; 272, 273, 274, 281, from weed-beds in river.

When we consider, in the light of this classification, the habitats from which the various species and forms have been obtained, a very interesting and instructive fact becomes apparent. Certain species and their forms are found here almost exclusively in pools (or river), while others are just as strongly devoted to swamps. Thus, all the species in my notes, from *O. Nägelii* to *O. subhexagona*, viz.:—*O. Nägelii*, *O. Novæ Semliæ*, *O. submarina*, *O. crassa*, *O. lacustris*, *O. parva*, *O. nodulosa*, *O. solitaria*, *O. rotula*, *O. subsphærica*, *O. apiculata*, and *O. subhexagona*, with almost all their forms, are pond-, river-, and plankton-types; whilst *O. Nordstedtiana*, *O. Choduti*, *O. australiensis*, *O. panduriformis*, and *O. ovalis*, along with all forms of *Eremosphæra*,* are swamp-dwellers. The constant association of this group of *Oocystis*-forms with *Eremosphæra* is noteworthy, as there are good reasons for believing them to be closely connected biologically.

Of *Eremosphæra viridis* in the British Isles, G. S. West, Brit. Frw. Algæ, p.229, remarks that it is found "more especially in Sphagnum-bogs." This, however, is not the case here. Out of seven gatherings from the only piece of Sphagnum-bog that I know, the type alone is present in three, and var. *ovalis* by itself in two others, in all cases *very sparsely distributed indeed.*

Scope.—The object of this paper is threefold:—(1) to give an account of all forms of *Oocystis* and *Eremosphæra* met with in New South Wales; (2) to direct attention to the polymorphism of *Eremosphæra*, and to its connection with *Oocystis*; (3) to supply the original descriptions and figures, as far as possible, of all published species and forms of the two genera.

* Out of 46 records of *Eremosphæra*, only 5 are out of pools, and, even in these cases, its cells are very little in evidence.

1. *Synopsis of Australian types.*

The various species and variations found locally are fully discussed in the body of the paper; hence it is not necessary for me to do more here than add a brief summary. Representatives of 17 species have been observed, but, in two cases, *O. crassa* Wittr., and *O. nodulosa* W. West, the types themselves have not been noted. The total number of local forms, therefore, amounts to 15 specific types, 14 variations, and 3 forms—32 in all. Of these, 19 (including *nom. nov.*) are here described as new, viz., 6 species, 11 variations, and 2 forms.

Species.—These new species are established principally on the basis of the shape of the vegetative cell, or autospore, and, in this, they are in line with all those published hitherto. I do not, however, consider any of the species of *Oocystis* to be biologically distinct, but merely polymorphic forms of one organism. It may be argued that the various types always retain their specific characteristics. They do, and they do not. It is true that any specified form gathered from many different localities in a country, or even from many different parts of the world, always exhibits the same shape, peculiarities, and range of dimensions. But, on the other hand, the same form, when closely observed in any given locality, will be found to be by no means as fixed and unalterable as it seemed. It may be noted mixed with variations of the same type, and even with forms of a different type, yet obviously connected with it. A good illustration of this is found in *O. apiculata* West. This species in its size, shape, and apiculus (found in no other type) possesses a group of characteristics which make it very distinct. It has also what, as far as my observation goes, is not found in any other species, viz., a broad, mucous lining to the membrane, such as may be observed on a larger scale in forms of *Eremosphæra.* Specimens of the type are plentiful in sample No.88, but mixed with them are others more slender and more elliptic, and also another type without an apiculus, and approximating in shape to *O. lacustris.* Nevertheless, this var. *simplicior* has the same mucous lining characteristic of the type, and its dimensions connect it with the smaller forms of the latter. Similarly, if Chodat's figures of *O. lacustris* be consulted (Etudes de biologie lacustre, in Bull. de l'herbier Boissier, T. v., Pl. 10), apiculate (not merely acuminate) forms may be noted, approximating to *O. apiculata* (*cf.* Text-figs. 5, 13). A form, then, may be characteristic of one "species," and yet biologically connected with another.

O. hexagona mihi, has also this mucous lining, and is biologically a variant of *O. apiculata*, the connecting link being *O. apiculata* var. *obesa*; it is often very difficult to say exactly to which of them a specimen belongs. *O. hexagona*, however, is of so distinct a shape, and so widespread, that it has seemed best to make it a new type.

O. crassa, *O. lacustris*, and *O. parva* seem to me to form but one species; they are only very slightly different, and are all plankton-forms. *O. australiensis* mihi shows the same shape, repeating itself, but in a swamp-form.

Again, *O. ovalis*, though its chloroplasts are of a type found in no other species, yet reproduces, on a large scale, the same set of forms as are found in *O. Nägelii* (*elliptica* West).

And further, the figures in Bull. de l'herbier Boissier (on *O. lacustris*), and in Wille's study of *O. submarina*, show that, in both these species, the smaller, reduced forms are *O. Novæ Semliæ* pure and simple.

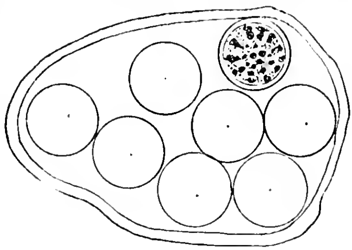
The nearest approach to a fixed type is, perhaps, *O. solitaria* Wittr., of which only a f. *major* and var. *maxima* have been noted, these being merely a reproduction of the type, with greater dimensions. Yet even so, *O. apiculata* has a form (var. *major* mihi) which counterfeits *O. solitaria* very closely.* Indeed, one might say that *we keep our types distinct by arranging intermediate forms as variations.*

Just as reduction-forms are produced in the *Desmidiaceæ* by rapidly repeated subdivision, so also, in the *Autosporaceæ*, they are brought about by the rapidly repeated formation of

* *O. solitaria* var. *notabile* West, also approximates very closely in outline to *O. apiculata*.

autospores. There is no need for the cell to be mature or even free, and the customary inflation very often does not take place.

Mother-cells.—It is to be deplored that comparatively little attention is given in descriptions to the exact shape of the vegetative cell and of the apex, and so much to the details of the mother-cell and the number of autospores. With regard to the latter, it appears to me quite certain that any species may have either 1, 2, 4, 8, or 16 autospores according to circumstances. As for the mother-cell, I think that its shape should not be considered at all in the description or identification of an *Oocystis*. It is generally produced by greater or less inflation of the vegetative cell, and the direction in which this takes place is not necessarily always the same. No doubt the resultant shape depends largely on the equality or inequality of the membrane, *cf.* Eichler, Materyaly do flory wodorostow okolic Miedzyrzeca, 1894, T. ii., f.5,(*fig. nostr.*1) where a mother-cell of *Eremosphæra* is shown with 8 small but typical autospores. The original cell had an incrassate membrane, and the inflation has obviously blown out one side of the cell. It should be noted in passing also that, whatever it was, the original cell was not a typical *Eremosphæra*; towards the right-hand side, the relics of a slight papilla or apiculus can be distinctly seen.



Text-fig. 1.
E. viridis De Bary; mother-cell, (×150); after Eichler.

Again, the apex of the vegetative cell is often incrassate within, or there is an incrassate band round the extreme tip; and when inflation takes place, this incrassation may be tough enough to permit the apex to remain as a small papilla. This would explain why the apical tubercle is so much more common in the mother-cells than in the vegetative cells or autospores.

Further, the mother-cell of any given species is not the same shape as the vegetative cell, nor has each species a mother-cell of characteristic form or size. Indeed, as a general rule, there may be said to be only three types—the globose or subglobose, the oval or oblong, and the tuberculate. It is the free vegetative cell, rather than the mother-cell or autospore, that is distinctive of the type.

Chloroplasts.—In the following notes, many variations will be found, which are established on differences in the chloroplasts. These should not be looked upon as distinct varieties, but as forms brought about by development. There seems to be no doubt that the small, discoid chloroplasts are produced from the simple, parietal lamina by a process of division into 2, 4, 8, 16, etc. While it is true that the two forms of chloroplast, the discoid and the laminar, are rarely found in the same species, this is because they are the products of different environments, the former being characteristic of swamp-forms, and the latter of plankton- or pond-life. It is probable that both are found in *O. Nägelii*, which seems to occupy an intermediate position.

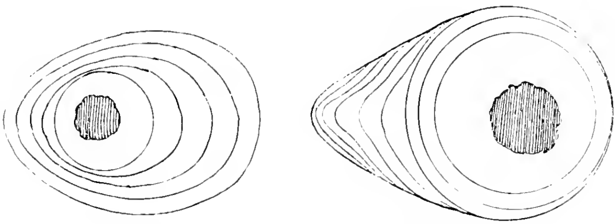
2. *Polymorphism of Eremosphæra.*

This was first demonstrated by Chodat, in Bot. Zeitung, liii., 1895(Ueber die Entwickelung der *Eremosphæra viridis* De By.), where a number of polymorphic forms and reduction-forms, *Glæocystis-*, *Palmella-*, and *Centrosphæra*-conditions are reproduced.* The most distinctive of the polymorphic forms, *l.c.*, T. v., f. 10, will be found described and figured in my notes on the species.

Physiological.—The *Palmella-* and *Centrosphæra*-states, I have not yet met with, nor even the *Glæocystis*-forms till just lately. These last were present, however, in a gathering from Woy Woy kindly sent to me by Mr. A. H. S. Lucas. Some of them will be found in Text-fig. 2. They measure from 80-100μ long, the breadth being somewhat less. The envelopes, of which there may

* This important contribution is a study in itself; there are too many points brought forward for me to do more than touch upon one here and there; out of a large number of interesting figures also, I can only reproduce one or two in support or illustration of my own observations.

be from 5 to 10 or so, are obviously membranous, some thinner, some stouter, the spaces between them being probably filled with the mucilaginous substance generally found in the mother-cells of *Eremosphæra* and *Oocystis*. This *Glœocystis*-condition seems to be brought about by the repeated formation of a single autospore, with the resulting accumulation of mothercell-membranes. The innermost cell is (diam. 40-60μ) the usual size for the smallest forms of *Eremosphæra*, while the whole, if spherical, would be about the dimensions of a normal cell.

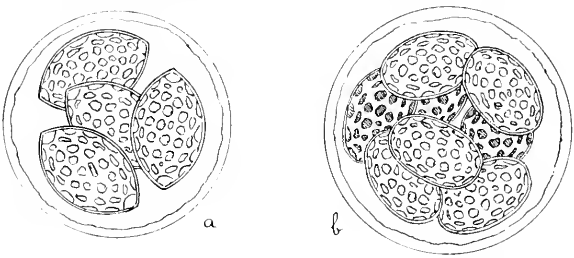


Text-fig.2.—*Glœocystis*-forms of *E. viridis*, (× 335).

Morphological.—But besides this physiological polymorphism, *Eremosphæra* can boast also a *polymorphism* of outward configuration. Four other forms beside the type are wide-spread here, one of which, var. *ovalis*, is almost as common in our waters as the type itself. It would be impossible to overlook these varieties even in quite a cursory examination of my gatherings. Nor can there be any mistake about their connection with *Eremosphæra*; as autospores, var. *ovalis* and var. *acuminata*, at any rate, have the same kind of mother-cell as the type (the other two I have not observed as autospores), the range of dimensions is markedly identical, and though they may not be found always in the same gathering, a majority of these forms has been noted from all the principal habitats for *Eremosphæra*. Thus, including the type in every case, at Auburn A and B* all 5 are found; at Potts Hill* 4; at Canley Vale* and Rookwood 3 each. Also 4 out of 5 are found in company at Lismore*, in an entirely different part of the country.

* All in the same gathering too.

Connection with Oocystis.—In *Eremosphæra*, as in *Oocystis*, the cell generally becomes greatly distended in the production of autospores; sometimes, however, this inflation does not, or cannot, take place. Under these circumstances (and perhaps under ordinary conditions also) especially in small cells, *Eremosphæra* will give rise to *Oocystis*-autospores. Chodat, *l.c.*, has already figured such cases,* (see fig.19*b*, under *O. rotula*), and, in Text-fig.3, I reproduce two that have come under my own notice. In



Text-fig.3.—*Eremosphæra* mother-cells with *Oocystis* autospores; (*a*)*Oocystis australiensis* mihi(× 665); (*b*) *O. Chodati* mihi (× 500).

Text-fig.3*b*, the autospores are *O. Chodati* mihi; in Text-fig.3*a*, *O. australiensis* mihi. The spherical mother-cells were easily recognisable as *Eremosphæra* by the thick mucous lining of the cell-wall, and, in the case of fig.3*a*, vegetative cells of *Eremosphæra viridis* of the same diameter(46 μ) were present in quantity; the autospores are types of *Oocystis* commonly found here as free vegetative cells. Further, *O. ovalis* sometimes produces *Eremosphæra*-autospores, *cf.* Pl. vii., f.20, size of specimen, long. 67, lat. 40 μ.

All my observations, then, tend to show that *Eremosphæra viridis* is an *Oocystis*, and should be included in that genus; the constitution of the cell is the same, the chloroplasts are the same, its polymorphic forms exhibit just as marked polarity as any species of *Oocystis*; and, upon occasions, it gives rise to *Oocystis*-

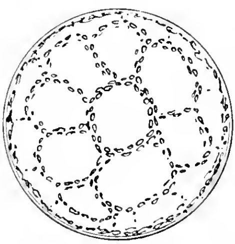
* In T. v., f.9, the autospores are *O. Chodati* mihi, but with radiating chloroplasts; in figs.19, 21, the lower mother-cell is *O. rotula* mihi; the autospores of the upper are suspiciously like *O. Nägelii* (*elliptica*).

autospores. In my opinion, it is, biologically, the mature form of the genus *Oocystis*, the varieties of which are really forms of one true species, in a greater or less degree of reduction.

Membrane.—In the typical, spherical forms, the membrane is generally stout (× 1-2 μ) but simple, and sometimes it is the same also in the other forms. Generally, however, the latter have this membrane lined with a thick, mucous structure (× 4 μ or so), which is usually longitudinally corrugated into rather broad gores. More rarely, the mucous lining is also marked by two or three horizontal corrugations just below the polar cap. In one specimen that I noted, the mucus was thinner, and sulcate in such fine wavy lines as to present the appearance of watered silk. Var. *nodosa* often has the mucous lining covered with shallow depressions, so that the membrane appears to be very coarsely scrobiculate.

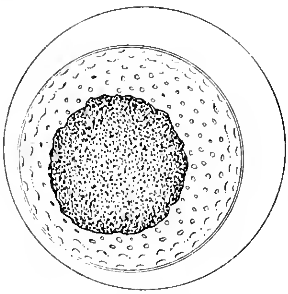
Text-fig. 4. *E. viridis*, with digitate chloroplasts, (× 370).

Chloroplasts.—The chloroplasts are usually minute, parietal discs (× 4-6 μ), but not, as far as my recollection goes, in lines, or adhering to one another (*cf.* G. S. West, Brit. Frw. Algæ, p.229). Nor have I come across any cells with radiating, laminar chloroplasts as figured by Chodat, Bot. Zeit., liii., T. v., f.6, 7. Sometimes, however, the chloroplasts are minutely fusiform or digitate (Text-fig.4) as in *Oocystis ovalis*, and, when this is the case, they have a tendency to lie along the strands of protoplasm by which the nucleus is suspended. Occasionally, the ends of these protoplasmic strands form a kind of cellular network on the surface of the cell-wall (Text-fig.5), and, to this network, the chloroplasts adhere.



Text-fig. 5.—*E. viridis*, with chloroplasts edging a pseudocellular structure, (× 330).

After revivification of a previously dried habitat, cells of *Eremosphæra* are often found in which the chlorophyll has been wholly or partially converted into a mass of yellowish-red globules closely surrounding the nucleus. On the cell resuming its normal existence, these are gradually transformed again into chloroplasts. I have observed the occurrence of this reddish substance in *Oocystis ovalis* also, and in a swamp-form of *O. lacustris* (see notes under these species). The last remnants of it may be noted as a faint, red tinge surrounding the central body.



Text-fig. 6.—Hypnospore of *E. viridis*, (× 335).

Hypnospores.—In sample No. 149, among quantities of *Eremosphæra*-cells of various shapes, I noted the formation which is reproduced in Text fig. 6. There was an outer cell(× 110μ) whose cell-wall differed not at all from that present in typical forms of *Eremosphæra*, and within, a smaller cell (× 90μ) with two membranes, the outer thin and smooth, the inner to all appearance thick (× 5μ) and certainly coarsely scrobiculate. I am of opinion, however, that the incrassate character of the inner membrane was an optical illusion. All the membranes were hyaline. The contents were shrunken, and details could not be discerned. The inner sphere, at any rate, was filled with a thick, mucilaginous substance, as, under pressure, the contents exuded. I am tentatively putting this down as a hypnospore.

3. *Previously published types.*

Of previously described species, such a large percentage has been observed locally, that it was thought worth while to include, within the scope of this paper, remarks on all forms published to date. Since De Toni's Sylloge Algarum, Vol. i., *Chlorophyceæ*, was brought out in 1889, a large number of species of greater or less validity has gradually accumulated. These are scattered through the pages of various scientific periodicals, and the papers in which they are embodied are often very difficult to obtain. Of the latter, the most important is W. West's, New British Frw.

Algæ, J.R.M.S., 1894, with notes on 14 forms of Oocystis (8 species, including 3 new). De Toni's Sylloge mentions only 9 species (all published at that time) of which two appertain to another genus. In the present paper, 31 published species* of *Oocystis* are discussed. Of these, two (*O. geminata* Näg., and *O. brunnea* Turn.) have been practically set aside, one (*O. mammillata* Turn.) is considered very doubtful, three (*O. setigera* Arch., *O. ciliata* Lag., and *O. Echidna* Bohlin) have long ago been relegated to *Lagerheimia* (including *Chodatella*), four are reduced to variations, seven ranked as synonyms, leaving us with fourteen fairly valid types. In addition to these, six new species are proposed. Every described variation or form has been included in my notes, with many others that seem to be new. Together, they amount to twenty-five, nineteen variations, six forms. In nearly every case, the original description and figure have been added.

With regard to *Eremosphæra viridis*, I consider it to be a species of *Oocystis*, but I have not altered the nomenclature. Several new forms are described and figured.

Genus Oocystis Nägeli.

"Oocystis . . . . genus Nägelianum ineditum" . . . ., A. Braun, Alg. unicell. (1855),† p.94, footnote. Syn., *Oocystella* Lemm., Zeitschr. f. Fischerie u. d. Hilfsw., 1903.

Oocystis Nægelii A. Br. (Pl. vii., f.1-6).

"Species nova minime rara, cellulis oblongis viridibus, nunc solitariis, nunc binis, quaternis aut octonis cellula matricali membranacea forma simplici inclusis." A. Braun, *l.c.*

Cell. veg., 17×10, 18×8, 18×10, 19×9, 19×10, 20×8, 20×9, 20×10, 20×11, 21×12, 22×11, 24×11, 24×12, 24×14, $25 \times 14\,\mu$.

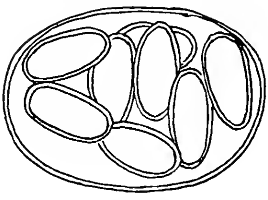
Guildford (60, 88, 114, 146); Sydney Water (67); Botany Bay (91); Auburn (57); Duck Creek, Clyde (74).

* Including *Cylindrocystis ovalis* Turn., *Hydrocytium macrosporum* Turn., *Oocystella natans* Lemm., and *O.* spec. Schm. These 31 are all that I know of up to date.

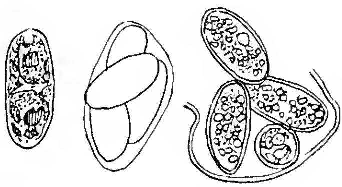
† By printer's error, 1845 in G. S. West, Brit. Frw. Algæ, p.227.

Syn., *O. elliptica* W. West, Alg. Eng. Lake Distr., 1892, p.24, f.56; and f. *minor* W. West, *l.c.*, and New Brit. Frw. Alg., 1894, p.14, f.26; W. & G. S. West, Frw. Alg. Madagascar, 1895, p.82, Pl.5, f.13, 14. *O. rupestris* Kirchner, Alg. von Württemberg, 1880, p.169, T. ii., f.2. *O. pelagica* Lemm., Ber. z. Kenntn. d. Planktonalg., xiv., 1901, p.95, T. iv., f.7; also Nord. Plankt., xxi., p.17, f.56.

It is always unsatisfactory to have to pass over a well-defined specific name for one which is obscure, but I feel bound to agree with Chodat, Alg. vertes, p. 189, that *O. elliptica* W. West, is identical with *O. Nägelii* A.Br, The one character given by the latter in his description, "*cellulis oblongis*," is fortunately decisive. It indicates a form longer than broad, with broadly rounded, or



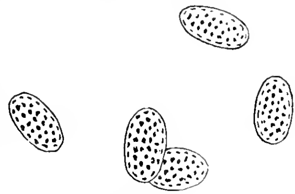
Text-fig.7.
Oocystis elliptica W. West, (×520): after West.



Text-fig.8.
Oocystis rupestris Kirchner; after Kirchner.

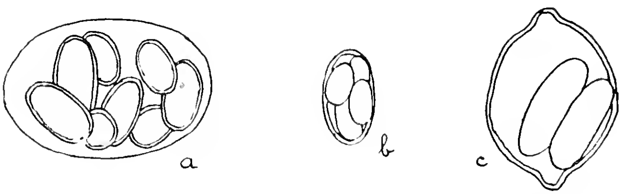
rounded subtruncate, ends and very slightly arcuate sides. West's description of *O. elliptica*, l.c., agrees perfectly with this, "*cellulis oblongo-ellipticis, ... apicibus rotundatis et non incrassatis.*" *O. rupestris* Kirchn., has been placed by Hansgirg as a variety, and by other authors as a synonym, of *O. solitaria* Wittrock. The latter, however, is narrowly elliptic, with ends acutely rounded and inwardly incrassate, whereas Kirchner, *l.c.*, says of *O. rupestris*, "*Zellen oblong*," and though his Fig.2*a* is somewhat irregular, it is certainly intended to have broadly rounded ends and slightly arcuate sides. The other figures merely serve to show the character of the mother-cell and the disposition of the autospores.

The only other oblong form that I know of, is (*fide* W. West, New Brit. Frw. Alg., Pl. ii., f.28) *O. gigas* Archer, which is out of the question, as it is one of the largest forms of *Oocystis*, while it is pretty certain (though Braun gives no note of the dimensions) that *O. Nägelii* is one of the small plankton-forms. This is sufficiently indicated by the habitat: "*Occurrit intra massam crustaceam viridem, Algis variis conflatam, quæ truncos pineos natantes obducit*," and the algæ which are mentioned as accompanying it, while not distinctly plankton-forms, are mostly such as are commonly found in a free-swimming condition. Moreover, *O. gigas* cannot be described as "*species minime rara*"; it is exceedingly rare.



Text-fig. 9.
O. pelagica Lemm., (× 750); after Lemmermann.

The only figure definitely given as *O. Nägelii* is by Kirchner, Mikroskopische Welt des Süsswassers, T. ii., f. 52, reproduced by Chodat, Alg. vertes, p. 189, fig. 104A (Text-fig. 10*b*). This agrees



Text-fig. 10.—(*a*) *O. elliptica* f. *minor* W. West, (× 520); after West. (*b*) *O. Nägelii* A. Br., after Kirchner. (*c*) *Hydrocytium macrosporum* Turner, (× 375); after Turner.

perfectly with the foregoing conclusions. *Cf.* Pl. vii., f. 6, which shows a mother-cell from a pond at Guildford, long. 38, lat. 23, autospores $20 \times 10\mu$, almost a facsimile of Kirchner's specimen. Pl. vii., f. 5, is an 8-celled family from the Sydney Water-supply, long. 60, lat. 48, autospores $20 \times 8\mu$, agreeing very well with West's forms (*O. elliptica*, l.c.) save that the autospores are more distinctly in pairs. In samples 88 and 91, free, vegetative cells are abundant (Pl. vii., f. 1-3).

With regard to size, West, *l.c.*, (for *O. elliptica* and f. *minor*) gives long. 15-17, 18-21, 24-25μ, lat. $7\frac{1}{2}$-8, 8-10, 11-$11\frac{1}{2}\mu$. My records nearly cover the same ground, viz., 17-25 × 8-14 μ. Kirchner (for *O. rupestris*) extends West's figures a little both ways, long. 13-27, lat. 6-12 μ. In all cases, it will be noted that the length is just about twice the breadth; in the 14 Australian specimens whose dimensions are given above, the axial ratio varies from 1·7-2·5 : 1·0, the average being nearly 2 : 1.

Eichler, Flory Wodor. ok. Miedzyrzeca, 1892, T. x., f.25, has figured what he identifies as *O. Nägelii*, cell. long. 30-44, lat. 17-25 μ, but is probably *Nephrocytium Agardhianum* var. *majus* Näg., Gatt. Einz. Alg., T. iii., c, fig.i, k, p,(= *N. Nägelii* Grun., = *N. obesum* W. West). The cells are too broad for *O. Nägelii*, and one also is distinctly reniform. If considered an *Oocystis*, it would fall better under my *O. Chodati*, infra.

I include three forms in the type, which are generally found intermingled, viz., (1)elliptic-oblong with broadly rounded ends, the sides and ends meeting in one even curve, (2)oblong with subtruncately rounded ends, (3)cylindrical: *vide* Pl. vii., f.1, 2, 3, respectively.

Var. AFRICANA (G. S. West) mihi. (Text-fig.12*c*).

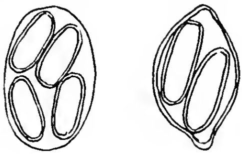
"Var. minima; autosporis 4 vel 8, dense compactis; chromatophoris multe-lobatis parietalibus singulis vel binis." G. S. West, *l.c.*

Syn., *O. elliptica* var. *Africana* G. S. West, Frw. Algæ, Ann. South Afr. Mus., Vol. ix., 1912, p.76, f.14, 17. I have not yet noted this form, which G. S. West has described from Angola. It differs from the type only in having a lobed, or fragmented, chloroplast. The corresponding form of *O. Novæ Semliæ*, however, is described here under that species. G. S. West gives long. cell. 8-13 μ; lat. cell. 4·5-7 μ.

Var. MACROSPORA (Turner) mihi. (Text-fig.10*c*).

Cellulæ oblongæ vel oblongo-ellipticæ, quam f. typica circa duplo majores.

Syn., *Hydrocytium macrosporum* Turner, Alg. E. Ind., 1892, p.154, T. xx., f.32: *O. sphærica* Turn., *ibid.*, p.155, no figure. This cannot, of course, be a species of *Hydrocytium* (*Characium*), as that propagates by zoospores, not autospores. Turner's dimensions are: Cell. matric. long. 50-65, lat. 39-52, autosp. long. 39, lat. 19μ. The autospores, however, are wrongly delineated. As drawn, they work out at 61 × 19 instead of 39 × 19. Turner says: "*sporis . . . . longe ovalibus*," but his drawing them cylindrical makes it certain that they were really oblong. The ratio of length to breadth also (at 39 × 19) is just 2:1, as in *O. Nägelii*. W. & G. S. West, Frw. Alg. Madagascar, p.82, identify this form (but doubtfully) with *O. elliptica* West (= *O. Nägelii*). The shape of the mother-cell is of no importance, *cf.* W. & G. S. West, *l.c.*, Pl.5, f.13-14 (Text-fig. nostr 11).



Text-fig. 11. *Oocystis elliptica* f. *minor* W. West, (×520); after W. & G. S. West.

Nordstedt's Sandwich Island specimens of *O. Nägelii* should probably be placed under this variation. He gives long. 30-32, lat. 14-15μ, Alg. aq. dulc. Sandvich., p.8. I have not come across this form in my gatherings yet.

Var. OBESA, n.var. (Pl. vii., f.7).

Præ longitudine crassior. Cell. long. 20-25, lat. 13-16μ. Guildford (146).

Var. CURTA, n.var. (Pl. vii., f.8).

Late-ovalis vel brevissime oblonga. Cell. long. 17. lat. 13μ. Guildford (146) cum priori rarius.

Syn., *O. Nägelii* in Lemm., Plankt. Schwed. Gewäss., p.107, where he remarks: "Zellen breit-oblong, 15-17:11-13μ." Both forms quite common in No. 146, from a pond at Guildford; the one is evidently a reduced form of the other. The ratio of length to breadth in var. *obesa* is from 1·4 to 1·7:1·0 as compared with 2:1 in the type. In var. *curta*, it is 1·3 to 1·0. Chloroplasts not noted, the contents deranged.

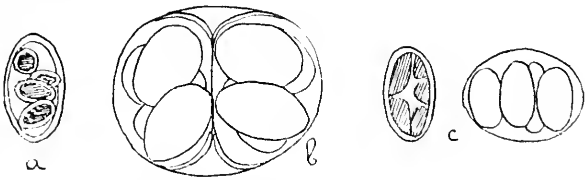
OOCYSTIS NOVÆ SEMLIÆ Wille. (Pl. vii., f.9, 10).

"O. cellulis homogeneis(?) singulis l. in familias e 4-8 cellulis formatas consociatis, familiis nonnunquam in massa gelatinosa 2-4 consociatis; membrana crassa, non tuberculo apicali instructa." Wille, *l.c.*

Cell. matric. × 20, 10 × 25, 12 × 9; autosp. 6 × 3, 7 × 4, 7 × 5, 8 × 4, $8\frac{1}{2} \times 5\frac{1}{2}$, 8 × 6 μ.

Parramatta Park (136); Auburn; Lismore, river,(272, 273).

Cf. Wille, Fersk. fra Novaja Semlja, 1879, p.26, T. xii., f.3. Syn., *O. Nägelii β Novæ Semljæ* (Wille) Chodat, Alg. vertes, p.189; *O. Nägelii* var. *minutissima* Bernard, Protococ. et Desm., 1908, p.172, f.355, 356. I cannot consider this a variety of *O. Nägelii*; no doubt there is a very close biological connection, but, typically, they are entirely different shapes, the latter being oblong or oblong-elliptical with broadly rounded ends, while *O. Novæ Semliæ* is elliptical with acutely rounded ends. No shape, curiously enough, is mentioned in the description, but the figure, *l.c.*, is distinct.



Text-fig. 12.—(*a*) *Oocystis Novæ Semliæ* Wille,(× 400); after Wille. (*b*) *O. Novæ Semliæ* var. *maxima* W. West,(× 520); after West. (*c*) *O. elliptica* var. *Africana* G. S. West,(× 1000); after G. S. West.

Also the ratio of length to breadth is different; in Australian specimens of *O. Novæ Semliæ*, it varies from 1·4 to 1·7 : 1·0 as against 2 : 1 in *O. Nägelii*. Moreover, the latter tends to be cylindrical, while the larger sizes of the former are oval, but still retaining a tendency to be pointed at the ends, *cf.* var. *maxima* W. West, and var. *australica* mihi (*infra*).

O. Nägelii var. *minutissima* Bernard (cells 5-7 × 4 μ) is a size of this species too close to the type to be separated from it; indeed, even f. *major* Wille, might well be included. Wille's original record for the type is 8 × 5 μ. The chloroplast is a single, very thin, parietal lamina.

Forma MAJOR Wille. (Pl. vii., f.11, 12).

Cell. matric. diam. 20, 24, 40; long. 24, lat. 14; autosp. 10 × 6, 10 × 7, 12 × 6, 12 × 7, 12 × 8 μ.

Potts Hill (138); Parramatta Park (136), cum f. typica.

Wille, *l.c.*, p.27, T. xii., f.1, gives dimensions 11 × 6μ; W. West, for British specimens, long. 11·1-12·5, lat. 7-7·9μ; W. & G. S. West, Welwitsch's Afric. Frw. Alg., p.238, record 16 × 9½-10μ for African ones. The ratio of length to breadth, as shown by these records, agrees very well with that given above for Australian specimens. The f. *major* figured by W. West, New Brit. Frw. Algæ, Pl. ii., f.24, does not agree in outline with Wille's type, but belongs to *O. Nägelii*.

Forma.

Cellulæ chloroplastidibus medio in transversum divisis.

Cell. matric. spher. × 20; autosp. 10 × 7μ.

Parramatta Park (136), cum f. typica.

Var. MAXIMA W. West. (Text-fig.12*b*).

"Var. cellulis 2-3-plo major quam forma typica." W. West, *l.c.*

Cell. matric. 34 × 30; autosp. 18 × 12μ.

Botany.

Cf. W. West, New Brit. Frw. Alg., p.13, f.25, 1894, where he gives long. 19-23, lat. 12-15μ as dimensions of the cells. W. & G. S. West, Welwitsch's Afr. Alg., p.238, record 33 × 23 for African specimens. Differs from the succeeding form only in its undivided chloroplasts and larger size.

Var. AUSTRALICA, n.var. (Pl. vii., f.13-17).

Cellulæ ellipticæ vel ovales, plerumque ad apices modice attenuatæ; chloroplastidibus singulis parietalibus lobatis, vel chloroplastidibus plus minusve distinctis 2-4, interdum pyrenoides singulos ferentibus.

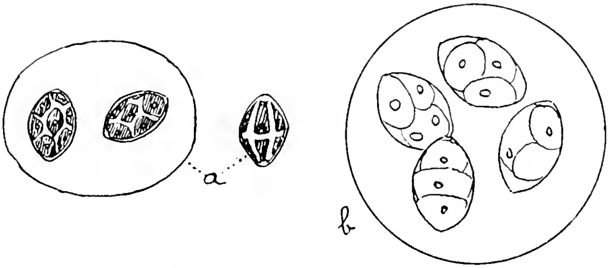
Cell. matric. diam. 30-40; autosp. vel cell. veg. 13 × 10, 14 × 11, 16 × 11, 16 × 12, 20 × 14μ.

Parramatta Park (136); Lismore, river, (273, 274); cum forma typica.

Corresponds to var. *Africana* G. S. West, in *O. Nägelii*. The chloroplast is lobed or fragmented (the intermediate stage of development between a simple lamina and parietal lozenges), or sometimes there are 2-4 chloroplasts more or less distinctly visible, occasionally with a pyrenoid apiece. This form is very close to *O. crassa* Wittrock, as figured by Ostenfeld, Proc. R. Soc. Edin., 1904-5, p.1113, Pl. i., f.8, *q.v.* Var. *australica* and var. *maxima*, which are practically one, differ somewhat in shape from the type, being more oval (broader in comparison with the length) and with less pointed ends.

OOCYSTIS CRASSA Wittrock. (Text-fig.13*a*).

In Wittrock et Nordstedt, Alg. dulc. exsicc. No.355; Bot. Notiser, 1880, p.117. *Cf.* G. S. West, Brit. Frw. Algæ, p.227, f.97C, D.



Text-fig.13.—(*a*) *Oocystis crassa* Wittrock, (×485); after G. S. West. (*b*) Var. *Ostenfeldii* mihi; after Ostenfeld.

Syn., *O. Marssonii* Lemm., Bot. Centralblatt, 1898, p.151; Plöner Forsch., 7, 1894, p.24, T. i., f.15-19. I have not met with any form that I could identify with *O. crassa*. It is referred to by G. S. West as a distinctly plankton-species. In W. & G. S. West, Frw. Alg. N. Ireland, p.68, the dimensions are given as long. 18·3-24, lat. 13-15·5μ. Chodat, *l.c.*, p.190, records long. 14-23, lat. 10-18μ for Swiss specimens. The ratio of length to breadth in this species seems to be 1·3 to 1·4 : 1·0.

Var. OSTENFELDII, nom.nov. (Pl. vii., f.18, 19).

Cellulæ lateribus æqualiter arcuatis, in medio haud subangulatis; apicibus acuminatis haud incrassatis. Chloroplastides 2-4, interdum pyrenoidibus singulis instructæ.

Cell. long.16, lat. 11μ.

Lismore, river (274, 281).

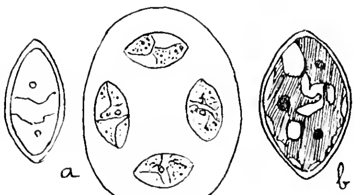
Ostenfeld and Wesenberg-Lund, Plankt. of two Icelandic lakes, Proc. R. Soc. Edin., xxv., 1906, p.1113, Pl. i., f.8. Syn., *O. lacustris* Ostenfeld, *l.c.*, p.235 (*sec. auctor. ipsum*). Ostenfeld remarks: "The species . . . . has one pyrenoid in each chloroplast; the chloroplasts are two or four in each cell, often tetrahedrally arranged; the cells are four (rarely two) in a globular mucilage; their shape is ellipsoid or ovate with subacute apices; length 22-26μ, breadth 16-20μ." I noted, in river-gatherings, mother-cells of this form in company with others of *O. Novæ Semliæ* var. *australica* mihi. It is probably intermediate between the latter and *O. crassa*. Var. *Ostenfeldii* differs from the type in being more regularly elliptical, not so rhomboid, with sides regularly arched, not bent in the middle, the apices not incrassate. It has fewer chloroplasts also.

OOCYSTIS LACUSTRIS Chodat. (Pl. vii., f.20).

"Cellulis binis vel quaternis in familiis consociatis, membrana gelatinosa crassa, utroque fine cellulæ leviter incrassata, late fusiformibus utroque acutis, chlorophoro laminam formante sæpe dimidiato, pyrenoide munito vel carente. Contentus sæpe oleosus." Chodat, *l.c.*

Cell. matric. 24 × 22, 30 × 22, autosp. 9 × 5, 14 × 9, 18 × 8, 18 × 9μ.

Dunedin, N.Z., Northern Reservoir.



Text-fig. 14.
(*a*) *O. lacustris* Chod.; after Chodat.
(*b*) *Oocystella natans* Lemm., (× 750); after Lemmermann.

Chodat, Etudes de biologie lacustre, Bull. de l'herb. Boissier, 1897, p.296, Pl.10, f.1-7, 13; Alg. vertes, p.190, f.105. The author, by a strange oversight, has given no dimensions in either publication. W. & G. S. West, Plankton of some Irish Lakes, p.107, record long. colon. 43-60, long. cell. 14-22, lat. cell. 8-15; and G. S. West, Third Tanganyika Exp., p.141, long. colon. 39-54, long. cell. 12-20, lat. cell. 7-13μ; both agree very well with Australian specimens, except that the colonies are larger. The type has either a single, laminar chloroplast, or one in each half of the cell; pyrenoids are often present.

Var. NATANS (Lemm.) mihi. (Pl. vii., f.21).

Cell. veg. long. 16, lat. 11 μ.

Auburn.

Syn., *Oocystella natans* Lemm., Zeitschr. f. Fischerei, 1903; Plankt. Schwed. Gewäss., p.156, T. i., f.11, 12. A form of *O. lacustris* with a lobed or fragmented chloroplast. No size is given by the author in the latter publication, but his fig.12 works out at 19 × 12 μ.

Var. PALUDENSIS, n.var. (Pl. vii., f.22-24).

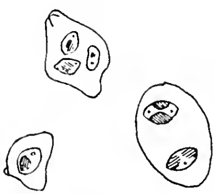
Formæ typicæ consimilis, chloroplastidibus autem fractis, in laminis minutis radiantibus vel in massis digitatis ordinatis.

Cell. matric. long. 110, lat. 85; autosp. 17 × 12, 20 × 12, 22 × 14 μ.

Canley Vale (128); Guildford (146).

These forms were found in small pools fed by surface-water. They differ from the type and var. *natans* only in the character of the chloroplasts. In Pl. vii., f.23, the original chloroplasts seem to have broken up into small, radiating laminæ, while in Pl. vii., f.24, the chloroplasts are small, digitate masses, as in *O. ovalis*, pointing away from the centre, and towards the pole in each half. A pyrenoid(?) is present in the centre of each half, sometimes pale green, sometimes pale brick-red in colour. Compare remarks under *O. ovalis*, infra.

OOCYSTIS PARVA W. & G. S. West. (Pl. vii., f.25, 26).



Text-fig. 15.
O. parva W. & G. S. West, (× 520): after G. S. West.

"O. minuta . . . . cellulis plerumque oblique ellipsoideis, $1\frac{1}{2}$-$1\frac{3}{4}$-plo longioribus quam latioribus, apicibus subacutis et non incrassatis; membrana firma. Contentum chlorophyllosum cellularum in massis parietalibus 2-3." W. & G. S. West, *l.c.*

Cell. matric. spher. diam. 12, 18, 24, 48; oval. 30 × 22, 54 × 42; autosp. 10 × 8, 12 × 8 μ.

Sydney Water (63, 65); Guildford (84).

Cf. W. & G. S. West, Notes on Freshwater Algæ, i., Journ. Bot., 1898, p.335; G. S. West, Alga-flora of Cambridgeshire, Journ. Bot., 1899, Pl.394, f.14-17. Dimensions given are long. cell. 6-12, lat. cell. 4-7.; long. teg. 13·5-29, lat. 10·5-18 μ. *O. parva* might very well be arranged as a variation of *O. lacustris*.

OOCYSTIS NODULOSA W. West. (Text-fig. 16).

"O. mediocris; cellulis solitariis vel in familiis e 2 cellulis formatis consociatis, cellulis oblongo-ellipticis, 1½-plo longioribus quam latioribus, apicibus late-rotundatis et nodulis incrassatis." W. West., *l.c.*

Cf. West, New Brit. Frw. Alg., p.15, Pl. ii., f.31, 1894. Syn., *O. crassa* γ *nodulosa* Chodat, Alg. vertes, p.190. I have not found the type.

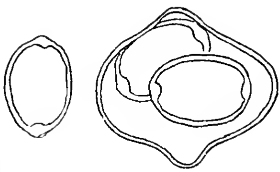
Var. AUSTRALIS, n.var. (Pl. vii., f.27, 28).

Forma paullo magis oblonga; membrana ad polos introrsum tantum incrassata.

Cell. veg. 21 × 12, 23 × 13, 25 × 15, 26 × 14 μ.

Botany Bay (91); Auburn (57).

This is a very rare form; a few specimens were noted in No. 91 among quantities of free cells of *O. Nägelii*. Our specimens differ somewhat from the type; they are a little more oblong, and the polar incrassation is entirely on the inner side of the membrane. West gives long. 25-26, lat. 16-17 μ as the dimensions of the type.



Text-fig. 16.
Oocystis nodulosa W. West, (×520); after West.

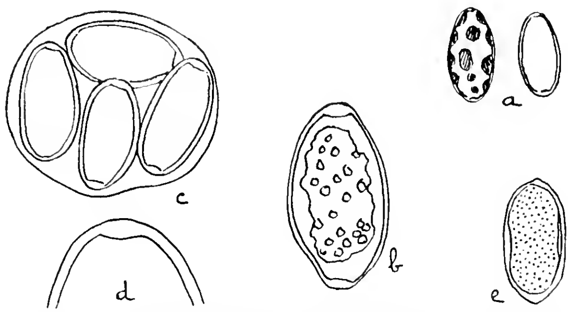
OOCYSTIS SOLITARIA Wittrock. (Pl. vii., f.29).

Cell. veg. 18 × 11, 18 × 12, 20 × 10, 21 × 11, 21 × 12, 22 × 11, 22 × 13, 23 × 15, 24 × 15 μ.

Guildford (146); Auburn (57); Duck Creek, Clyde (74).

In Wittrock et Nordstedt, Alg. aq. dulc. exsicc., No.244, 1879; Bot. Notiser, 1879, p.24; G. S. West, Brit. Frw. Algae, p. 227, f.97 A, B. Very rare in this country, though "undoubtedly the commonest species" (G. S. West, *l.c.*) in Britain. The figure in

British Frw. Algæ is narrowly elliptic, with acutely rounded ends, the membrane at the poles being incrassate on the inner side only. The chloroplasts are discoid. From all accounts, the ratio of length to breadth varies from 1·5 to 2·1 : 1·0, with which our specimens agree; 1·74 : 1·00 average of 9.



Text-fig. 17.—(*a*) *O. solitaria* Wittrock, (× 485); after G. S. West. (*b*) Forma *major* Wille, (× 520); after W. West. (*c*) Var. *maxima* Gomont, (× 300); (*d*) apex (× 580); after Gomont. (*e*) Var. *notabile* W. West, (× 520), after West.

Forma MAJOR Wille. (Text-fig. 17*b*).

Ferskvandsalg. fra Novaja Semblia, 1879, p.26. A larger form, the same shape as the type. Wille gives 40 × 22 μ as the dimensions, and exactly the same size is recorded by W. & G. S. West, Welwitsch's Afr. Alg., p.238, for African specimens. I have not noted this form yet.

Var. MAXIMA Gomont. (Text-fig. 17*c*, *d*).

"Cellulæ ambitu ellipticæ, solitariæ, vel 2-4 in familias consociatæ, 50 ad 65 μ longæ, 26 ad 40 μ crassæ, membrana tenui, ad polos incrassata." Gomont, *l.c.*

Flore algolog, de la Haute-Auvergne, Bull. de la Soc. botan. de France, tom.43, 1896, p.386, Pl. x., f.13. From the text-figure, it will be seen that this form is the same shape as the type in Brit. Frw. Algæ. Borge, Süssw. Chlor. v. Feuerland u. Isla Desolacion, p.23, records var. *maxima* at long. 47-51, lat. 26-29 μ.

The ratio of length to breadth varies from 1·6 to 1·9 : 1·0, as far as can be determined from the figures given, lying evenly, therefore, within the generally observed limits for the species. I have not come across this form.

Var. NOTABILE W. West. (Text-fig. 17*e*).

"Cellulis lateribus subrectis et incrassatis; membrana irregulariter punctata. Long. 29μ, lat. 16·5μ." W. West.

Journ. R. Micr. Soc., 1894, p.15, Pl. ii., f.29. I have not met with this form.

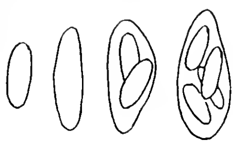
OOCYSTIS SUBMARINA Lagerh. (Pl. vii., f.30).

Lagerheim, Bot. Notiser, 1886, p.45, f.1; Wittr. & Nordst., Alg. aq. dulc. exsicc. No.726; Wille, Zur Entwickl. d. Gatt. Oocystis, Deutsch. Bot. Gesells., 1908, T. xv., the last being a thorough investigation of this species, with a large number of excellent figures. Lemmermann, Nord. Plankt., xxi,, p.15, f.54, 55 (after Lagerheim).

Cell. veg. 24 x 8, 25 x 12, 28 x 10μ.

Sydney Water-Supply (100).

The cells vary from elliptic to linear-elliptic, with acutely rounded ends. The chloroplast is a laminar, parietal band, very narrow for the length of the cell (often one in each half of the cell). Wille, *l.c.*, pp.813, 820, gives two, long lists of sizes (*in extenso*) which may be summarised as long. 7-20, lat. 3½-9μ, the ratio of length to breadth being 1·7 to 2·1 : 1·0 (averages of 9 and 10 records respectively). It will be seen that, in this respect, *O. submarina* begins where *O. Novæ Semliæ* leaves off. G. S. West reports it from the Yan Yean Reservoir, Melbourne (Journ. Linn. Soc., Bot., Vol. xxxix., p.75) at long. 23-25, lat. 7½-8μ.

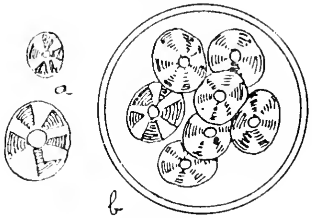


Text-fig. 18.
O. submarina Lagerh., after Lagerheim.

The axial ratio is more than 3 : 1 in the Victorian specimens, and in some of ours, indeed, the linear-elliptic form should be considered typical, the shorter and broader cells being practically identical with *O. Novæ Semliæ*. In spite of its name, it is a fresh-water species, but was first noted in somewhat brackish ditches in Sweden.

OOCYSTIS ROTULA, nom.nov. (Pl. vii., f.31).

Cellulæ parvæ, ovales, ubique rotundatæ; apicibus late-rotundatis haud incrassatis. Chloroplastides (sectione opticali visæ) in laminis minutis radiantibus 5-6 ordinatæ.



Text-fig. 19.
(*a*) *O. rotula* mihi. (*b*) *E. viridis* with *O. rotula* autospores; after Chodat.

Cell. veg. 14 × 11 μ.

Guildford (146).

Chodat, Bot. Zeit., 1895, T. v., f.9, 21, 13 (the two, lower, right-hand examples). A rare form; I have only once observed it. Chodat, *l.c.*, fig.9, shows autospores of this form produced by an uninflated mother-cell of *Eremosphæra viridis*, an indication that the various *Oocystis*-forms are merely reduction-states of *Eremosphæra*. I have figured the same phenomenon in the case of *O. Chodati* and *O. australiensis*.

OOCYSTIS SUBSPHÆRICA, n.sp. (Pl. vii., f.32, 33).

Cellulæ subglobosæ, ubique rotundatæ, papilla nulla nec incrassatione. Chloroplastides pulviniformes vel in laminis radiantibus ordinatæ.

Cell. veg. 14 × 12, 18 × 16, 24 × 20, 25 × 21, 50 × 46 μ.

Guildford (146); Parramatta Park (136); Lismore (240).

A form so broadly oval as to be nearly globose. There is no point or papilla or incrassation, that I can see, to mark the apices. The chloroplasts are of the usual discoid shape, or have the appearance of small, radiating laminæ. The axial ratio varies from about 1·1 to 1·2 : 1·0, the cells being generally about one-fifth longer than broad.

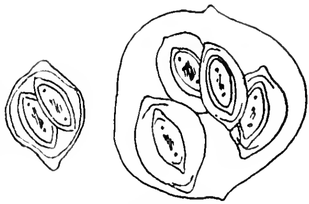
OOCYSTIS APICULATA W. West. (Pl. viii., f.1, 2).

"O. in familias e 2-4 cellulis formatis consociatis, oblongis, diametro duplo longius, subapiculatis et incrassatis ad unumquemque polum." W. West, *l.c.*

Cell. veg. 16 × 7, 17 × 8, 18 × 7, 18 × 8, 18 × 9, 20 × 10, 20 × 11, 22 × 11, 22 × 12 μ.

Duck Creek, Clyde (74); Guildford (88); Botany Bay (91); North Botany (92).

Cf. W. West, Notes on Scotch Frw. Alg., in Journ. Bot., Apr., 1893, p. 99, Pl.333, f.7, 8. Syn., *O. glœocystiformis* Borge, Süssw. Chlor. von Feuerland u. Isla Desolacion, p.23, T. ii., f.1. This species is oblong-elliptic with obtusely rounded ends, or narrowly elliptic with ends more acutely rounded, a minute and very often indistinctly outlined apiculus at each pole. In most of the empty cells that I have observed, there is a vagueness about the outlines due to the membrane being furnished with a relatively broad, inner, mucous lining. It is characteristic of all forms of this species. West gives for dimensions: long. cell. 11-15 μ, lat. cell. 5-6 μ. Borge, for *O. glœocystiformis*, which seems to me to be the same species, records long. cell. circ. 9 μ, crass. 4-5·5 μ. Our forms are larger, but I have noted the species once at 12 × 5 μ.



Text-fig.20.
O. glœocystiformis Borge, (× 740); after Borge.

Var. SPLENDIDA, n.var. (Pl. viii., f.23).

Cellulæ longe ovales, quam forma typica circa duplo majores. Chloroplastides disciformes.

Cell. long. 37, lat. 20-21 μ.

Lismore (240).

In outline very like *O. solitaria*, for which I, at first, mistook it. There is, however, no internal, apical incrassation, and the cells are apiculate. It is about twice as large as the type, and more elongated than var. *obesa*. The chloroplasts are disciform, and arranged as in *O. solitaria*.

Var. ASYMMETRICA (W. West) mihi. (Text-fig.21*a*).

Cell. veg. 12 × 5, 14 × 6 μ.

Botany (92), cum forma typica.

Syn., *O. asymmetrica* W. West, New Brit. Frw. Algæ, in J. R. M. Soc., 1894, p.14, Pl. ii., f.27; *O. crassa β asymmetrica* Chodat, Alg. vertes, p.190. This is a form of *O. apiculata* in which the cells are unequally developed, the long axis through the apiculations being slightly to one side of the midline. West gives long. cell. 15-8 μ, lat. cell. 7-8·6 μ.

Var. OBESA, n.var. (Pl. viii., f.3).

Cellulæ ovales, quam forma typica modice majores et aliquanto latiores, utroque polo apiculo humillimo instructæ.

Cell. veg. 18 × 11, 19 × 12, 21 × 13, 22 × 13, 23 × 15, 24 × 16, 34 × 25, 35 × 25 μ.

Guildford (60, 146); Botany (95).

Somewhat larger than the type, and considerably broader, oval. The axial ratio varies from 1·4 to 1·6 : 1·0.

Var. SIMPLICIOR, n.var. (Pl. viii., f.4-6).

Cellulæ elliptico-lanceolatæ, lateribus æqualiter arcuatis ad apices convergentibus, apicibus acuminatis haud incrassatis nec apiculatis.

Cell. veg. 11 × 7, 14 × 7, 14 × 8, 15 × 7, 15 × 8, 15 × 10, 16 × 10, 18 × 11 μ.

Guildford (23, 88); Auburn (57); Botany Bay (91).

A simpler form of the type, generally found in company with it. The apiculus is replaced by a pointed apex.

OOCYSTIS SUBHEXAGONA, n.sp. (Pl. viii., f.7).

Cellulæ parvæ subhexagonæ; lateribus in medio parallelis, ad apices convergentibus; apicibus acuminatis haud incrassatis.

Cell. veg. 12 × 7, 16 × 10, 17 × 9, 17 × 10, 20 × 12, 20 × 14, 21 × 13, 22 × 13, 25 × 14, 25 × 15, 26 × 15, 26 × 17, 34 × 24 μ.

Guildford (45, 60, 70, 146); Auburn (49, 57, 149); Sydney Water (65); Duck Creek, Clyde (74); Botany Bay (91).

Chloroplasts discoid. This form is very closely connected with *O. apiculata*, being probably intermediate between var. *obesa* and *O. australiensis* mihi. Its axial ratio agrees with that of the former, varying, as it does, from 1·4 to 1·8 : 1·0; average of

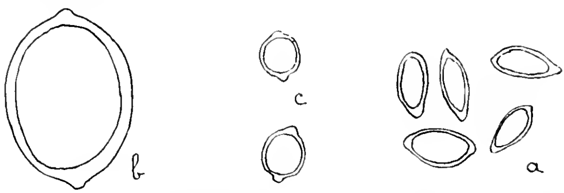
12 specimens, 1·6 : 1·0. It has the internal, mucous lining common to forms of *O. apiculata*, but the shape is of a different type, and the apex, though pointed, is not apiculate. I have, therefore, kept it separate.

OOCYSTIS NORDSTEDTIANA (De Toni) mihi. (Pl. ix., f.13).

"Cellulæ (binæ aut quaternæ) ellipticæ vel fere circulari-ellipticæ, membrana in utroque fine tuberculo instructa (ut in omnibus speciebus hujus generis plus minus evidenter?)." Nordstedt, *l.c.*

Cell. veg. long. 28, lat. 18 μ.

Lismore (185).



Text-fig.21.—(*a*) *O. asymmetrica* W. West, ($\times$520); after W. West. (*b*) *O.* spec., Schm., ($\times$600); after Schmidle. (*c*) *O. rotunda* Schm.; after Schmidle.

Syn., *O. Nägelii* forma, Nordstedt, Frw. Alg. N.Z., 1888, p.21; *O. Nägelii* forma *Nordstedtiana* De Toni, Sylloge Alg. i., 1889, p.664; *O* spec., Schmidle, Alg. aus dem Nyassasee, 1902, p.79, T. iii., f.5. In the first place, it seems to me impossible to place Nordstedt's specimens under *O. Nagelii*. The latter is an oblong type verging on the cylindrical, while these are described as ranging from elliptical to *almost circular-elliptic*. There is also the question of the apical tubercle. From his remarks in parenthesis, *supra*, Nordstedt seems to have considered its presence as of little importance. Nevertheless (apart from mother-cells) the only published type with an apical papilla is Schmidle's unnamed species from Lake Nyassa. And, in my experience, the apical papilla is exceedingly uncommon; out of 170 specimens of *Oocystis* measured for these notes, only two showed a papilla; and, of those that showed a slight apiculation, all, without exception, appertained to *O. apiculata* West, of which species the apiculus is characteristic. Nor is the papilla more common in *Eremosphæra viridis* (which, from my point of view, is an *Oocystis*). Out of 70 specimens measured, it occurred in no more than two. The only forms in which the tubercle seems to be indifferently present or absent are *O. panduriformis* West, and *Erem. viridis* v. *doliformis* mihi. I have never noted either tubercle or apiculus in any form which is generally non-tuberculate or non-apiculate.

Var. ROTUNDA (Schm.) mihi. (Text-fig. 21*e*).

Cell. rotundæ, 10-11 μ latæ, utroque polo tuberculatæ." Schmidle, *l.c.*

Schmidle, Beitr. z. Alpinen Algenfl., p.8, T.14, f.7*a*, *b*, 1895. I have not noted the occurrence here of this form, which seems to me to be a more globose variation of *O. Nordstedtiana*. Nordstedt's smallest size is 16 × 10 μ.

OOCYSTIS CHODATI, nom.nov. (Pl. viii., f.8-11).

Cellulæ ovales vel ovali-oblongæ, ubique æqualiter rotundatæ; lateribus arcuatis, apicibus late-rotundatis nec apiculatis, nec incrassatis. Chloroplastides pulviniformes.

Cell. matric. sphær. diam. 33-40, oval. long. 30-47, lat. 25-40; cell. veg. vel autosp. 16 × 12, 18 × 12, 20 × 12, 24 × 16, 24 × 18, 28 × 22, 30 × 20, 34 × 25, 40 × 30 μ.

Auburn (49, 56, 135); Guildford (60, 124, 146); Fairfield (112).

Syn., *O. solitaria*, pro parte, in Chodat, Alg. vertes, p.189, f.104F, autospores. This species is regularly oval or oval-oblong, rounded everywhere. It differs from *O. solitaria* especially in the broadly rounded ends without papilla or internal incrassation. Also, the cells being broader, the axial ratio is smaller. The latter varies, in the examples given above, from 1·3 to 1·6 : 1·0, the average being 1·4 : 1·0. In *O. solitaria*, the ratio is greater, the cells being proportionately longer and more pointed. Some of the smaller sizes of *O. Chodati* come very near to *O. Nägelii*; the cells, however, are broader in proportion and more oval. This form is generally found on swampy ground, especially the larger sizes.

Oocystis australiensis, n.sp. (Pl. viii., f.12,13).

Cellulæ late elliptico-lanceolatæ; lateribus æqualiter arcuatis usque ad polos sensim sensimque convergentibus; apiculis acuminatis haud incrassatis. Chloroplastides pulviniformes.

Cell. matric. sphær. diam. 46, lanceol. 45 × 38; cell. veg. vel autosp. 20 × 12, 20 × 14, 21 × 13, 23 × 17, 24 × 14, 24 × 15, 27 × 18, 30 × 17, 30 × 20, 30 × 21 μ.

Auburn (49, 57, 104, 105, 135, 139); Collector; Lismore (185).

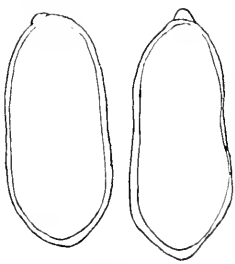
Cf. Chodat, *l.c.*, p.189, f.104 G, H, for somewhat similar but irregular forms. This species is another of our swamp-forms. The cells are the shape of *O. lacustris* Chod., but have discoid chloroplasts, and a different habitat, *O. lacustris* being a plankton-form. In optical section, there are nearly always five chloroplasts each side, and one at each end. The dimensions are much the same as in *O. Chodati*; in both also the axial ratio is approximately 3:2. As autospores, they are generally found in thin-walled, oval or lanceolate mother-cells, but I have noted them produced by undoubted, uninflated specimens of *Eremosphæra viridis*, easily recognised by the irregular, mucilaginous, inner cell-wall. See text-figure 3 in the introduction, and compare Chodat, Bot. Zeit., 1895, Pl. v., f.9.

Oocystis panduriformis W. West. (Pl. viii., f.14).

"O. magna; cellulis solitariis vel in familiis e 4-8 cellulis formatis consociatis, cellulis 2-2½-plo-longioribus quam latioribus, ovatis, lateribus leviter concavis, apicibus incrassatis et subacutis." W. West, *l.c.*

Cell. veg. long. 82, lat. max. 30 μ.

Rookwood (107).



Text-fig.22.
O. panduriformis W. West, (×520); after W. West.

W. West, New Brit. Frw. Alg., J.R.M. Soc., 1894, p.15, Pl. ii., f.33-35. A rare form, of which I have seen only one specimen; the shape, however, is too characteristic to be mistaken. West's dimensions are 50-61½ long, by 23-25½ broad. A forma *major* West, is distinguished by him in the same place, size: "long. cell. 77 μ; lat.

medio 29μ; lat. max. 32·5μ." Considering the variation in dimensions, which is general in these forms, this might very well be included in the type along with that given above. Chodat considers that this species is biologically a form of *Eremosphæra viridis*, and with this I entirely agree. It is, however, a character which *O. panduriformis* shares with all the other "species" of *Oocystis*.

A var. *pachyderma* West, *l.c.*, p.16, Pl. ii., f.36, is also recorded, differing only in the very thick cell-wall ("membrana cellularum 2·5-2·8μ crassa," West.

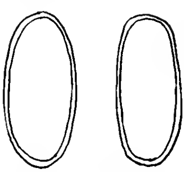
OOCYSTIS OVALIS (Turner) W. & G. S. West. (Pl. viii., f.15, 16).

"Mediocris, 2-2½-plo longior quam lata; cellulis ovalibus, lateribus ventricosis, apicibus rotundatis. Membrana crassa, glabra." Turner, *l.c.*

Cell. veg. 50 × 26, 62 × 32μ.

Rookwood (107).

Syn., *Cylindrocystis ovalis* Turner, Frw. Alg. E. Ind., 1892, p.16, T. i., f.5 (fig. sinistr.). About this form, W. & G. S. West, Some recently published Desmidieæ, Journ. Bot., 1895, No.387, p.66, remark: "From the perfectly elliptical form and smooth, thick membrane, this appears to us to be a species of *Oocystis*." Their opinion is confirmed by my finding it here in the form of autospores, Pl. viii., f.17. It is not surprising, however, that Turner should have considered it a *Cylindrocystis*, as the generally prevailing character of the chloroplasts is unlike that of any other species of *Oocystis*, and, in some specimens, the contents are disposed almost exactly as in that genus, Pl. viii., f.15. The chloroplasts are minute, fusiform or digitate masses, disposed longitudinally, and radiating somewhat from the nucleus to the apices. The same type of chloroplast is found also in *Eremosphæra* occasionally. Turner's specimens were smaller than ours; he gives long. 40-42, lat. 17-20μ.



Text-fig. 23.
Cylindrocystis ovalis Turner; after Turner.

Var. SUBTRUNCATA, n.var. (Pl. viii., f.17-19).

Cellulæ oblongæ interdum pæne cylindraceæ, lateribus minus arcuatis, apicibus subtruncato-rotundatis.

Cell. matric. elliptic. 80 x 40; cell. veg. vel autosp. 50 x 20, 50 x 26, 54 x 24, 60 x 32, 61 x 32, 62 x 26, 62 x 32, 70 x 32 μ.

Rookwood (107); Lismore (240).

Cylindrocystis ovalis Turn., *l.c.*, T. i., f.5 (fig. dextr.). Turner gives two different forms for his *Cyl. ovalis*, the right-hand one one of which can hardly be described as oval. I have separated this form, therefore, as var. *subtruncata.* It is more common than the type, and is distinctly oblong, verging sometimes on subcylindrical, with subtruncately rounded ends. In specimens found with the type in sample No.107, the chloroplasts were digitate, but I have noted others at Lismore with chloroplasts of the usual discoid character.

Forma.

Apicibus late-rotundatis nec subtruncatis.

Cell. veg. 70 x 32 μ.

Auburn (140).

Var. CYLINDRACEA, n.var. (Pl. viii., f.20-22).

Cellulæ plus minusve distincte cylindraceæ; lateribus levissime arcuatis subparallelis; apicibus late-rotundatis vel subtruncatis.

Cell veg. vel autosp. 52 x 28, 66 x 28, 67 x 40, 86 x 32 μ.

Rookwood (107).

In this form, the sides are nearly parallel, and only slightly arched. Slender specimens are quite cylindrical, the broader more oblong. I have noted that, in this variation, it may, perhaps, occur also in the other forms, the cell is provided with what appear to be two, large, pale reddish-brown pyrenoids, one in either half of the cell. In this condition, the cell simulates a *Cylindrocystis* very closely indeed. The same occurs in *O. lacustris* var. *paludensis* mihi, in which form this presumed pyrenoid is sometimes pale brown and sometimes pale green. I am inclined to believe, however, that these bodies are not pyrenoids, but nuclei with a layer of chlorophyll or oil-drops surrounding them. Pyrenoids, when they occur, are found, one in each chloroplast, not occupying the centre of the semicell. Moreover, the chloroplasts in such cells radiate from this central body to the ends and to the centre. Again, this form of cell always develops a pair of spherical autospores; we may take it, therefore, I think, that such are temporarily binucleated, prior to formation of autospores. We have here also a case of an *Oocystis* giving rise to the smaller sizes of *Eremosphæra*; cf. Pl. viii., f.20, and Chodat, Bot. Zeit. 1895., T.v., f.8.

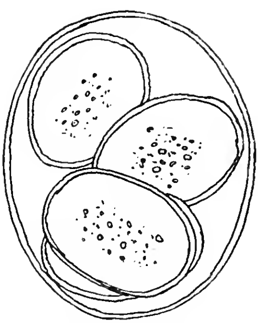
Species unknown to me.

OOCYSTIS GEMINATA Näg.

"Familiis e cellulis geminis formatis, cellulis ovoideis, nonnunquam singulis intra cellulæ matricalis membranam vesiculo ampliatam." De Toni, *l.c.*

In Rabenhorst, Fl. Eur. Algarum, iii., p.53 (1868); De Toni, Sylloge Alg., i., p.664. Syn., *Oocystis minor* (*micrococca*) Itzig. *O. geminata*, in my opinion, is a *nomen delendum*. Without figure or dimensions, the expression "*cellulis ovoideis*" applies equally well to any number of forms. Every species, also, is capable of developing two autospores to the family.

OOCYSTIS GIGAS Archer.



Text-fig.24.
O. gigas f. *minor* W. West, (×520); after W. West.

"Familiis (cellulis initialibus) late ellipticis, subinde quasi globosis, amplis, 60-70×50-60μ, plerumque cellulas 2 includentibus." De Toni, *l.c.*

"O. magna; cellulis solitariis vel in familiis e 2 cellulis formatis consociatis; cellulis late ellipticis, $1\frac{1}{4}$-plo longioribus quam latioribus, apicibus latissime rotundatis et non-incrassatis; contentum chlorophyllosum cellularum granulosum læte viride." W. West, *l.c.*

Cf. Archer, in Quart. Journ. Micr. Sci., 1877, p.105 (no fig.), De Toni, Sylloge i., 1889, p.665. W. West, New Brit. Frw. Alg., 1894, p.14; the last-named gives long. cell. 40-50·5μ, lat. cell. 32·5-40μ; diam. fam. 1 cell. 67 × 52μ.

Forma MINOR W. West. (Text-fig.24).

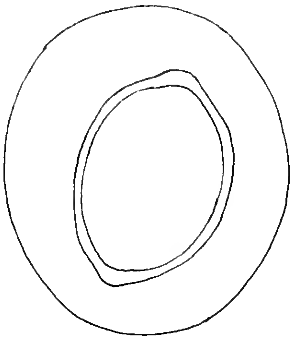
"F. cellulis minoribus, $1\frac{2}{5}$-plo longioribus quam latioribus, singula vel in familiis e 4 cellulis compositis." West, *l.c.*, p.14, Pl. ii., f.28.

The author records the dimensions as Fam. 4 cell. 76 × 63 μ; long. cell. 36·2-40, lat. cell. 26-28·5 μ.

Var. INCRASSATA W. West. (Text-fig.25).

"Var. membrana cellularum incrassata et apicibus incrassatis et subprotuberantibus." W. West, *l.c.*, p.14, Pl. ii., f.37.

The dimensions given are, long. cell. 56 μ, lat. cell. 39 μ. Quite a different shape from that figured as the type: it would be better placed as a variation of *O. nodulosa* W. West, *l.c.*, Pl. ii., f.31.



Text-fig.25.
O. gigas var. *incrassata* W. West, (× 520); after W. West.

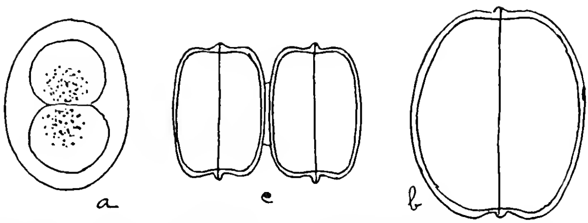
OOCYSTIS PUSILLA Hansgirg.

Mentioned by W. & G. S. West, in Notes on Frw. Alg., Journ. Bot., 1899, p.335, where it is compared with O. *parva* W. & G. S. West. I do not know in what publication it is described.

OOCYSTIS(?) BRUNNEA Turn. (Text-fig.26*a*).

"Cell with pale brown mucous contents, of an oblong form, contained in a proper membrane, having two orbicular cells placed in the direction of its long axis, which nearly fill up the entire length, and are pressed closely together at the centre. These cells appear filled with perfectly clear colourless fluid or mucus, and have at their inner margins each a reddish-brown granular nucleus. Outer cell-membrane punctated. Long. 38, lat. 27 μ." Turner, *l.c.* (Wallich MS. No.348).

Cf. Turner, Alg. E. Ind., 1892, p.156, T. xxi., f.7. Both figure and description are taken from Wallich's manuscript. The note of interrogation in the name is Turner's, and, indeed, from the description ("pale brown mucous contents," &c.), it is extremely unlikely that the specimen figured was an *Oocystis*, or any other species of freshwater algæ. The name may well be set aside.



Text-fig.26.—(*a*) *O.*(?) *brunnea* Turner,(× 600); after Turner. (*b*) *O.*(?) *mammillata* Turn.,(× 1500); after Turner. (*c*) *Hyalotheca hians*, a form,(× 550), original.

OOCYSTIS(?) MAMMILLATA Turn. (Text-fig.26*b*).

"O. sub-circularis, paullo longior quam lata, apicibus paullo depressis, apice in centro rotundata vel distincte mammillata; divisio verticalis; a vertice visa perfecte circularis. Long. 18, lat. 15·2 μ." Turner, *l.c.*

Cf. Turner, Frw. Alg. E. Ind., 1892, p.155, T. xxi., f.14. The query again is Turner's. This form might have been accepted without question as a genuine *Oocystis* but for the vertical line from pole to pole. Such a thing, I have never noted in any specimen of *Oocystis* whatever.* In empty cells of *Eremosphæra*, it is true, faint lines, 2-4 or so in number, may often be seen radiating out from the poles, but even these do not stretch distinctly from pole to pole. I figure here a form of *Hyalotheca hians* Nord., with prosilient suture, which, both in size and appearance, comes very close to Turner's specimen. The dimensions of the cells are 21 × 31 μ, suture 37 μ. Solitary cells of *Hyal. hians* are not at all uncommon in my gatherings.

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* On this point, however, the figures of (?)*Glaucocystis cingulata* Bohlin, Alg. Regnellschen Exp., T. i., f.11-13, are worthy of consideration.

OOCYSTIS SOCIALIS Ostenfeld.

Cells 4-8 in a family, elliptical, 15-20μ long and 8-12μ broad, with two chloroplasts.

Cf. Ostenfeld, Phytopl. fra det Kasp. Hav., (Medd. fra den naturh. Foren. Kopenhagen, 1901) p.138, f.10. I have not seen this memoir, and the details I give are from Lemmermann, Nord. Plankt., xxi., p.16.

Synonyms.

O. rupestris Kirchner = *O. Nägelii* A. Braun.—"Zellen oblong, ungefähr doppelt so lang als dick, meist einzeln, da die Mutterzellhaut sehr früh zerrissen wird." Kirchner, *l.c.*

O. setigera Archer = *Lagerheimia* spec.—Quart. Journ. Micr. Sci., 1877, p.194, M. C. Cooke, Brit. Frw. Algæ, p.27, remarks: "We are unable to give any description of this species, which, so far as we are aware, bears only a manuscript name."

O. ciliata Lagerheim = *Lagerheimia ciliata* (Lag.) Chodat.—*Cf.* Lagerheim, Pedi. Protococc. o. Palmell.,(K.Vet.-Akad. Forh., 1882, No.2) p.76, T.iii., f.33-37. Syn., *Chodatella ciliata* (Lag.). Lemm.*

O. ciliata β amphitricha Lag. = *Lagerheimia ciliata* var. *amphitricha*. *Cf.* Lagerheim, Bidr. t. Sveriges Algflora, (K. Vet.-Akad. Forh., 1883, No.2) p.61, T. i., f.25, 26.

O. ciliata var. *radians* W. & G. S. West = *Lagerheimia ciliata* var. *amphitricha* Lag. *Cf.* W. & G. S. West, New and Interesting Frw. Algæ, J.R.M.S., 1896, p.161, Pl. iii., f.15.

O. Echidna Bohlin = *Lagerheimia Echidna* (Bohlin). *Cf.* Bohlin, Zur Morph. u. Biol. einzell. Alg., p.518. Syn., *Chodatella Echidna* (Bohlin) Chodat, Alg. vertes, p.192.

O. Nägelii, forma, Nord. = *O. Nordstedtiana* (De Toni) mihi.

O. Nägelii f. *Nordstedtiana* De Toni = *O. Nordstedtiana* (De Toni) mihi.

O. rotunda Schmidle = *O. Nordstedtiana* var. *rotunda* (Schm.) mihi.

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* In Plankton of the Sydney Water-Supply, these Proceedings, 1912, Vol. xxxvii., Part 3, I have shown that *Lagerheimia* and *Chodatella* are one. There is no generic difference in the setæ, which are interchangeable in the same form.

O elliptica W. West, incl. f. *minor* West, = *O. Nägelii* A.Br. —"O. cellulis in familias e 4-8 cellulis formantes consociatis, cellulis oblongo-ellipticis, $2\frac{1}{4}$-plo longius quam latius, apicibus rotundatis et non-incrassatis." W. West, Alg. Eng. Lake Distr., p.24.

O. sphærica Turner, = *O. Nägelii* var. *macrospora* (Turn.) mihi. —"Cellulæ hyalinæ globosæ, interne familias 2-8 cellularum ellipticarum includentes. Cellulæ juveniles forma irregulariter subsphæricæ. Diam. outer cell 65; inner cell long. 32, lat. 13μ." Turner, Frw. Alg. E. Ind., 1892, p.155, no fig. A spherical mother-cell, with elliptical autospores $32 \times 13\mu$ in dimensions. The latter are almost certainly identical with the autospores of *Hydrocytium macrosporum* Turner, *ibid.*, p.154, T. xx., f.32, [= *O. Nägelii* var. *macrospora* (Turn.) mihi] which measure $39 \times 13\mu$. The difference in outline of the mother-cell is of no consequence.

Hydrocytium macrosporum Turn. = *O. Nägelii* v. *macrospora* (Turn.) mihi.—"H. dimensione irregularis: cellula ovata, apicibus acuminata (fere ut in *H. acuminatum* Braun) sed tubo parvo vel foramine apicali instructa; sporis 2-4 magnis longe ovalibus includentibus." Turner, *l.c.*, p.154, T. xx., f.32.

Cylindrocystis ovalis Turner = pro parte *O. ovalis* (Turn.) W. & G. S. West; pro parte *O. ovalis* v. *subtruncata* mihi.—"C. mediocris, 2-$2\frac{1}{2}$-plo longior quam lata; cellulis ovalibus, lateribus ventricosis, apicibus rotundatis. Membrana crassa, glabra." Turner, *l.c.*, p.16, T. i., f.5.

O. asymmetrica W. West = *O. apiculata* var. *asymmetrica* (West) mihi.—"O parva; cellulis semper solitariis, asymmetrice oblongo-ellipticis, $2\frac{1}{4}$-plo longioribus quam latioribus, dorso valde convexis, ventre leviter convexis; apicibus incrassatis et acuminatis; contentum cellularum viride granulatum." W. West, New Brit. Frw. Alg., p.14, 15, Pl. ii., f.27.

O. Marssonii Lemm. = *O. crassa* Wittrock.—*See.* W. & G. S. West, Frw. Alg. N. Ireland, p.68; and Chodat, Alg. vertes, p.190.

O. gigas var. *Borgei* Lemm. = *O. Nägelii* v. *Borgei* (Lemm.) mihi.—"Zellen länglich cylindrisch, 8-14 : 3-5μ," Lemmermann, Plankt. Schwed. Gewäss., p.107; in O. Borge, Bot. Notiser, 1900, T. i., f.3. It is impossible to understand why this form has been placed under *O. gigas*, which is a very large form, and broadly oval or oblong. The cylindrical is one of the regular type-forms of *O. Nägelii*, and Lemmermann himself, *l.c.*, classifies it with that species. I have not seen the figure.

O. pelagica Lemm. = *O. Nägelii* A.Br.—"Zellen zu 4-8 von der weiten, gallertartigen Mutterzellhaut umschlossen, elliptisch, mit zahlreichen wandständigen Chromatophoren, ohne Pyrenoide, 12μ lang und 7μ breit, Hülle 66:77μ." Lemmermann, Nord. Plankt., xxi., p.16, f.56. The author himself classes this with *O. Nägelii*; and the very large mother-cell, on which he relies, is of no value as a specific characteristic.

O. spec., Schmidle = *O. Nordstedtiana* (De Toni) mihi.—"Zellen stets einzeln, beiderseits mit je einem Tuberkel, breit elliptisch, 40μ lang, 32 breit." Schmidle, Alg. aus d. Nyassasee, p.79.

O. Nägelii β *Novæ Semliæ* = *O. Novæ Semliæ* Wille.

O. crassa γ *nodulosa* (West) Chodat = *O. nodulosa* W. West.

Oocystella natans Lemm. = *O. lacustris* var. *natans* (Lemm.) mihi.

O. glœocystiformis Borge = *O. apiculata* W. West.—"Cellulæ ellipsoideæ in utroque fine tuberculo parvo instructæ, 2-multæ in familias tegumento generali crasso ut in *Glœocystide* involutas congestæ; contentus guttulas 2 oleosas fovens." Borge, Süssw. Chlor. v. Feuerland, p.25, T. ii., f.1.

O. Nägelii v. *minutissima* Bernard = *O. Novæ Semliæ* Wille.

O. elliptica var. *Africana* G. S. West = *O. Nägelii* v. *Africana* (G. S. West) mihi.

Genus Eremosphæra De Bary.

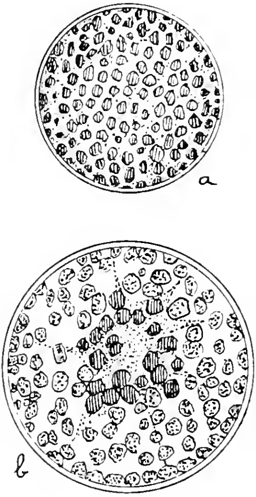
Syn., *Chlorosphæra* Henfrey, 1859, *sec.* G. S. West, Brit. Frw. Algæ, p.229.

Eremosphæra viridis De Bary. (Pl. ix., f.1, 2).

Cell. matric. diam. 104, 118, 230, 250, 280, 285, 290, 306, 330μ. Cell. veg. vel autosp. diam. 42, 44, 46, 48, 50, 60, 65, 70, 74, 76, 78, 80, 86, 90, 94, 95, 100, 105, 110, 133μ. Membr. crass. 1-4μ. Corp. centr. diam. ca. 16μ.

Auburn (57, 59, 67, 118, 119, 135, 140, 148, 149); Rookwood (107, 171); Potts Hill (138); Guildford (70, 124); Canley Vale (128); Lismore (240); Coogee (4, 13, 24).

Cf. De Bary, Conjugatæ, 1858, pp.55, 56, T. viii., f.26, 27; Chodat, Entwickelung der *Eremosphæra viridis*, Bot. Zeit., liii., T. v.; Eichler, Matery. do flory Miedzyrzeca, 1894, T. ii., f.5; G. S. West, Brit. Frw. Algæ, p.229, f.99.



Text-fig.27.
E. viridis De By. (*a*) ×300, (*b*) ×390; after De Bary.

De Bary's figures work out at diam. 82-84μ. Eichler, *l.c.*, p.123, gives 40μ, if I read aright his note ("w kazdej do 40μ srednicy"), but his figure shows diam. 65μ. G. S. West furnishes 55-200μ, and Chodat 25-200μ. I have never observed any vegetative specimen or autospore smaller than diam. 42μ. The much greater size of the mother-cells, compared with that of even the largest vegetative cell, shows that the formation of autospores is generally accompanied by inflation of the original cell.

Var. ACUMINATA, n.var. (Pl. ix., f.3-6).

Cellulæ liberæ subglobosæ vel ellipticæ, ad polos plus minusve acuminatæ, interdum apicibus papilla humillima instructis.

Cell. veg. 63 × 57, 70 × 64, 70 × 67, 72 × 64, 74 × 70, 78 × 67, 80 × 65, 80 × 74, 80 × 75, 82 × 74, 82 × 76, 95 × 87, 100 × 90, 106 × 95, 120 × 114μ. Membr. crass. 1-4μ.

Auburn (67, 106, 140, 148, 149, 159); Potts Hill (138); Rookwood (163); Lismore (240).

This variety is not uncommon wherever the type is found. With the two following, it shows distinctly the polarity of *Eremosphæra*, which is very little noticeable in spherical specimens. Every degree of inflation can be observed, connecting this form with the type, but the apices are more or less acuminate in all.

The membrane is often somewhat incrassate at the poles, and occasionally, but very rarely, a slight papilla is present. Axial ratio varies from 1·05 to 1·23:1·00, the average of twelve records being 1·1 to 1·0.

Var. OVALIS, n.var. (Pl. ix., f.7, 8).

Cellulæ late-ovales; apicibus late-rotundatis nec acuminatis; membrana interdum utroque polo introrsum incrassata. Chloroplastides ut in forma typica.

Cell. veg. 54 × 48, 80 × 66, 80 × 70, 80 × 74, 84 × 70, 84 × 74, 85 × 75, 90 × 82, 92 × 82, 94 × 88, 96 × 86, 98 × 86, 98 × 88, 100 × 86, 100 × 88, 104 × 94, 110 × 93, 110 × 100, 110 × 104, 120 × 110μ. Membr. crass. $1\frac{1}{2}$-6μ.

Coogee (58, 93); Auburn (67, 119, 140, 148, 149, 164); Rookwood (107); Canley Vale (128); Potts Hill (138); Guildford (146).

Almost as common here as the type, in company with which it is generally found. The apices in this form are rounded off, not acuminate as in var. *acuminata*. Occasionally, they are flattened somewhat, showing a tendency to pass over into var. *doliformis*. The inner mucous layer of the membrane, when present, is nearly always longitudinally corrugate. The ratio of the axes varies from about 1·1 to 1·2:1·0, the average of the twenty specimens given above being 1·12:1·00. Quite plentiful in some gatherings, *e.g.*, Nos.67 and 107.

Var. DOLIFORMIS, n.var. (Pl. ix., f.9, 10).

Cellulæ liberæ oblongæ, doliformes; lateribus plus minusve arcuatis; apicibus truncatis interdum papilla instructis; angulis obtuse-rotundatis. Cellulas matrices non vidi.

Cell. veg. 86 × 72, 88 × 70; 114 × 100 ap. 30; 120 × 97 ap. 30; 120 × 105, 142 × 118μ.

Auburn (118, 140, 174); Fairfield (79); Canley Vale (128); Lismore (240).

Rarer than the preceding forms, it nevertheless generally turns up in any habitat where the type is found. Chloroplasts are of the usual irregular lozenge-shape. Sometimes there is a slight apical incrassation on the inner side of the membrane, and, more rarely, a tubercle outside.

Var. NODOSA, n.var. (Pl. ix., f.11, 12).

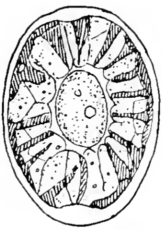
Cellulæ sphæricæ, membrana utroque polo introrsum incrassata.

Cell. diam. 40, 42, 50, 52, 56; membr. crass. 2-3 μ.

Potts Hill (138); Auburn (140, 148, 149); Lismore (240).

Var. CHODATI, nom.nov. (Text-fig. 28).

Cellulæ late-ellipticæ, ovales; lateribus arcuatis; apicibus late-rotundatis, utroque polo interdum introrsum incrassatis. Chloroplastides in laminis radiantibus ordinatæ.



Text-fig. 28.
E. viridis var. *Chodati* mihi; after Chodat.

Cf. Chodat, Bot. Zeit., 1895, T. v., f.10; no dimensions given, nor magnification. I have not met with this form, which is somewhat like var. *ovalis* but more elliptic, not so subglobose. The chloroplasts also are different, being small, radiating laminæ, instead of the usual parietal discs. The large, central body indicates that it is a form of *Eremosphæra.*

EXPLANATION OF PLATES VII.-IX.

Plate vii.

Figs. 1-4.—*Oocystis Nägelii* A.Br., three forms of the type; (1-3), × 1000; (4), × 1330.

Figs. 5, 6. ,, ,, mother-cells; (5), × 500; (6), × 665.

Fig. 7. ,, ,, var. *obesa*, n.var., (× 1330).

Fig. 8. ,, ,, var. *curta*, n.var., (× 1330).

Figs. 9, 10.—*O. Novæ Semliæ* Wille; (9), mother-cell, (× 665); (10), one of the autospores, (× 1330).

Figs. 11, 12. ,, ,, f. *major* Wille; (11), mother-cell, (× 500); (12), an autospore, (× 1330).

Figs. 13-17. ,, ,, var. *australica*, n.var., (13-15), from Parramatta; (13, 14), × 665; (15), × 1000; (16, 17), from Lismore, (× 1330).

Figs. 18, 19.—*O. crassa* var. *Ostenfeldii*, nom.nov., (18), mother-cell, (× 665); (19), one of the autospores, (× 1000).

Fig. 20.—*O. lacustris* Chodat, with two generations of autospores, (× 1000).

Fig. 21. ,, var. *natans* (Lemm.) mihi, (× 1000).

Figs. 22, 23. ,, var. *paludensis*, n.var.; (22), mother-cell, (× 330); (23), one of the autospores, (× 1330).

Fig. 24. ,, the same, with different chloroplasts, (× 1000).

Figs. 25, 26.—*O. parva* W. & G. S. West, (× 1000).

Figs. 27, 28.—*O. nodulosa* var. *australis*, n. var.; (27), × 1330; (28), × 900.
Fig. 29.—*O. solitaria* Wittrock, (× 1330).
Fig. 30.—*O. submarina* Lagerh., (× 1330).
Fig. 31.—*O. rotula*, n. sp.: (*n*), nucleus, (× 1000).
Figs. 32, 33.—*O. subsphærica*, n. sp.; (*n*), nucleus; (32), × 665; (33), × 1000.

Plate viii.

Figs. 1, 2.—*Ocystis apiculata* W. West, (× 1330).
Fig. 3. ,, ,, var. *obesa*, n. var., (× 1330).
Figs. 4-6. ,, ,, var. *simplicior*, n. var., (× 1330).
Fig. 7. ,, *subhexagona*, n. sp., (× 1330).
Figs. 8-10. ,, *Chodati*, nom. nov.; (8, 9), free, vegetative cells, (8) × 1330, (9) × 665; (10), mother-cell, (× 1000).
Fig. 11.—*Eremosphæra viridis* with autospores of *O. Chodati* (× 500).
Figs. 12, 13.—*O. australiensis*, n. sp.; (12) mother-cell, (× 800); (13), free, vegetative cell, (× 1000).
Fig. 14.—*O. panduriformis* W. West, (× 500).
Figs. 15, 16.—*O. ovalis* Turner; (15), with digitate chloroplasts, (× 665); (16) with discoid chloroplasts, (× 500).
Figs. 17-19.—*O. ovalis* var. *subtruncata*, n. var.; (17) mother-cell (× 665); (18, 19) free, vegetative cells, (× 665).
Figs. 20-22.—*O. ovalis* var. *cylindracea*, n. var.; (20) as mother-cell to two autospores of *E. viridis*, (× 570); (21, 22) × 665; (*o*) red oil-globules.
Fig. 23.—*O. apiculata* var. *splendida*, n. var.; (× 900).

Plate ix.

Figs. 1, 2.—*Eremosphæra viridis* De Bary; mother-cells with small-sized autospores (diam. 60μ); (1) much inflated (× 135), (2) very little inflated, the membrane closely swathed round the four autospores (× 335); 8-celled specimens in the same condition were also noted.
Figs. 3-6.—*E. viridis* var. *acuminata*, n. var.; (3, 5) free, vegetative cells (× 360), (4) mother-cell (× 135), (6) one of the autospores (× 400).
Figs. 7-8.—*E. viridis* var. *ovalis*, n. var.; (7) × 335, (8) showing longitudinal and horizontal sulcæ (indicated by dotted lines) in the inner membrane (× 500).
Figs. 9, 10.—*E. viridis* var. *doliformis*, n. var.; (9) × 270, (10) with apical papilla (× 380).
Figs. 11, 12.—*E. viridis* var. *nodosa*, n. var.; (12) showing inner membrane pitted with shallow scrobiculæ interiorly, (× 665).
Fig. 13.—*Oocystis Nordstedtiana*; n. sp., (× 665).

THE CHEMICAL INVESTIGATION OF SOME POISONOUS PLANTS IN THE N.O. SOLANACEÆ.

Part ii. *Nicotiana suaveolens*, and the Identification of its Alkaloid.

By James M. Petrie, D.Sc., F.I.C., Linnean Macleay Fellow of the Society in Biochemistry.

(From the Physiological Laboratory of the University of Sydney.)

Nicotiana suaveolens Lehm., the "native tobacco" of Australia, and the only endemic species, is plentiful in the interior of this State. It grows about three feet high, and is often a troublesome weed in the stock country. It is a drought-resistant plant, and spreads over large tracts of land in the dry seasons. Hence it is that, when grass and other fodder plants are withered or overrun by this weed, it is often the only green plant left available to starving animals. It is then readily eaten by stock, and, according to the reports of the owners and Inspectors, the results are variable. Though in many cases no apparent harm has followed, there is still a consensus of opinion among stockmen, that many of their losses must be attributed to this plant.

The only record of tests having been made on this species, is a paper by Dr. Bancroft (Proc. Roy. Soc. Queens., iv., 1887, p.9), in which he states that the physiological effect of the extracts on animals resembled that of extracts of true tobacco and of pituri.

The following is the account of a chemical investigation of this plant, which was undertaken to decide definitely the nature of its active principle, and also to determine whether this constituent is present in quantity sufficient to cause death.

Extraction of active principle:—For this purpose, plants were collected in the midsummers of 1911, 1912, and 1913, chiefly from the dry North-West. Through Chief Inspector Symons, of the Stock Department, a sample was received from Narrabri. This, on its arrival, contained 37 per cent. of moisture, and consisted of leaves, stalks, and roots. The whole sample was extracted with alcohol, and the solvent afterwards removed by distillation under diminished pressure. The extract gave all the general alkaloid reactions, and smelt strongly of tobacco. The alkaloid was completely removed from this extract by petroleum spirit (b.p. under 45°C) after making alkaline with sodium hydroxide. From this coloured solution, the alkaloid was carefully purified without loss, by shaking it into water and petroleum spirit successively, many times, and finally obtained as a colourless, aqueous solution. This solution was slightly alkaline, and possessed the odour of nicotine. It was then titrated with tenth-normal acid and alkali, and gave an equivalent of 2 c.c. of acid neutralised by the alkaloid. If this quantity be calculated as nicotine, it represents 0·0324 gm., and is 0·124 per cent. of the plant (dried at 100°).

A second sample, from the Castlereagh River, in the Coonamble district, was obtained from Mr. Breakwell, of the Department of Agriculture. This sample had been spread out to dry in the air to avoid mould in transit, and when received it contained only 9 per cent. of moisture. The whole of the material, consisting of leaves and stalks, in this case was subjected to dis tillation in a current of steam, the powdered plant being first mixed with 0·5 per cent. sodium hydroxide in solution, and a large excess of milk of lime. The whole of the alkaloid passed into the distillate; and the residue in the still being free from alkaloid, showed that no non-volatile alkaloid existed in the plant. The voluminous distillate contained much ammonia, which is derived from the cleavage of amido compounds, and this free ammonia was eliminated by passing a current of air through the solution for many hours. The alkaloid was next converted into oxalate, and the fluid concentrated at a low temperature to about 300 c.c. From this solution ether removed the alkaloid, and the ether extract was carefully purified and dried. The ether was then slowly removed, and the residue dried to constant weight; 0·07 gm. was obtained, which represented 0·011 per cent. of the plant-material dried at 100°C.

Another quantity was collected for me, near Picton, about 50 miles from Sydney, by Mr. E. Cheel, of the National Herbarium. This consisted of fresh, green leaves and stalks, with 72 per cent.

of moisture. The whole was distilled as before, in a current of steam, until the alkaloid was completely volatilised. The alkaloid was isolated and purified as in the last case, neutralised with excess of tenth-normal oxalic acid, and the excess determined by titration, using cochineal indicator. The result in this case gave 0·0178 gm. of alkaloid, or 0·015 per cent. of the plant (dried at 100°).

If we regard the above sample containing 72 per cent. of water as a fair average specimen of fresh material, we can express these results also in terms of the green plant, and thereby form a better idea of the amount of alkaloid in the original plant as eaten by stock. The results may then be stated :—

Amount of Alkaloid expressed as Nicotine.

(1)	0·035% of fresh plant.	0·124% of plant dried at 100°C.
(2)	0·003% of fresh plant.	0·011% of plant dried at 100°C.
(3)	0·004% of fresh plant.	0·015% of plant dried at 100°C.

Examination of the Alkaloid,—The aqueous solution is alkaline to litmus, and possesses a burning taste, and the characteristic tobacco odour. The pale yellow substance, when exposed to the air, oxidises, and turns dark brown; it then possesses the nauseating odour of nicotine.

Of the salts of nicotine, the most characteristic, and the one best adapted for the identification of the alkaloid, is the picrate. Accordingly, the picrate was prepared from the aqueous solution by the addition of excess of picric acid. The dense yellow precipitate, amorphous at first, gradually assumed, on standing, the characteristic, thin, yellow, needle-shaped crystals. At the same time, pure nicotine picrate was prepared under similar conditions, and the crystals compared. Under the microscope, they were precisely alike. The crystals were washed completely with distilled water, and recrystallised three times from water, then finally dried at 100°C. The melting-points were then determined together:—

Picrate of N. suaveolens alkaloid ...... —m.p.	218°C. (corrected).
Picrate of pure nicotine....................	218
The two mixed together....................	218

The melting-point of nicotine picrate has been determined by Pinner and Wolffenstein as 218°C. (Ber. 24, 1891, 66).

The alkaloid of *Nicotiana suaveolens* is therefore nicotine.

For the purpose of comparison, pure nicotine tartrate (B.W.) was decomposed, and the nicotine distilled from it in a current of purified hydrogen gas. It was collected and at once sealed up in the receivers. From this colourless liquid, the nicotine picrate was prepared.

Toxicity of the plant:—Nicotine is probably the most violent poison known. Wynter Blyth gives the lethal dose for a human adult as about 6 mgs. In Abderhalden's "Biochemisches Handlexikon," it is stated that 5 mgs. suffice to kill a medium-sized dog in three minutes. It is evident from these data, taking even the lowest value of nicotine in the above results, that there is enough contained in one half pound of the green plant, to poison an ordinary sized sheep.

References to the plant as a stock poison:—Of the 80 or more species of Nicotiana, only a few are known to contain nicotine. *Nicotiana suaveolens* being limited to the Australian continent, the records of fatalities are all local. But it is referred to, also, by European authorities, such as Dragendorff in "Die Heilpflanzen," (1898) as a poisonous plant; by Greshoff in his "Monographia de plantis venenatis" as poisonous for cattle; and by Pammel ("Poisonous Plants," 1911) as poisonous to stock. It is described by F. M. Bailey, as a stock poison in Queensland, and by Professor Ewart as a feebly poisonous plant in Victoria. Mr. J. H. Maiden states that it is very deadly to all stock, and refers to many instances of poisoning of cattle, sheep, pigs, and rabbits. In his "Plants reputed poisonous to Stock," Mr. Maiden describes a sudden fatality, in 1891, of 300 healthy cattle, travelling on the great stock route through Milparinka.

Summary.—The results of this paper prove that *Nicotiana suaveolens* contains the extremely poisonous alkaloid nicotine, and that the nicotine is present in sufficient quantity to poison stock.

I express my thanks to Professor Sir Thomas Anderson Stuart, in whose laboratory the work was done.

THE INSTABILITY OF LEAF-MORPHOLOGY IN ITS RELATION TO TAXONOMIC BOTANY.

By A. A. Hamilton.

In the ordinary routine-work of the Sydney National Herbarium, parcels of specimens are received from horticultural, agricultural, arboricultural, pastoral, and dairying districts accompanied by requests for information from the consignors, Farmers, Stock-Inspectors, Shire Clerks (administering the "Noxious Weeds Act"), Foresters, Secretaries of Agricultural Bureaux, School-Teachers, and other correspondents who do not profess any knowledge of systematic botany. As a consequence, the specimens forwarded, in many cases, are examples in leaf only; and the difficulty in determining such specimens, arising from the absence of the definite characters exhibited by the flowers and fruits, especially in the case of economic plants or those suspected of poisoning stock, to which considerable responsibility attaches, attracted the attention of the writer to the extensive range of leaf-variation found within the limits of a species, and a corresponding similarity in the leaves of distantly related plants. While engaged collecting a series of specimens to illustrate the ecology and xerophily of the strand-flora of Lady Robinson's Beach, a change in the leaves of *Senecio lautus* Forst., from flaccid, thin, and entire, at a distance from the beach, to crass, firm, succulent, and pinnatisect as the beach was approached (**13**; 1913, p.396), together with examples of *Clematis glycinoides* DC., exhibiting a gradual reduction of the normal trifoliate leaf, to a simple one, occurring on an individual plant, (*loc. cit.*) accentuated the impression already created. Attention was directed to the subject in the field, and collections made, demonstrating, for the greater part, the variation of leaves within a species, and exhibited from time to time at the Meetings of this Society. A series of examples, chiefly Australian, most of them familiar to local workers and readily available, together with references from the works of Australian botanists, illustrating the leaf-characters affected, is now submitted, and, in certain cases, evidence is offered as to the conditions operating in the production of leaf-variation. For exotic examples and more detailed causation, see Schimper(**23**) and Warming(**25**) The factors affecting leaf-morphology, examples of which are given, may be briefly summarised.

Edaphic. —The preference shown by certain plant-associations of our indigenous flora for a particular soil-formation has been demonstrated by local botanists and geologists (though further data on this interesting subject are desirable), and this influence is largely contributory to leaf-variation; the growth on a rich basaltic soil, compared with that inhabiting a poor sandstone formation, needs no comment, so obvious is the effect on the size and shape of the leaves in plants capable of adaption to both situations.

Climatic.—The degree of heat or cold encountered largely regulates the size, pilosity, texture, and glaucousness of leaves. The occurrence of similar forms of leaf in some species of alpine and desert plants, due to the climatic conditions obtaining in such regions, is noted in all ecological text-books; and plants approaching these inhospitable regions from stations in which the conditions are more temperate, exhibit variation, which, in some instances, may be traced by well marked gradations.

Exposure v. Shelter.—The adaptable, dry ridge, or elevated plateau habitué, alters its foliar characters in conformity with the conditions obtaining in the valley, or sheltered slope, when changing its habitat. The close association of plants (growing in exposed situations) for mutual protection and shelter, modifies the size of the leaf.

Elevation.—The measure of elevation is seen to affect leaves in size, pilosity, and texture. Examples of hairiness in alpine plants growing under xerophytic conditions, and glabrous forms growing as hygrophytes are given(**16**; p.34).

Phenological.—Irregularity of rainfall is the principal agent in phenological leaf-change; a sudden, copious rain after a prolonged period of drought, accelerates the production of foliage which cannot be maintained, when the supply of water is exhausted, the leafage, as a consequence, becoming attenuated. Heterophylly, and dimorphism, may (in part) be attributed to this cause.

Hydrophylly.—The degree of permanence of the water-supply (river, creek, lagoon, waterhole, &c.) necessitates elasticity in the leaf-characters of the individuals, or associations of plants frequenting these stations.

Instability of foothold.– One of the devices adapted as a protection against uprooting, by plants growing in the shallow pockets of soil in alpine situations, and exposed to fierce storm-blasts, is the rosetted form of basal leaf (**16**; p.33). This character is simulated by several swamp-dwellers, notably members of the Orders Goodeniaceæ and Droseraceæ, as a supporting agency in maintaining an upright position, and to counteract the laxity of the soil-conditions obtaining in a bog. An instance of a plant (*Goodenia dimorpha* Maiden & Betche) which had been prostrated by a storm, growing an extra, basal rosette on a branch which touched the ground, and rooting it to secure an anchorage, was given (**13**; 1914, p.470). The muddy, insecure environment of the saline estuary has imposed on its plant-guests the task of making provision for repelling tidal invasion; and similarity of leaf-characters has been brought about, through the use of the same protective devices, by *Zoysia pungens* Willd., and *Sporobolus virginicus* Humb. & Kunth, the convolute leaves of these estuarine grasses offering a minimum of resistance to the ebb and flow of the tide. The insecurity of the shifting sand-dune is, in some measure, responsible for similarity in the foliage of the carpet-forming species, *Mesembryanthemum edule* Linn., and *M. æquilaterale* Haw., though, in this, as in the previous examples, more potent factors than those indicated have also been engaged in moulding the leaf-characters of these plants.

Drainage.—Stagnant water lying at the roots of plants in clayey soils, clay-pans, and shallow rock-basins, appreciably alters the facies of the foliage. In hilly sandstone-country, sudden dessication, owing to rapid drainage after a copious rainfall, compels the dweller in such regions to modify the size and texture of its leaves.

Halophily.—Succulence is the predominating character noted in species growing in saline situations, which affects their leaf-morphology; and it has been demonstrated that the leaves of certain species are increased in size and thickness by their proximity to tidal waters. Characters evolved by the necessity for provision against the absorption of an undue quantity of sodium chloride have, in the case of many beach and estuarine plants, induced a degree of similarity in the leaves of plant-associations adopting a common device, and variation in groups dependent upon differing contrivances to obviate this danger.

Humous acidity.—The swamp-dwelling fraternity of plants supplies instances of similarity of foliage arising from the communal use of xerophytic devices tending to decrease the absorption of the swamp-water, which contains the elusive, deleterious compounds, known as humous acids.

Insolation v. Shade.—Among plant-associations growing in open sandstone-country incapable of carrying an arboreal vegetation, a similarity in foliage is displayed by species belonging to differing families, due to the common necessity for a reduced leaf-surface, with accompanying characters, calculated to minimise the injurious action of unbroken sunlight. The shade, and luxuriant food-supply afforded by the conditions obtaining in the "Brush" forest, have permitted an increase in the size and flaccidity of the leaves of its inhabitants, which has resulted in many resemblances in leaf-characters, in plants widely separated in relationship.

Juvenility v. Adolescence.—The variation attributable to the transition from juvenile to adult growth affects pilosity, viscidity, armature, marginal division, and axial altenation; the division of the young leaves (pinnate) in the genus Acacia, as opposed to the phyllodic character of the adult foliage, and the opposite or alternate arrangement of the juvenile or mature leaves of the genus Eucalyptus, is common knowledge. Characters, arising from protective devices adopted by the young leaves, are discarded when no longer necessary. Scabridities, and asperities become more conspicuous as the leaves age, owing to shrinkage in their texture. The foliage of young plants is frequently larger than that of older growths.

Transpiration.—The preventive measures adopted by plants against excessive transpiration are responsible for similarity, or variability in leaf-characters, according to the resultant effects of uniformity or opposition, arising from the methods used to regulate the loss of moisture.

Adaptability.—The plant possessing the ability to exist in a varied habitat must, of necessity, be capable of modifying its leaf-structure to conform with the changes in the environmental conditions, the phrase "common and variable" being exceptionally applicable to adaptable species.

Teratological.—The meristematic attack of microscopic insects probably plays a more important part in the moulding of leaf-characters than has been generally recognised. Leaf-twisting, and axial disarrangement of the alternation of whorls, may be set up by insect-attack or mechanical injury.

Most of the above factors are capable of demonstration, but there remain, the uncertain effect of heredity, and the still less known equation "Mutation," to exercise a disturbing influence on leaf-characterisation. The changes brought about by natural hybridisation, and cross-fertilisation, though still largely a matter for conjecture, cannot be disregarded in a consideration of the morphology of leaves.

Examples.

RANUNCULACEÆ.

The marginal toothing, the leaf-character separating *Clematis aristata* R.Br., from *C. glycinoides* DC., is inconstant; and variation in the leaflets of the latter has already been noted. The foliage of *Ranunculus plebeius* R.Br., and that of *R. hirtus* Bks. and Sol., are difficult to separate, hairiness, the character chiefly relied upon, being subject to age, and environmental conditions; the dissection of the leaves varies on the individual plant.

DILLENIACEÆ.

The xerophytic leaves of several Hibbertias are so similar as to be of little value to the systematist; those of *H. linearis* R.Br., and *H. obtusifolia* DC., approach each other, and are finally inseparable.

CRUCIFERÆ.

The flaccid leaves, ranging from simple to lyrate, and pinnatifid, of many Cruciferous plants, are generically similar, and frequently indistinguishable.

VIOLARIEÆ.

Leaf-divergence in *Ionidium filiforme* F.v.M., due to environmental conditions, was noted, and specimens from the Blue Mountains exhibited before this Society (**12**; p.392) showing, under hygrophytic conditions, a flaccid, elongated leaf 2½ inches long; while, on examples from an elevated, dry ridge, the longest leaf found measured barely ½ inch.

PORTULACEÆ.

Mr. A. H. S. Lucas brought living plants of *Claytonia australasica* Hk., from Mt. Kosciusko to Sydney, and found that the new shoots became perfectly glabrous, the glaucousness of the plant also disappearing, with the vestiture, under cultivation in a warmer climate(**16**; p.22).

RUTACEÆ.

Exceptional heterophylly in *Zieria involucrata* R.Br., was demonstrated in a series of specimens from Valley Heights, exhibited before this Society(**12**; p.393). Mr. J. Stirling, F.L.S., (**24**; p.1052) remarks of *Zieria Smithii* Andr., var. *macrophylla*, "in specimens of this arborescent form, procured at different altitudes and situations as regards humidity, dryness, &c., differences in the leaves represented by thickness, and (in the subalpine vars.) in having a dense, stellate tomentum on the underside." Again, under *Boronia anemonifolia* A. Cunn.,(*l.c.*, p.1054) "the division of the leaves into pinnæ in some forms, and the pubescence of others, are not constant characters." Mr. Stirling also refers to leaf-variation in other Rutaceous plants, arising from differences in soil, climate, and elevation. The Blue Mountain representative of *B. polygalifolia* Sm., var. *robusta* Benth., is a xerophytic form of *B. anemonifolia* A. Cunn., the leaflets in the latter showing a gradual change as the plants attain a more luxuriant station(**13**; 1914, p.648). The heterophyllous leaves of *B. ledifolia* Gay, a species well known to local botanists for its leaf-variation, are described(**4**; Vol. i., p.314) as simple, trifoliate, or rarely 5-, or even 7-foliate. Specimens from French's Forest (Coll. E. A. Holden; Sept., 1906), exhibited before this Society by Mr. J. H. Maiden, F.L.S., on behalf of Mr. T. Steel, F.L.S., with reference to a case of assumed hybridism, *B. floribunda* × *B. serrulata* Sm.,(These Proceedings, 1906, p.566) showed an interchange of leaf-characters between these two species, which was accentuated by further variation, in another example from Deewhy,(T. D. Mutch; August, 1915) exhibited for Mr. Maiden(**13**; 1915, p.419).

A series of specimens of *Eriostemon hispidulus* Sieb., from Springwood, illustrating leaf-variation in size, shape, margin, and length of petiole, was exhibited(**13**; 1915, p.415) taken from bushes growing under apparently similar, environmental conditions; and an additional series is here noted, from plants of *E. salicifolius* Sm., also growing under similar conditions, on a sandy flat at Woy Woy(A. A. Hamilton; June, 1915), ranging from broad lanceolate, $2 \times \frac{5}{8}$ inch, to narrow linear, $2 \times \frac{1}{8}$ inch, and from $\frac{1}{2}$ to 3 inches long. Specimens of *Phebalium squamulosum* Vent., in the National Herbarium, show a considerable range of variation in the dimensions of the leaves of this widely distributed species, in several instances obviously due to environment; the scurfy scales vary in colour from red to black, the margins are from barely recurved to almost revolute, and the apices are from acuminate to broadly obtuse, truncate, or emarginate.

Meliaceæ.

Mr. Bentham's description of *Flindersia maculosa* F.v.M.,(Fl. Aust. i., p.389) is elastic.

Sapindaceæ.

The botanical description given by Mr. Maiden of *Atalaya hemiglauca* F v.M.,(**19**; ii., p.122, Pl.60) shows that the leaves of this species may be simple or pinnate, from 2-8 inches long, the petiole terete or winged, or the leaflets decurrent on the petiole, forming a large 2- or 3-lobed leaf, such a leaf being depicted as a detail, in the carefully executed plate by Miss M. Flockton, illustrating this species. A series of leaves of *Dodonaea triquetra* Wendl., showing a considerable range of variation within this species, was exhibited before this Society(**13**; 1915, p.628).

Leguminosæ.

In this Order, the genus Acacia has presented many problems in leaf-variation to the systematist, the exceptionally wide range of habitat of many species of the genus necessitating considerable alterations in the structure of the foliage, to meet the requirements of the varied environmental conditions encountered within the sphere of their activities. An example of this elasticity is found in the alteration of the texture of its phyllodes, by *A. suaveolens* Willd., during its passage from the lower to the higher elevations on the Blue Mountains(**12**; 1915, p.389). In a footnote to his description of *A. rostellifera*, Bentham, (**4**; ii., p.368) who has reduced *A. subbinervia* Meissn., to a synonym of his species, writes :—"The second nerve of the phyllodia, from whence Meissner derived his name, very seldom occurs, and was therefore in some measure exceptional in the specimen described by him." Discussing the *A. decurrens* Willd., group of "Wattles," Mr. J. H. Maiden(**19**; iii., p.40) draws attention to the following points :—The pinnules of all vary more or less in each variety in length, breadth, and insertion. . . . . A decurrence of leaf-stalks is common to all. . . . . . The indumentum is variable. . . . . . The number of glands varies in each variety in the same tree. Further remarks by the author accentuate the wide range of variation within this group. Under *A. pumila* Maiden & Baker, (**20**; p.87) is the following note by Messrs. Maiden & Betche :— "Since publication of this species, many additional localities have been discovered . . . . . and the additional material necessitates some modification of the description. The phyllodia are described as 6 lines long and 1 line broad; it should read instead, phyllodia from ½ to nearly 1½ inches long, 1 line broad in the short-leaved forms, considerably narrower in the long-leaved specimens." Mr. R. H. Cambage, F.L.S.,(**5**) illustrates some of the difficulties in discriminating between several members of this genus on foliar characters, with special reference to venation and texture. In (**5**; 1900, p.595) he applies the test of brittleness to the phyllodes as a differentiating character between two closely allied species, incidentally mentioning that this test is of no value in dried specimens. In a later paper,(**5**; 1900, Mr. Cambage returns to this subject, and notes (p.719) that the species *A. homalophylla* A. Cunn., "Yarran," whose foliage was, by its clean break, separated from *A. Cambagei* R. T. Baker, "Gidgea," shares this character with *A. pendula* A. Cunn., "Myall," similarity in phyllodic texture between them being also noted. In his description of *A. difformis*, the author, Mr. R. T. Baker, F.L.S., (**3**; 1897, p.154) considers it necessary to explain, at some length, the differences in foliar characters between his species and *A. penninervis* Sieb., to avoid confusion between them, referring also to the variability in foliage found in the latter species and its vars. Examples of the pinnate-leaved *A. discolor* Willd.,(**13**; 1915, p.209) collected from a series of plants growing in company on the slope of a hill at Cook's River, emphasised the irregularity of the number of pinnæ, relied upon by Bentham (**4**; ii., p.318) to differentiate two groups, the range of the size of the leaflets as given in the description of this species (*l.c.*, p.414) also displaying insufficient elasticity. *A. implexa* Benth., (**13**; 1915, p.415) furnished evidence, by means of a series of phyllodes taken from a small colony of some half-dozen plants, evidently with a common parentage, growing on a sandstone-hill at Glenbrook, of morphological, foliar divergence within this species, more pronounced than that differentiating it from *A. Maideni* F.v.M., the texture, and venation of the foliage of these two species showing similarity. Dimorphic foliage, the result, in some instances, of seasonal growth, is not infrequent in this genus. Examples showing the lower phyllodes larger than the upper ones, others again with the larger phyllodes uppermost, and a specimen with two, opposing branches on a single stem whose phyllodes showed a considerable divergence, were noted (**13**; 1914, p.648). Variation was also noted in the phyllodia of *A. elongata* Sieb.,(**13**; 1914, p.397) and those of *A. suaveolens* Willd., of which measurements were given (**13**; 1914, p.471); examples of this species were also exhibited to illustrate leaf-twisting (**13**; 1915, p.418) The phyllodia of the *A. falcata* Willd., *A. penninervis* Sieb., and *A. pycnantha* Benth., group are not easily separated on the characters of shape, size, texture, and venation, each of these species having a fairly wide range of these characters within itself. Specimens of *A. binervata* DC., in the National Herbarium, collected at Stanwell Park, by Mr. J. H. Maiden, have the following field-note by the collector—"Twigs from a young tree, phyllodes very wide, and tripleveined." Mr. Maiden's leaves are from 3 to above 4 inches long, and from $1\frac{1}{2}$ to 2 inches broad. A further series of this species collected in the same locality by the writer (August, 1915), from an old tree, are narrow and normally two-veined, ranging in size from $2 \times \frac{1}{2}$ to $6 \times \frac{3}{8}$ inch, and in shape from straight to falcate, with a long, acuminate apex. The description of Acacia-seedlings given by Mr. R. H. Cambage (**7**; p.97) discloses variation in shape, size, number of leaflets, degree of pilosity, colour, venation, length and dilation of petiole, and distance of internodes, in the seedling-plants. In a concluding note, Mr. Cambage says (p.118)—"In all the above descriptions the measurements quoted of the various parts of the seedlings are either the average lengths or the extremes so far met with, but in some cases the variation is so considerable that it seems likely further investigation may show that the greatest extremes of length have not yet been recorded."

The spiny leaves of *Daviesia acicularis* Sm., *D. ulicina* Sm., and *D genistifolia* A. Cunn., are progressively merged, and those of *D. latifolia* R.Br., and *D. corymbosa* Sm., are, in many instances, inseparable. Of the latter, Mr. Maiden (**15**; p.8), notes the commingling of glaucous and non-glaucous forms; and a series of leaves of this species illustrating variation was noted by the writer (**13**; 1914, p.254). Local botanical collectors have, probably without exception, noticed the variability in the foliage of *Dillwynia ericifolia* Sm., and the similarity in the leaves of other species within the genus. Mr. R. H. Cambage (**5**; 1900, p.600) records some very marked features in the foliage of *Cassia eremo-*

phila A. Cunn., showing gradations from flat to cylindrical, under varying climatic conditions. The influence of xerophytic or hygrophytic conditions on leaf-variation was illustrated by a series of examples, exhibited before this Society (**13**; 1915, p.418), of *Bossiæa heterophylla* Vent., (a species whose foliar instability is intimated by its specific name) in which the transition from a degree of aphylly, in the elevated, dry-ridge xerophyte, and harsh, diminutive foliage of its fellow of the dry claypan, to the broad, soft leaves of plants of this species living under hygrophytic conditions, was demonstrated; in these latter examples, to which under normal conditions a regular supply of water is assured, the flattened stems, and the persistence of the narrow, linear leaves in company with the broader ones (heterophylly), disclose a provision for a return, when necessary, to xerophytic conditions, as it was noted that the broad leaves exhibit extreme sensitiveness to drought-conditions, and respond by becoming deciduous. A series of specimens of *Platylobium formosum* Sm., exhibited before this Society (**13**; 1915, p.415) showed alterations in the size of leaf brought about by xerophytic versus hygrophytic conditions. It is noted that several genera of Western Australian Leguminosæ are exceptionally liable to marginal leaf-variation.

SAXIFRAGEÆ.

The alternation of seasons favourable or deterrent to plant-growth, has caused considerable leaf-variation in *Ceratopetalum gummiferum* Sm. In some examples from Cowan (Coll. A. A. Hamilton; May, 1915), the larger leaves are found on the tips of the branches; in others, the smaller leaves are so placed, and there is a third stage showing a branch on which the leaves are all small, and closely packed.

DROSERACEÆ.

The leaves of *Drosera peltata* Sm., and *D. auriculata* Backh., are identical, and those of some of the rosetted forms are barely separable.

Halorageæ.

Variation in the emerged and submerged leaves occurs in the genus Myriophyllum. In both *Haloragis ceratophylla* Endl., and *H. heterophylla* Brongn., leaf-division occurs, varying from almost entire, to coarsely-toothed, and pinnatifid; and both are irregular in the alternation of their leaves.

Myrtaceæ.

In the N.O. Myrtaceæ, the genus Eucalyptus provides many instances of leaf-variation. The attention concentrated on the genus by leading Australian botanists, who have specialised in this sylvatic group, has resulted in a searching investigation of their structure, from the cotyledon to the mature tree, and has incidentally disclosed many examples of the difficulty of discriminating between some of its members on leaf-characterisation. Bentham (**4**; iii., p.186) says:—"The old division of the genus according to the opposite or alternate leaves is now found to be quite fallacious," and, *loc. cit.*, "The extraordinary differences in the foliage of many species at different periods of their growth add much to the ordinary difficulties arising from the gradual transition of varieties, races or species, one into the other." Again,(p.187) "It appeared quite useless in any manner to describe these sapling leaves in the several species where they have been observed, for they present at once the greatest similarity in the corresponding leaves of different species, and the greatest dissimilarity in the different leaves of the same species or specimens." Baron von Mueller(**22**) notes several instances, in his specific descriptions, of members of this genus exemplifying the instability of leaf-morphology as a terminological factor. In his preface to (**18**), the author, considering Variation in the Genus(p.6), offers some generalisations on the modification of leaf-characters, and, in the already published portion of this comprehensive work, has cited numerous instances of similarity of leaves in opposing, and variation within the compass of species, accompanied by plates showing differing forms of leaves. Modification of leaf-characters in *E. coriacea* A. Cunn., referable to elevation (**16**: p.35) are noted by the author, who writes, "The case of *E. coriacea* is a notable instance of the decreasing size, increased succulence, and glaucousness of the leaves, as the higher elevations are reached." Mr. Maiden also writes at some length on the question of the specific rank of *E. pulverulenta* Sims, on the validity of which species some doubt had been expressed by previous writers, chiefly in respect of the variability of leaf-characters (These Proceedings, 1901, p.547). In (**20**a), Mr. J. H. Maiden, referring to "A species in the making,"—akin to *E. melanophloia* F.v.M.,(p.233), says:—"We have been of course aware for many years how variable is the foliage of *E. melanophloia*, lanceolate-leaved forms being well known. Particulars may be found in (**18**; Part 12, p.71). . . . . . Owing to changes of environment, it is very often the case that we have breaks, and in the present case we may have a break from *E melanophloia* in the direction of narrower, more petiolate leaves, with other minor differences." In (**20**b), Mr. Maiden, under *E. Risdoni* Hook. f.,(p.28) says:—"Perusal of p.175, and of Plate 32 of my work (**18**) will show that I had already confirmed Bentham's observation by noting 'lanceolate leaves are common on the tops of branches of *E. Risdoni*,' and Mr. Deane and I compared them with a similar phenomenon in *E. pulverulenta* (*cinerea*)." In a paper (**20**d, MS.), (extracts from which I have, by the courtesy of the author, been permitted to quote) Mr. Maiden, under Homoplasy, writes:—"In Eucalyptus, so often do organs (particularly leaves) simulate each other, that it is usually necessary to demand specimens exhibiting a full suite of organs, in order that species may be determined"; and he gives the following quotation from Daydon Jackson's "Life of Bentham" (p.217), "On 27th April, 1870, Mr. Wilson Saunders again contributed to the Linnean Society, a set of mimetic plants, as the President phrased it, "a very interesting exhibition of pairs of plants with almost identical foliage from very different natural orders . . . . very much alike when in leaf only, so as in many cases to be quite indistinguishable, eighteen pairs of them" (p.220). A further reference is given (*loc. cit.*) to "Nature," iv., p.11. In a Chapter on Provisional Species, the author, when considering Mature Leaves (Eucalyptus) says:—

"There is infinite variation here." In a reference to "Hybridism in the Genus," the author (*loc. cit.*) refers to a personal experience in a Eucalyptus-plantation in Algeria, where intermediate forms of planted species, displaying pronounced, morphological characters, were obtained from spontaneous seedling trees. Variation of leaf-characters within, and resemblance without a species, is recorded by Messrs. Baker and Smith (**2**). *E. dextropinea* R. T. Baker, is noted (p.38) to have leaves almost identical with those of *E. lævopinea* (of this work), and resembling also those of *E. obliqua* L'Her.; and (p.41) *E. lævopinea* "sucker-leaves alternate or rarely opposite . . . . . mature leaves varying in size and shape, petiole varying from ½ inch to 1 inch long." Mr. R. H. Cambage has devoted a considerable portion of his Presidential Address (**6**) to an exhaustive summary of the morphological characters of the leaves of Eucalypts, showing extensive variation brought about by the necessity for modifications of structure, position, and other characters, to enable them to meet the varying requirements occasioned by the conditions of soil, climate, and other ecological and xerophytic factors, affecting the functional organisms of the members of this difficult genus, in their varied habitats. This writer has also drawn attention to similarity in the texture of the leaves of *E. stricta* and *E. viridis* (**5**; 1900, p 602), and (*l.c.* p.203) great similarity in the leaves of *E. dumosa* and *E. oleosa* Further references bearing on this subject will be found in a series of botanical papers by Mr. Cambage (**5**). The question of hybridism in Eucalypts has been exhaustively treated in (**18**) and other publications by Mr. Maiden, and other specialists in the genus; and the evidence adduced contains examples of similarity in the leaves of apparently distinct species brought about (presumably) by this agency. The similarity in foliage resultant from xerophytic conditions in the small-leaved group of the Myrtaceæ, is well exemplified in the allied genera, *Micromyrtus* and *Bæckea*, the diminutive, triquetrous, more or less decussate leaves of *M. microphylla* Benth., being, with difficulty, separated from those of *B. brevifolia* DC. Succulence, due to a halophilous environment, has enlarged the leaves ef *Bæckea crenulata* R.Br., when growing on the coast or saline estuary, to such an extent that the leaves of plants of this species, growing in a habitat unaffected by salinity, show as much variation relatively to the succulent form, as that obtaining between the leaves of two distinct species of this genus, e.g., *B. Gunniana* Schau., and *B diosmifolia* Rudge.

The growth which oppeared on some bushes of the latter at Valley Heights, after a fire had run through them, presented a marked difference from that obtaining in the foliage of the unscathed plants. *B. densifolia* Sm., exhibits a foliar difference in examples growing in a sheltered position at Valley Heights, and those growing at Newnes Junction (3500 feet) exposed to the bleak "Westerlies" (**13**; 1914, p.254). The leaves of the xerophytic, coastal swamp-form of *Darwinia taxifolia* A. Cunn., are inferior in luxuriance to those of the same species growing on the poor but well drained sandstone-hills at Cowan.

An example of leaf-variation within a species, is given in *Angophora melanoxylon* R. T. Baker. In his description of this species, the author writes:—"The rare shape of some of the leaves (the lanceolate form) connect it with *A. intermedia*, whilst the rounded, auricular base of the predominant shaped leaf gives it some affinity to *A. subvelutina*." (These Proceedings, 1900, p.85). A series of leaves of *A. cordifolia* Cav., showing variation within this species was noted (**13**; 1915, p.487). Specimens showing leaf-variation in the suckers of a form of *A. intermedia* DC., taken from a series of young trees (over which a fire had passed), growing on the Wianamatta Shale, near Clyde Railway-Station, are here noted. Example 1 : two, lower whorls of sucker-leaves ternate, the remainder gradually passing into the adult stage, and all opposite. Example 2 : two, upper whorls of adult leaves ternate, with a pair of opposite, adult leaves immediately below, merging into the sucker-leaves, which are all, from these downwards, alternate. Example 3 : juvenile and adult leaves, all opposite. Example 4 : lower whorl of sucker-leaves, ternate, those above opposite. Example 5 : three, lower whorls ternate, and one pair above, opposite (all juvenile). Example 6 : all sucker-leaves ternate. An exceptional range in size, shape (basal and apical), length of petiole, etc., is shown in both the juvenile and adult foliage. On example 1, a pair of leaves are seen coherent by their margins; the fusion exists along the greater part of their length, and they are, together, little broader than an individual normal leaf; the well-developed midrib of each leaf, and the deeply notched apex, disclose the unity.

In the hygrophytic group of this family, the leaf-characters show similarity as a result of the conditions of shade, shelter, moisture, and rich soil, found in the Brush Forest. The pendulous leaf, with its long, acuminate, dripping point, a device to throw off superfluous water, which, by remaining too long on the leaf, would interfere with transpiration (**23**; p.17) is found in the "Brush-Myrtles" of the allied genera, Myrtus and Eugenia, and the more distantly related *Syncarpia leptopetala* F.v.M. The similarity in the case of the "Myrtles" is enhanced by the glossy coating of the leaves, another factor engaged in expediting the exit of surplus moisture (*loc. cit.*). The inconstancy of the opposite versus alternate arrangement of the leaves in the genus Melaleuca, used by Bentham in his key to the species (**4**; iii., pp.125,126), as a differentiating sectional character, is a not infrequent source of difficulty to the systematist; and leaf-twisting, in certain members of the genus, is not an invariably reliable character.

Ficoideæ.

Similarity in the effect produced by the xerophytic conditions obtaining on the beach, is exemplified in the case of the heavy, triangular, succulent leaves of *Mesembryanthemum æquilaterale* Haw., and those of the introduced *M. edule* L., a resemblance doubtless responsible for the deferred detection of the latter species, until quite recently (**13**; 1913, p.396). Both plants are of the carpet-forming type, their heavy, succulent leaves eminently fitting them for existence on the shifting sand-dune.

Umbelliferæ.

Examples of some forms of *Siebera Billardieri* Benth., from Leura (A. A. Hamilton; January, 1915) with leaves from rotundate and ¼ inch to ½ inch long, to narrow lanceolate and

$2\frac{1}{4}$ inches long, with intermediate examples showing an extensive range of variation in form and size, are now exhibited. Specimens of *Xanthosia pilosa* Rudge, (Cook's River; A. A. Hamilton; April, 1915) show variation in the leaves from $\frac{1}{4}$ inch to $1\frac{3}{4}$ inches in length, and from 2 lines to $\frac{3}{4}$ inch in width; they are almost sessile, or on petioles up to $\frac{3}{4}$ inch long, and have a tomentum ranging from pale grey to dull brown. Two specimens of the well known *Actinotus Helianthi* Labill., are exhibited, to illustrate the effects, on the foliage, of bad drainage.

Compositæ.

The leaves of *Brachycome diversifolia* Fisch., & Mey., and those of *B. stricta* DC., both range from simple to pinnatifid, many examples of these species being inseparable on the foliar characters. The radical and cauline leaves of most of the Brachycomes, and many other herbaceous composites, are differently shaped. The minute, clustered leaves of *Olearia floribunda* Benth., and *O. lepidophylla* Benth., show similarity; while their ubiquitous congener, *O. ramulosa* Benth., has numerous forms. Of the latter, Bentham (**4**; iii., p.477) says, "There are two principal forms, which are often distinguished as species, but only differ in the shape of the leaves." Specimens of *O. myrsinoides* F.v.M., were exhibited before this Society (**13**; 1914, p.159) showing leaf-variation due to environment, in dimensions, texture, and length of petiole; and it is now noted that the tomentum varies within this species, from dull red to silvery-white. Leaf-variation resultant from seasonal growth, was illustrated in a series of specimens of *Cassinia aculeata* R.Br.,(**13**; 1915, p.209); and three forms of *C. longifolia* R.Br., from Blue Mountain localities, showing leaf-variation, were exhibited (**13**; 1915, p.722). A change in the xerophytic, protective character from hairiness to viscidity, adopted by an old bush of *Helichrysum semipapposum* DC., was noted (**13**; 1915, p.289), young plants in its vicinity, evidently its progeny, retaining the pilose character. Mr. J. H. Maiden (**15**; p.18) notes three forms of *Helichrysum rosmarinifolium* Less., var. *thyrsoideum*, at different elevations on Mt. Kosciusko, the leaves varying in size, thickness, and density of wool; and presents (**16**; p.34), under Piloism, instances in Compositæ, and other families, of an increased vestiture assumed by plants on the higher elevations, growing under xerophytic conditions. Plants of *Helipterum incanum* DC., growing in the Hartley Valley, near the banks of the Lett, show alterations in the leaves from short and broad, to narrow-linear, yellow, white, and variegated flowers being found among this series. Examples of this species in the National Herbarium, from Mt. Kosciusko (Coll. J. H. Maiden), have basal, obovate-spathulate leaves, 1 inch long; and there are examples from various localities with elongated, thread-like leaves reaching 4 inches in length. The adaptability of the weedy *Helichrysum apiculatum* DC., has given rise to a large series of forms, only equalled, perhaps, by the ubiquitous "Cudweed," *Gnaphalium japonicum* Thunb.

GOODENIACEÆ.

Specimens of *Scaevola suaveolens* R.Br., and *S. microcarpa* Cav., were noted (**13**; 1914, p.397), exemplifying an insufficient range of herbarium-material, or field-experience, necessary for a reliable description, one of the characters depended upon to separate these two species (size of leaf) being shown to be inaccurately applied. A difference in size and texture is here noted, characterising the leaves of old and young plants of *Goodenia ovata* Sm., from Stanwell Park (A. A. Hamilton; August, 1915). *G. heterophylla* Sm., and *G. hederacea* Sm., can, with difficulty, be separated on the leaf-characters.

EPACRIDEÆ.

The sheathing-leaves of *Sprengelia ponceletia* F.v.M., are similar to those of the short-leaved forms of *S. incarnata* Sm., the latter showing a considerable range in length of leaf. The genus Leucopogon has several species which cannot be separated on leaf-characters. *Acrotriche divaricata* R.Br., and *A. aggregata* R.Br., are inconstant in the leaf-characters separating them, viz., hirsuteness, and shade of colour on the underside of the leaves (**4**; iv., p.226). Of *Epacris crassifolia* R.Br., it is noted

(**4**; iv., p.237) that specimens from Port Jackson (near the sea), have large leaves, and others (summit of the Blue Mountains) have smaller leaves. The latter statement must be qualified by due regard for environmental conditions, as examples from the higher elevations on the Blue Mountains, growing under different conditions, also have large leaves, which approach in size and shape those of *E. obtusifolia* Sm.(**13**, 1915, p.721). Similar environmental conditions were noted (**13**; 1914, p.544) in the case of *E. reclinata* A. Cunn., and a transition in the foliage, from flaccid and pilose to rigid and glabrous, was observed.

Myrsinaceæ.

Irregular, marginal toothing occurs in *Myrsine variabilis* R.Br.; the presence of teeth on the young growth, and their absence on the leaves of adult branches, have frequently been noted.

Oleaceæ.

The leaves of *Notelæa ovata* R.Br., and those of *N. longifolia* Vent., approach each other, and are finally merged; leaves of the latter, exhibiting extensive variation, were noted (**13**; 1914, p.326). In a footnote to *N. longifolia*, Bentham (**4**; iv., p.299) says, "The northern and southern specimens belong almost entirely to the glabrous form, the pubescent one is chiefly about Port Jackson, and in the Blue Mountains, to New England, some of C. Stuart's specimens from the latter station being densely and softly pubescent all over." Venation, the leaf-character chiefly relied upon by Bentham (**4**; iv., p.300) to separate *N. microcarpa* R.Br., *N. ligustrina* Vent., and *N. linearis* Benth., is variable in each of these species, occasionally on the same specimen; and all three are beset with more or less conspicuous dots, a character ascribed by Bentham to *N. punctata* R.Br., only (*l.c.*).

Convolvulaceæ.

Specimens of *Ipomœa Pes-Capræ* Roth., (Stanwell Park; Aug., 1915; A. A. Hamilton) showing variation in the length of the petiole of the leaves, in an individual plant, ranging from 1 inch to 4 inches, is here noted.

Solaneæ.

Under the genus *Solanum*, Bentham (**4**; iv., p.443) says:—"The distinction and determination of the numerous species of this genus . . . . . . is attended with peculiar difficulties, the chief characters being derived from the very variable ones, of foliage, armature, and indumentum." Examples of the small, red-fruited, *S. stelligerum* Sm., are not infrequently found with some leaves armed with spines, and others without any, on the same plant. *S. vescum* F.v.M., and *S. aviculare* Forst., are inseparable on leaf-characters, both having simple, and variously divided leaves, occasionally on the same branch, each species exhibiting within itself a degree of foliar variability, equal to that existing between the two species.

Bignoniaceæ.

Specimens of *Tecoma australis* R.Br., were noted (**13**; 1914, p.397) showing variation in the size, and number of leaflets, and marginal division.

Myoporineæ.

Spencer le M. Moore (**21**; p.258) writes:—"*Pholidia gibbifolia* F.v.M., is a very singular plant. . . . . The chief peculiarity resides in the leaves, which are much reduced, appressed to the stem, and curiously tuberculated. Had the specimens described by me in this memoir as *P. homoplastica*, not been in flower when they were gathered, I should have concluded without hesitation that they must be referred to Mueller's species, for in habit, as in leaf, the two seem absolute counterparts."

Labiateæ.

Bentham, in his key to the genus *Prostanthera*, (**4**; v., p.92) says of *P. denticulata* R.Br., "Leaves from ¼ inch and ovate to 1 inch and linear, entire, sometimes echinate. Plant pubescent or nearly glabrous." *P. incisa* R.Br., and *P. Sieberi* Benth., approach each other in leaf-characters, the latter merging into *P. violacea* R.Br.

Proteaceæ.

This largely xerophilous Order is probably (among phanerogams) the worst offender against regularity in its leaf-system.

Of heterophylly within a species, and homoplasy in opposing species, and the gradual metamorphosis of the leaves of one species into those of another, this well named Order provides numerous examples. Members present at the Meeting of this Society in July, 1910, will recollect the remarkable series of examples illustrating interchangeable leaf-characters between three *Grevilleas*, viz., *G. Gaudichaudii* R.Br., *G acanthifolia* A. Cunn., and *G laurifolia* Sieb., exhibited by Mr. J. J. Fletcher, which he presented as evidence of reciprocal hybridism within these species (These Proceedings, 1910, p.433). The leaves of *Grevillea linearis* R.Br., and those of *G. sericea* R.Br., overlap, and, in some of the narrower forms, are not easily separated; the foliar characters dividing *G. sphacelata* R.Br., and *G. phylicoides* R.Br., are not strong. In all four of these *Grevilleas*, the tomentum—one of the characters relied on by Bentham (**4**; v., p.464) to separate the two latter—is subject to considerable interchangeable variation, both in colour (silvery to ferrugineous), and flocculence, as opposed to appression. A series of examples of *G. oleoides* Sieb., are here noted, showing variation from narrow-linear, with revolute margins, to broad lanceolate, the margins but slightly recurved, and ranging from $3 \times \frac{1}{16}$ to $3 \times \frac{3}{4}$ inch (Heathcote; October, 1915; A. A. Hamilton).

Spencer Moore (**21**; p.259) says, "some Proteaceæ, *Grevilleas* and *Hakeas* especially, can scarcely be distinguished from Acacias when not in flower or fruit." The terete-leaved Hakeas, which exhibit, within the limits of a species (**13**; 1915, p.289, *H. pugioniformis* Cav.), as great a variation as is found in opposing species, are gradually altered viâ the dimorphic-leaved *H. microcarpa* R.Br., into the flat-leaved section of which the variable *H. dactyloides* (**13**; 1914, p.88) is a representative. The leaf-variation in *H. dactyloides* has been noted by Mr. J. H. Maiden (**19**; v., p.147, Pl.179), and several forms of leaf are depicted in the admirable plate by Miss M. Flockton, illustrating this species. A xerophytic condition inducing similarity in the leaves of certain members of a species, and causing variation between them and their congeners of the same species, which are not subjected to similar treatment, is exemplified in *Isopogon ane-*

monifolius R.Br., (**13**; 1915, p.118), and *Hakea pugioniformis* Cav., (*l.c.*, p.289) the latter species being also used to illustrate ecological, varietal effects (*l.c.*).

The leaves of *Petrophila pulchella* R.Br., *P. pedunculata* R.Br., and *P. sessilis* Sieb., are difficult to separate, and similarity exists between the leaves of all three, and *Isopogon anethifolius* R.Br.(**13**; 1915, p.419).

The genus *Persoonia* provides a foliar range from the acicular leaves of *P. pinifolia* R.Br., to those of the exceptionally large, broad, flat leaves of *P. salicina* Pers. The latter species offers a wide range of leaf-variation (**13**; 1914, p.648, as opposed to the similarity existing in the foliage of *P. media* R.Br., and *P. cornifolia* A. Cunn, the length and venation of the leaves, (characters used to separate the two latter, **4**; v., pp.391-392) showing inconstancy.

The Banksias exhibit a transformation in leaves from *B. ericifolia* L., to *B. spinulosa* Sm., and *B. marginata* Cav., leaving the systematist occasionally in doubt as to which species he should refer contiguous examples, the marginal toothing, and size of the leaves showing many irregularities. A series of leaves of *B. marginata* is figured on the plate illustrating that species (**10**; ii., p.12) showing a number of forms, with a considerable range of variation. Similarity, on the other hand, between the leaves of *B. serrata* L., and those of *B. æmula* R.Br., is very pronounced.

Examples of *Conospermum taxifolium* Sm., and *C. ericifolium* Sm.,(**13**; 1914, p.325) demonstrated the difficulty of separating these two species on leaf-characters. The two species of *Symphyonema* (endemic in New South Wales) are separated chiefly on the foliage, which is largely influenced by environment, the swamp-form of *S. montanum* R.Br., on the Blue Mountains, frequently producing leaves the counterpart of those of the swamp-dwelling, coastal *S. paludosum* R.Br. Attention is drawn to the similarity between the leaves of certain species of the Order Proteaceæ, and others of the Sapindaceæ (**9**; 1900, p.586) by Mr. H. Deane; and the writer has shown examples of variation within a species in *Lomatia silaifolia* R.Br., (**13**; 1914, p.159), *L. longifolia* R.Br.,(*l.c.*;1915, p.487), *Telopea speciosissima* R.Br., (*l.c.*; 1908,p.286, and *l.c* ,1914, p.325), and *Xylomelum pyriforme* Sm.,(*l.c.*, 1915, p.289) [the latter also illustrating the well known diversity in marginal toothing, between the juvenile and mature foliage], from time to time, at the Meetings of this Society. As is the case with the Order Leguminosæ, many genera of Western Australian Proteaceæ are exceptionally liable to variation in marginal leaf-division, and dimorphism.

THYMELEÆ.

Many specimens of *Pimelea* are uncertain in the alternation of the leaves, and the venation is also variable. *P. linifolia* Sm., an exceptionally adaptable species, and consequently widely distributed, has altered its foliar characters to meet the exigencies of its varied environment. One of its forms is inseparable from *P. glauca* R.Br., on leaf-characters.

CASUARINEÆ.

Examples of *Casuarina glauca* Sieb., were exhibited (**13**; 1915, p.288) to illustrate the dislocation of the symmetry of the whorls of teeth (leaves), caused by larval attack

CONIFERÆ.

Leaf-twisting, due to mechanical injury, was demonstrated in specimens of *Podocarpus spinulosa* R.Br , exhibited before this Society (**13**; 1915, p.418). This character (leaf-twisting) is occasionally used to separate closely allied species, e.g., *Conospermum taxifolium* Sm., v. *C. ericifolium* Sm., and *Xyris complanata* R.Br., v. *X. gracilis* R.Br. In both cases cited, the character is interchangeable.

ORCHIDEÆ.

The cylindrical leaves of *Dendrobium teretifolium* R.Br., (examples of which from Tuggerah Lakes, April, 1914; Coll. A. A. Hamilton, are exhibited) range from 1½ to 18 inches long, and are so similar to those of *D. striolatum* Reichb., that the smaller plants of each species appear identical when not in flower.

Similarity in the leafage is found in the members of the opposing Orders, Irideæ, and Amaryllideæ, in respect of scabridity, texture, and marginal toothing, the two former characters varying considerably with the degree of moisture available. The succulent, cylindrical leaves of many Liliaceous plants are almost identical, and are equally like the leaves of some terrestrial orchids. *Triglochin procera* R.Br., when growing in mid-stream, and subject to a strong current, has flat leaves, which are permanently bent, and lie on the surface of the water, while the leaves of plants growing near the bank, or in the still waters of a lagoon, are upright and almost terete. In the Orders Juncaceæ, Restiaceæ, and Cyperaceæ, the leaves of many species are so similar, that they afford very little assistance to the taxonomist. The rigid, convolute, pungent-pointed leaves of *Zoysia pungens* Willd., are very similar to those of *Sporobolus virginicus* Kunth, when these plants are growing associated in a saline estuary, both having adopted the same xerophytic, protective agency against the natural forces operating against them, in their exposed habitat. *Schedonorus littoralis* Beauv., has rigid, pungent-pointed leaves, simulating those of a Juncus.

Conclusion.

A consideration of the varied influences brought to bear on the modification of the morphology of leaves, as demonstrated by the foregoing examples (which might be indefinitely multiplied), discloses, it is submitted, sufficient evidence to warrant the assertion that the foliar characters in herbarium-specimens should be cautiously advanced in the determination of a species. It has been shown that a specimen taken from an individual shrub may differ as much in its leaf-character from other examples taken from the same plant, or from a neighbouring shrub of the same species, as it would from one taken from a distinct species. The examples cited in this paper (p.157) referring to the inaccurate description of the position of the simple and trifoliate leaves in *Zieria involucrata*, and the relative size of the leaves, in *Scævola suaveolens* and *S. microcarpa*, (p.169) are instances which show the necessity for extensive field-work, and the examination of a large quantity of botanical material in respect of leaf-characters, before describing a species, or proposing a new variety, the elasticity of the plant frequently showing disregard for the rigidity of the description. In following a botanical description with herbarium-material, frequently limited in quantity, and from few, and often obscure localities, the variations in foliage brought about by local conditions must, in the absence of such information, be largely speculative. Nor does the possession of a type-specimen entirely remove the difficulty, unless the environmental conditions under which the type existed are available. The most valuable assistant to the taxonomic botanist is personal observation of his flora *in situ*, but as this is frequently impracticable, the carefully compiled field-notes of competent observers, with a knowledge of the factors liable to affect the morphology of leaves, are extremely helpful. In this direction, the value of the numerous references embodied in the writings of local botanists (who are, without exception, field-botanists) to the influences at work on the alteration, in our native vegetation, of the characters relied upon by the systematist, cannot be overstated. The following expressions of opinion may be quoted. Bentham (**4**; iii., p.186), in his remarks on the genus Eucalyptus, says: "but to the botanist who is unable to compare them in a living state, the due limitation and classification of their species presents almost insuperable obstacles." In his Presidential Address to this Society (**8**; 1915, p.649), Mr. Henry Deane refers to the determination of plants from leaves, and quotes a Presidential Address to the Linnean Society in 1870, by Bentham, who points out the unreliability of determinations made on leaves only, and mentions that De Candolle had been in error as to Natural Orders of species of which he possessed leaves alone. Later (**9**; 1900, p.581) Mr. Deane stigmatises as ridiculous the case of a botanist who would attempt a classification and description of a hitherto unexplored flora on a collection of leaves, and notes (p.588), that Ettingshausen points out in his paper the impossibility of carrying out any system of classification on leaf-characters, offering examples of similarity in widely separated, and heterogeny in more closely allied plants. Mr. Deane in his paper(**9**), also tabulated a number of species, and supplied figures of leaves, instituting comparisons as to their similarity in opposing, and variation in allied plants, with special reference to venation. In a paper published in the Botanical Gazette, University of Chicago Press (Vol.59, 1915, p.484) on "The Origin and Distribution of the Family Myrtaceæ," Mr. Edward M. Berry, referring to a paper on this subject by Mr. E. C Andrews, published in these Proceedings (1913, p.529), says (p.486), "for although in accordance with paleo-botanical usage I have identified numerous forms of Eucalyptus in the N. American Upper Cretaceous, I have long thought that these leaves represented ancestral forms of Eugenia or Myrica, but have hesitated suggesting any change based merely on personal opinion, and also from a consideration that such change in nomenclature is undesirable at the present time from the standpoint of stratigraphic paleobotany." Mr. J. H. Maiden(**17**: p.177) says:—"Except in the case of very characteristic material botanists who deal with the existing flora usually ask to be excused from determining a plant on a leaf only." In (**20**c, p.326), the author says:—"Other characters of Eucalyptus leaves we require to know more about, are their size, texture, and prominence of venation. They are minor characters, and some species present much variation in this respect"; and in (**18**: Part viii., p.247) Mr. Maiden says:—"I attach great importance to studying the trees in the field. . . . . In these researches I may be pardoned for saying that I have travelled more or less in every State of the Commonwealth, covering thousands of miles on foot in pursuit of this study alone, in contradistinction to mere herbarium work." Mr. E. C. Andrews(**1**), discussing "The Age of Dicotyledons," gives (p.360) examples of the difficulty of determining the correct botanical classification of existing plants on leaf-characters, showing differences of opinion among our greatest systematists, as to the family in which certain trifoliate-leaved plants should be placed. Sir J. D. Hooker (**14**: p.13), says:—"The result of my observations is that differences of habit, colour, hairiness, and outline of leaves . . . . are generally fallacious as specific marks, being attributable to external causes and easily obliterated under cultivation."

Specimens of the examples cited in this paper will be incorporated in the National Herbarium.

Since the foregoing was written, my attention has been drawn by Mr. Maiden to a reference on this subject in "A Text-Book of Botany," by Professors Coulter, Barnes, and Cowles, members of the Botanical Staff of the University of Chicago (1910-1911). In Vol. ii. of this work, which treats of Ecology, a chapter is devoted to "Variation in Leaf-Forms," (p.589) in which the authors note the value of the determination of the causes underlying leaf-forms, in relation to specific distinctions, and (*loc. cit.*) offer an hypothesis founded on species with an ancestral plasticity and fixed descendants, or possibly (pp.590-591) that some forms have always been rigid and others always plastic. "Form Variation in Amphibious Plants" is discussed (p.593), and examples given, showing the wide range of variation obtaining in the structure of the aërial and water-leaves of this aquatic group. Juvenile and adult leaves are considered (pp.596-597) in relation to ancestry, and the phenomenon of rejuvenescence, the latter being regarded as an indication of a sudden shock which causes the plant to return to a youthful stage. [An example of rejuvenescence in *Acacia floribunda* Willd., attributable to mechanical injury, is given by the writer(**13**; 1914, p.159), and a further example in *A. melanoxylon* R.Br., in which the cause of the change is not apparent (**13**: 1914, p.254)].

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ON *BRACHYCHITON POPULNEO-ACERIFOLIUS* F.v.M. (THE CRIMSON-FLOWERED KURRAJONG).

By J. H. MAIDEN, F.R.S., F.L.S.

Allow me to invite your attention to a paper by the late Baron von Mueller, "Notes on Hybridism in the genus *Brachychiton*," in these Proceedings, ix., 379, 1884.

I was present at the presentation of the paper, which was read by the late Dr. J. C. Cox, who had drawn Mueller's attention to the Mulgoa tree described. It was, and is growing at "Fern Hill," his birthplace; and I remember asking him what was the history of the tree, but he did not know it for certain, although Mueller says it "arose" in his brother's garden ("Fern Hill").

When I took charge of the Botanic Gardens, my attention was drawn to a smaller but similar tree then in the Garden Palace Grounds, but the history of that tree was also uncertain. Some years since, I visited the Mulgoa tree, and have a complete suite of specimens. By means of the newspapers, I got into touch with owners of similar or closely allied trees in various parts of the State.

Although Mueller did not publish a strictly formal description, he admitted, and I think rightly, as a matter of convenience, the species *Brachychiton populneo-acerifolius* F.v.M., formally into the New South Wales flora (Second Census, 1889).

The type (Mulgoa) tree was, in 1908, about 40 feet high, and 3 feet in diameter at a foot from the ground. Its spread of branches is fully 40 feet. The leaves are strictly simple; no appearance of lobes could be detected. The only *Brachychiton* in the vicinity is *B. acerifolius*; there is some *B. populneus* in the district, though not at Fern Hill.

The rhachises in *B. populneo-acerifolius* are greenish-yellow to creamy-white; and wholly scarlet, except in an occasional streak or strip, in *B. acerifolius*.

The panicles are simple in *B. populneo-acerifolius*, much branched in *B. acerifolius*.

The flower-buds of *B. populneo-acerifolius* are, when unexpanded, long-pointed, flowers 4-6 lobed, the lobes recurved. In *B. acerifolius*, the shape of the buds is more turbinate and, when unexpanded, nearly flat-topped, giving the bud the aspect of a pear, but, in rare cases, the bud is somewhat pointed.

The flowers appear to be much more numerous than in *B. acerfolius*. "The colour of the calyces holds the middle between that of the respective organ of the parent-plants; it is pale yellowish outside, much as in *B. populneum*, but inside crimson and not sprinkled as in *B. acerifolium*. . . . ." (Original description). This requires some correction. The flower of *B. populneo-acerifolius* is usually self rose-pink and not pale yellowish, although some flowers may be a little pale yellowish outside; but inside, sprinkled rose-pink, giving the general impression of greyish-rose, except at the base of the throat where it is greenish-yellow. The outside is Salmon Old Rose No.143, shade 1, and inside Madder Carmine, No.241, shade 4, of Rép. de Couleurs, to speak with precision.

The flower of *B. acerifolius* is not "sprinkled": it is quite a self scarlet. It is No.85 (shades 1 and 2) or scarlet, of Rép. de Couleurs.

(2). The tree which many knew as the Garden Palace one, is strictly typical *B. populneo-acerifolius*; it was removed in consequence of the widening of Macquarie Street to Bed No.9, Middle Garden, in 1912, where it is now about 18 ft. high, 2 ft. in girth 3 ft. from the ground, and it flowers every year, usually in November-December, but sometimes January. Its origin is unknown.

(3). There are some typical trees of *B. populneo-acerifolius* in gardens at Parramatta, of considerable age. I first receiveu specimens from Mr. Fred. Williams.

(4). Mr. J. A. T. Rochfort, Inspector of Stock, Jerilderie, sent me some specimens from a tree growing at the Public School, which are quite typical of *B. populneo-acerifolius*. Mr. Rochfort sent pods, which are rather larger than those of *B. populneus*, and smaller than the pods of *B. acerifolius*.

All the following trees are also of the crimson-flowered strain, and are usually described as flowering freely in November or December. It is only known from New South Wales at present.

(5). At Wentworth, in a public street, there is a tree, perhaps 25 feet high, and there is no other like it in the town. I have received specimens at different times from the Mayor, Mr. R. J. P. Long, the Head Teacher (whose name I have lost), His Honor Judge Bevan, Sergeant J. Mc. A. Clark, and Miss Louise Buckridge, of the Public School. They vary from typical *B. populneo-acerifolius* to with slightly lobed leaves.

Some years ago it was believed that this tree came from the Botanic Gardens at Melbourne, but Mr. Guilfoyle, to whom I spoke on the subject, had no recollection of the matter.

Judge Bevan says there is a similar tree in the Public Garden, North Adelaide.

(6). Mr. Joseph Stevens, Manly, sends a specimen with leaves of the *B. acerifolius* type.

(7). Mr. Edward Bowman, Skellatar, Muswellbrook, sent specimens which grew in the mountains about 12 miles due east of Muswellbrook, between Ravensworth and Muswellbrook Some replanted by him about 1903 at Skellatar. Known as "Mountain Kurrajong." Scrub since totally destroyed. These plants (only two survived) are natural hybrids. Grew amongst Cedar, Nettle-trees, &c. Very close to *B. acerifolius* as far as leaves are concerned.

(8). Mr. Thomas H. H. Goodwin, "Ruvigne," Gunnedah, sends twigs from a tree growing in Gunnedah, but slightly lobed, but obviously showing affinity to *B. acerifolius* in the leaves Fruits freely.

Mr. James Muffett, Ulamambri, Coonabarabran, sends twigs with leaves pointed and lobed; crimson flowers; ordinary light flowers *(populneus)* were growing on the same tree

Of all these trees, those of Mr. Edward Bowman are the only ones of which we are certain we know the origin, and that the origin, at least in those cases, is spontaneous.

The forms (hybrids) I have seen, vary almost between the two extremes of the reputed parents, so far as foliage is concerned.

The type has a simple leaf, without lobing, but we have, in various trees, examples of leaf-outline approaching that of *B. acerifolius* and some of the "diverse" shapes of *B. diversifolius*, while the texture is intermediate between the thickish *B. acerifolius* and the thinner *B. populneus*, and the shade of green is intermediate also. The venation of the leaves of the hybrid is intermediate.

It is obvious that we have a recent and not well-established species; in naming plants, I, of course, keep as close to the type as possible for *B. populneo-acerifolius*, but include all *crimson-flowering* forms in it, with a herbarium-note when they much approach one parent or the other.

The instability of some forms of *Brachychiton* is referred to in a brief paper by the late Mr. Betche and myself, entitled "Notes on *Sterculia* (*Brachychiton*) *lurida* and *discolor*," these Proceedings, xxiii., 159, 1898.

His Honor Judge Bevan, speaking of the Wentworth tree, says:—"The seed that has been taken from it, has always produced the white-flowered variety [the common Kurrajong, *B. diversifolius*, J.H.M.] . . . . it stands close to Kurrajong trees of the white-flowered variety."

Sergeant J. Mc. A. Clark makes a similar statement. Here is an experiment, on Mendelian lines, to be followed up, but the difficulty of the length of time one has to wait for the flowers of the progeny is a factor, when one considers the few years a man usually occupies an official post. Sowings have twice mysteriously disappeared already—distributed, or planted out by a zealous gardener.

The evidence is not conclusive that the species *B. populneo-acerifolius* originated at Mulgoa. It may have so originated, but it would not account for a precisely similar form, as old or older, at Parramatta, and the other trees, typical *B. populneo-acerifolius*, or inclining to one or other reputed parent, which are to be found in different parts of New South Wales.

The Botanic Gardens, Sydney, which celebrates its centenary this year, continued the work of the "Governor's Garden" or "Government Garden" in the propagation and distribution of trees. Brachychitons have been distributed for many years, perhaps over a century. We obtain the seeds from various sources, from private donation, and from our own collectors. Seed received as *B. acerifolius* or *B. populneus* would be sown under that name, and nothing would be easier, in a large nursery stock. than to pass over a few hybrids (obtained we do not know whence, as the seeds of the same reputed species are not kept separate unless there is reason for so doing), especially as the plants are young, and the fact that a hybrid has been received would, by most people, only be noticed when it displayed its flowers. It is in the highest degree unlikely that the Mulgoa and Parramatta trees were not received from the Botanic Gardens, and the same remarks apply to the trees scattered through the State. Neither *B. acerifolius* nor *B. populneus* occurs naturally in the Mulgoa garden; I believe that any trees of these species in the neighbourhood were introduced (probably from the Botanic Gardens), as I believe the hybrid was.

ON A EUCALYPT HYBRID (*E. CALOPHYLLA* × *E. FICIFOLIA*).

By J. H. Maiden, F.R.S., F.L.S.

Everyone who knows Sydney and Melbourne, and who pays attention to horticultural matters, must have noticed the great development, during the last few years, of the cultivation of what the ordinary citizen calls "Flowering-Gums." By this he means with flowers comparatively large in size and other than white in colour. Some people, a little more definite, simply call them Red-flowering, and many, Scarlet- or Crimson-flowering indiscriminately, using the terms scarlet and crimson as if they were interchangeable, just as they are said to be both "red." As one to whom flowers of various kinds are often sent I find that, as often as not, when a man writes "scarlet," he means "crimson," and vice versâ. In the case of trees like Eucalypts and Kurrajongs, which include both scarlet and crimson flowers, the confusion may be inconvenient.

Colour of flowers (filaments).

The colour of the filaments of *E. ficifolia* F.v.M., is not given in Mueller's original description, but is stated to be "crimson" in "Eucalyptographia," in the first half of the formal description, but in the second half it is described as "beautifully cinnabar-red, occasionally varying to a lighter colouration, but never very pale." Further down, in contrasting *E. ficifolia* with *E. calophylla*, he says, "the filaments (of *E. ficifolia*) are of a splendid crimson." This may be carelessness, but it probably arises from a not very clear knowledge of English terms for the colours concerned.

I have received from Dr. G. P. U. Prior, Mental Hospital, Rydalmere, near Sydney, flowers which are true *E. ficifolia*. They are bright scarlet in colour or, in the language of Plate No. 79 of Rép. de Couleurs, bright fiery-red or russet-orange.

The filaments do not contrast with the whitish anthers for the pollen-masses are scarlet too.

The calyx-tubes are suffused with scarlet, and so the whole inflorescence is of a uniform tone of colour.

Dr. Prior's No.2 is a shrub at present; it is the *E. ficifolia alba* of nurserymen: it has white filaments, with a suspicion of colour at the base, arising from the coloured rim. Calyx-tube green. A little colour on the operculum.

In *E. calophylla* R.Br., the filaments are white or creamy, and I saw the trees in flower over large areas in their native habitats. Mr. W. V. Ftzgerald states that the filaments are "rarely pink"; this indicates a tendency.

The muddle that Mueller got into as regards the filaments of *E. ficifolia* is continued by the nurserymen. Large numbers of plants are sold: indeed, the demand exceeds the supply. I need scarcely observe that precision is desirable, and sometimes necessary, in speaking of the colours of flowers; the following is a useful work of reference. "Répertoire de Couleurs (quoted as Rép. de Couleurs) publié par la Société Française des Chrysanthémistes," &c. (Rennes and Paris, 1905). Two portfolios of plates and a handbook.

In Vilmorin's (Paris) Catologue of Plants, the colour of the flowers of *E ficifolia* is given as "rouge carmin," which is not a colour admitted, as such, into Rép. de Couleurs. The firm is evidently following the late M. Naudin, a great French authority on the genus, who, Mém. Eucal., i., 555, says – "*E. ficifolia* qui les a d'un rouge carmin très brillant, au moins dans une de ses variétés."

In examining the catalogues of good Australian firms, I find the following given under *E. ficifolia.*

1. "Red-flowering Gum," 20 feet. This colour may mean anything.

2. Scarlet, 15 feet; "Scarlet-flowering Gum" 15 feet. Scarlet is correct.

3. Crimson, 20 feet; Crimson-flowered Gum, 20 feet; "Bright Crimson" 15-20 feet. This may or may not be a confusion with

scarlet, as begun by Mueller: I shall have something to say about a Crimson-flowering Gum presently.

Then one firm has:—

6. "Scarlet flowering Gum, 15 feet, literally a blaze of beautiful rich crimson shade."

In examining the catologues of Australian nurserymen, I cannot find one which describes the colour of *E calophylla* correctly. It should be white. One firm calls it "rich pink."

Several firms, however, have *E calophylla rosea* in their lists, either without comment, or "Bright pink, 30 feet," or "Similar to *E. ficifolia* but rosy pink flowers."

I think this view of the case is correct; the rose- or crimson-flowering forms, which are large-growing (getting size from their *calophylla* parent, and their colour more or less from their *ficifolia* parent). The habit of these trees reminds me more strongly of *E. calophylla* than of *E. ficifolia*, and, as to colour, we have them of all shades of the faintest blush-pink (almost white) to deep crimson.

The flowers of *E. ficifolia* and *E. calophylla* are honey-smelling, the perfume heavy and oppressive in a room. They flower mostly in December and January, and the climatic conditions in Sydney, during the last season, have induced an exceptionally fine display of bloom.

I have received from Dr. Prior, flowers, fruits, and seeds of what I call No.1. The flowers are Tyrian Rose in colour; see Plate No.155 of Rép. de Couleurs. There is a short, white attachment to the anther, which is creamy-white in colour, with a line of Tyrian rose running round the back, and this colour is sometimes blurred. When old, the anther-cells inside take a pinkish shade. The pollen is creamy-white.

In Proc. Roy. Soc. Qsld., x., 17 (1893), the late F. M. Bailey described "what is probably an accidental sport" in the Melbourne Botanic Gardens, with flowers of a "deep rose" as *E. ficifolia* var. *Guilfoylei* . . . . . "It proved to be only a form of *E. ficifolia* differing from the normal plant in its smaller foliage, more compact inflorescence, different colour of flowers, with prominent umbo to the operculum and slight difference of seed-wing. I have received specimens of this form both from the late Mr. Guilfoyle and from Mr. J. Cronin. The yellow anthers contrast well with the filaments. The calyx-tubes are urceolate and apple-green, and both on account of the contrast of filaments with anthers and calyx-tubes, the effect in the mass is most charming.

The Rydalmere tree is 40 feet high, and flourishing. In every respect that I can see, it is identical with *E. ficifolia* var *Guilfoylei* and *E. calophylla* var. *rosea* Hort., and I am inclined to think that the more reasonable view is to look upon it as a form of *E. calophylla*. The habit and size of the hybrid incline to those of *E. calophylla*, while the pink or purple tinge (in contradistinction to the scarlet of *E. ficifolia*), naturally occurs in *E. calophylla*.

Size and habit.

E. calophylla is a huge tree, with gnarled trunk and scrambling, umbrageous branches, the counterpart of the Apple (*Angophora intermedia*). of Eastern Australia. The size is given as up to 150 feet, with a stem-diameter of 10 feet ("Eucalyptographia") and I am certain this is not exaggerated.

E. ficifolia, on the other hand, is a small tree; I think it rarely exceeds thirty feet in height, and it is usually erect, and not scrambling.

The hybrid may be fairly stated as intermediate in size.

Seeds.

Those of *E. calophylla* are large, ovate, black. flat, and with a raised angle on one face, the edges acute but scarcely winged, the hilum large on the inner face.

Those of *E. ficifolia* are of a pale colour, testa expanded at one end, or round one side into a broad, variously-shaped wing (B.Fl., iii., 256). The hilum is towards the end of the seed, and furthest from the wing.

The seeds of the *E. calophylla* × *E. ficifolia* hybrid are flatter than those of *E. ficifolia*, and also paler in colour. As compared with those of *E. ficifolia*, they are a little darker and less winged, but the hilum is more remote from the wing In other words, they are intermediate between the two species. Most of the seeds are, however, sterile, and these are pale reddish-brown in colour, shining, and mostly boomerang-shaped.

The sterile seeds of *E. calophylla* are similar in shape, perhaps a little darker in colour.

It seems to me that, in this rose-crimson series, we have incontrovertible evidence of hybridisation, the two most obvious factors being colour and size; and I, therefore, add *E. calophylla* and *E. ficifolia* to the very long list of pairs of species of which the evidence that they hybridise appears to be sufficiently clear.

I have touched on the general question of hybridisation in the genus in Report Aust Assoc. Adv. Science, 1904, p.297, in the Proceedings of this Society, xxx., p.492 (1905), and on many other occasions.

ORDINARY MONTHLY MEETING.

MAY 31st, 1916.

Mr. A. G. Hamilton, President, in the Chair.

Miss VERA IRWIN SMITH, B.Sc., Woolwich, Parramatta River, was elected an Ordinary Member of the Society.

The President announced that, in consequence of the limitations of paper-supply, and the increased cost of what is available, due to war-conditions, it had become necessary to consider the question of economising space in the matter of printing. Following the example of British Journals, &c., therefore, the Council appeals to Members who propose to offer Papers to the Society, to condense them, and to limit them as far as possible to the description of new results. [*Vide* "Nature," March 23rd, 1916, p.85; British Medical Journal, April 1st, 1916, p.496; and recent Nos. of the Abstract of Proceedings of the Zoological Society of London].

The Donations and Exchanges received since the previous Monthly Meeting (26th April, 1916), amounting to 9 Vols., 57 Parts or Nos., 11 Bulletins, 1 Report, and 14 Pamphlets, received from 40 Societies, etc., and three private donors, were laid upon the table.

NOTES AND EXHIBITS.

Mr. Fred Turner exhibited specimens of, and offered observations on:—(1) *Polygonum orientale* Linn., var. *pilosum* Meissn., Syn. *P. pilosum* Roxb., collected by Mr. K. M. Niall, Buckiinguy Station, Nyngan district, on the Macquarie Marshes, Macquarie River, N.S.W., which is another western locality for this interesting species.—(2) *Leptospermum scoparium* Forst., a form with bright pink flowers, collected at Middle Harbour by Miss A. Gowland, who described the shrub as being "like a peach tree in full bloom, and a most attractive sight."—(3) *Phytolacca octandra*

Linn. An abnormal growth, characteristic of the plant from which it was gathered, which was growing amongst a number of normally developed ones at Chatswood.

Mr. Froggatt showed entomological specimens, including (1) Examples of *Chalcis*, n.sp., a new parasite upon the maggots of the Sheep Blowflies. A description and figures of this handsome little Chalcid are being prepared for publication.—(2) Larvæ of one of the large click-beetles, *Petrolobus fortnumi* Hope, (Fam. *Elateridæ*). These are very curious, obese, white grubs, with a small head and thorax, a large, rounded abdomen, with the terminal segment ending in a trident-shaped appendage, the whole larva covered with reddish hairs. They are very active, live in dead wood, and form a stiff, papery-like cell when ready to pupate. Specimens received from Mr. Geo. Turner, school-teacher, Bourke.—(3) A new species of Mealy Bug, *Palæococcus*, sp., (*Coccidæ*) received from Miss M. Dymock, Hughenden, North Queensland. The members of this genus are closely allied to the Icerya-group, but differ in forming no ovisac, and in giving birth to living larvæ.—(4) A series of galls and female coccids of *Apiomorpha fletcheri* Fuller, from near Hay, N.S.W., upon the Box-gum, *Eucalyptus bicolor*, showing the remarkable structure of the upper half of the gall in the bark and the lower half in the wood.

Mr. W. S. Dun exhibited a piece of stalactite from the Ettrema Cave showing, in a cavity, portion of a Myriapod calcified.

Dr. J. B. Cleland exhibited some webbing of gossamer spiders, kindly forwarded by Mr. W. C. Grasby, of Perth, together with newspaper extracts detailing the extent of the fall of this interesting material in that State. The material and extracts were submitted to Mr. W. J. Rainbow, of the Australian Museum, who identified the webbing as that of gossamer spiders, and has summarised the data connected with the fall as follows:—The gossamer-silk fell during the month of October, 1915, at the following localities. October 5th: Capel River, Bedfordale, Gingering (near York), Pinjara, Lower Kalgan River, and

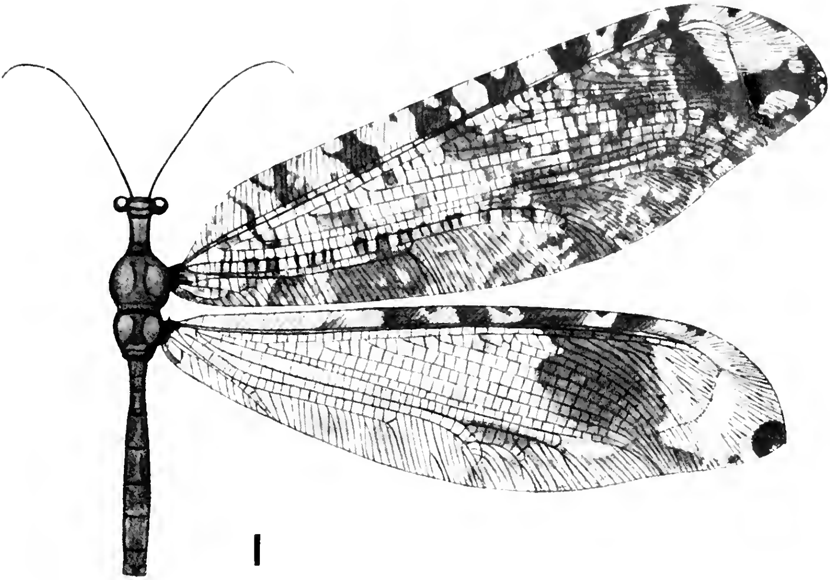
Takenup (viâ Albany), Mt. Barker to Toolbinup (Salt River), Porongorups (King River), and an area between Boyup Brook and Bunbury. October 6th-7th: Carrolup (viâ Katanning). October 10th: Lowdon, Preston Valley. October 25th: Dwellingup. October 29th: Tenterden, Preston Valley. Other localities, for which no specific date was given, were Serpentine and Kirrup. In some areas, it is stated, the ground looked as though covered with a light fall of snow. It is not possible to say what species was responsible for this so-called "phenomenon," as the web contained only fragments of the tiny aêronauts. No official records are known from Australia of such "falls," but such incidents are not unknown in other parts of the world, in support of which there are the writings of Darwin, Blackwall, McCook, and White ("Natural History of Selborne").

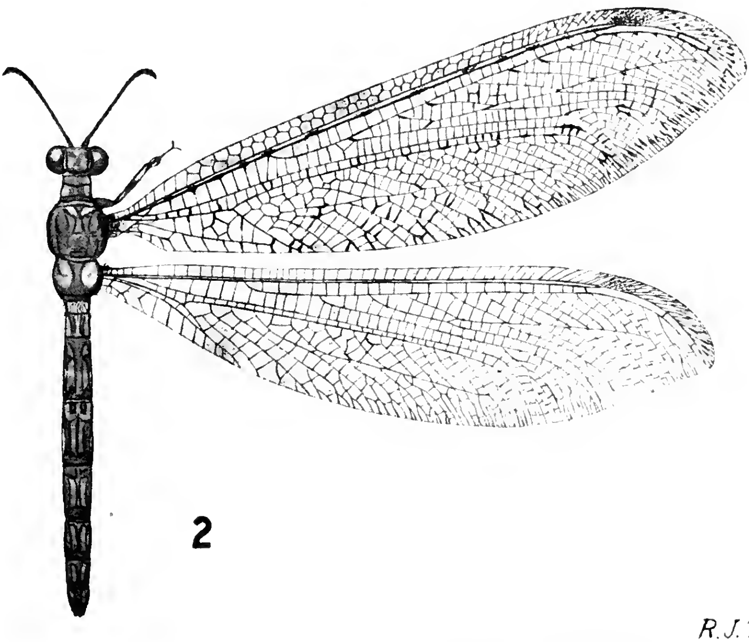
Mr. R. H. Cambage exhibited a Cowrie shell (*Cypræa vitellus* Linné), from Murramarang, about 16 miles south of Ulladulla. This species is common in tropical waters, and occurs on the New South Wales coast, rare at Port Jackson, which is its previous southernmost recorded limit.

Mr. Maiden showed specimens of the hybrid Crimson-flowered Kurrajong (*Brachychiton populneo-acerifolius* F.v.M.); and of a hybrid Eucalypt (*E. calophylla* × *E. ficifolia*) to illustrate two papers read at last Meeting.

Mr. E. Cheel exhibited an interesting series of seeds of "French Bean" (*Phaseolus vulgaris*) showing considerable variation in the colour of the seed-coats, without any artificial aid in the pollination, thus supplementing the notes published in these Proceedings, 1914, xxxix., pp.160-161. The results are briefly as follows. "Black Wax" (Yates), a dwarf plant having purplish flowers, waxy-yellow pods, and black seeds. Seeds of this were sown; all, with the exception of one, produced plants similar to the parent-stock. The one exception was a tall semitrailer, having purplish flowers, green pods, and rather smaller seeds with splashes of dark and light brown markings mingled with a purplish-black background. This has been provisionally named "Mutant." Seeds

[Printed off, 12th June, 1916.]





R.J.T. del

1. *Euporismus albatrox*, g.et sp.n. 2. *Acanthaclisis petersoni*, n.sp.

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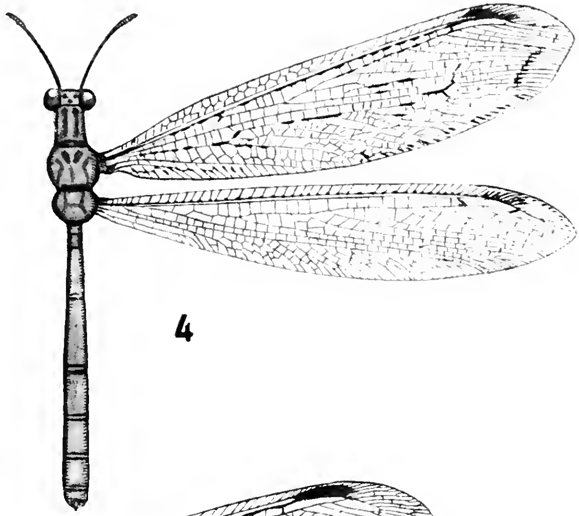

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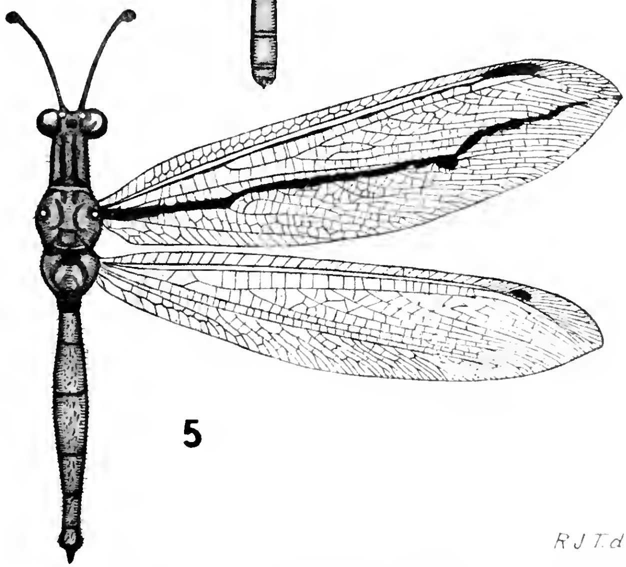

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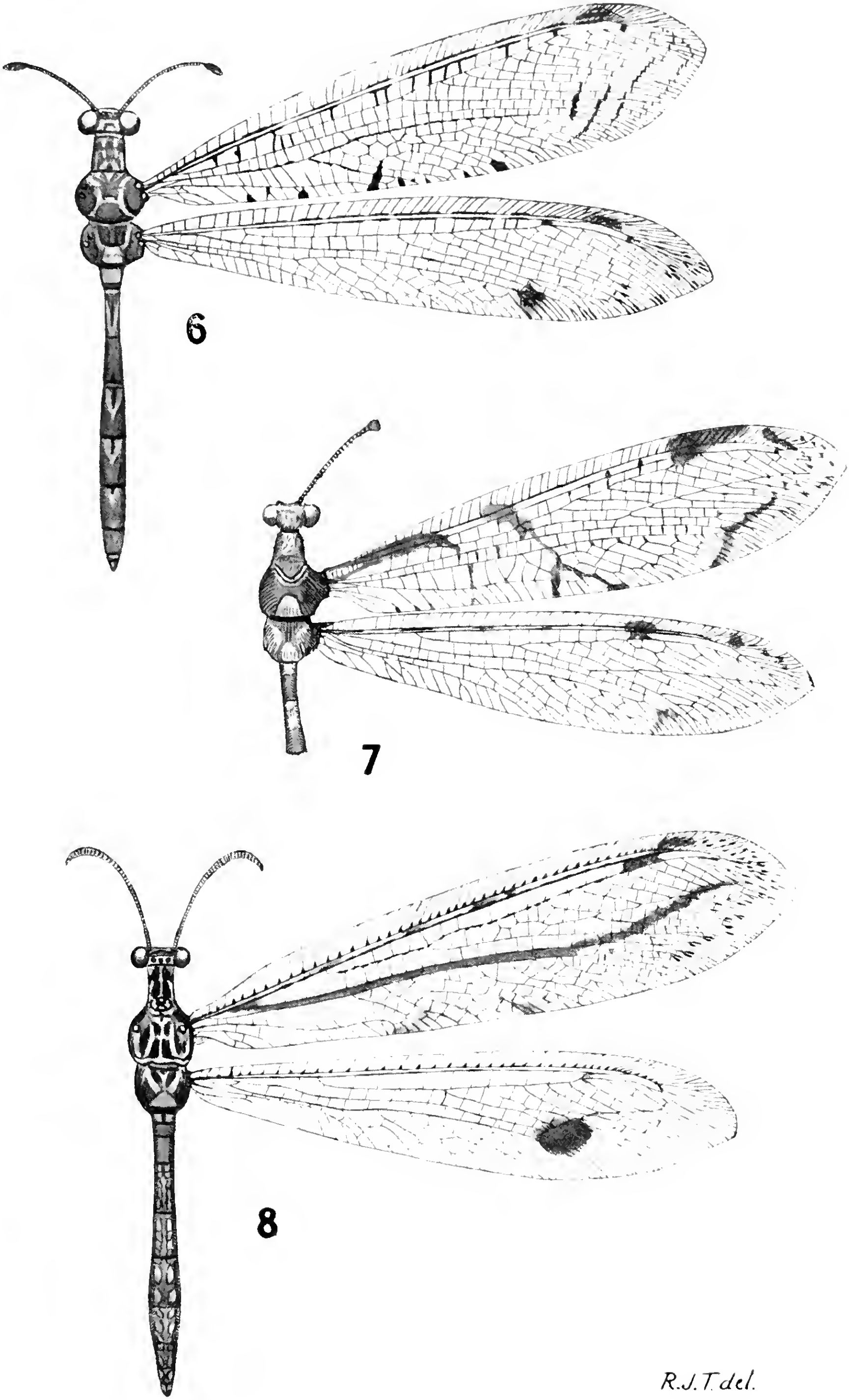
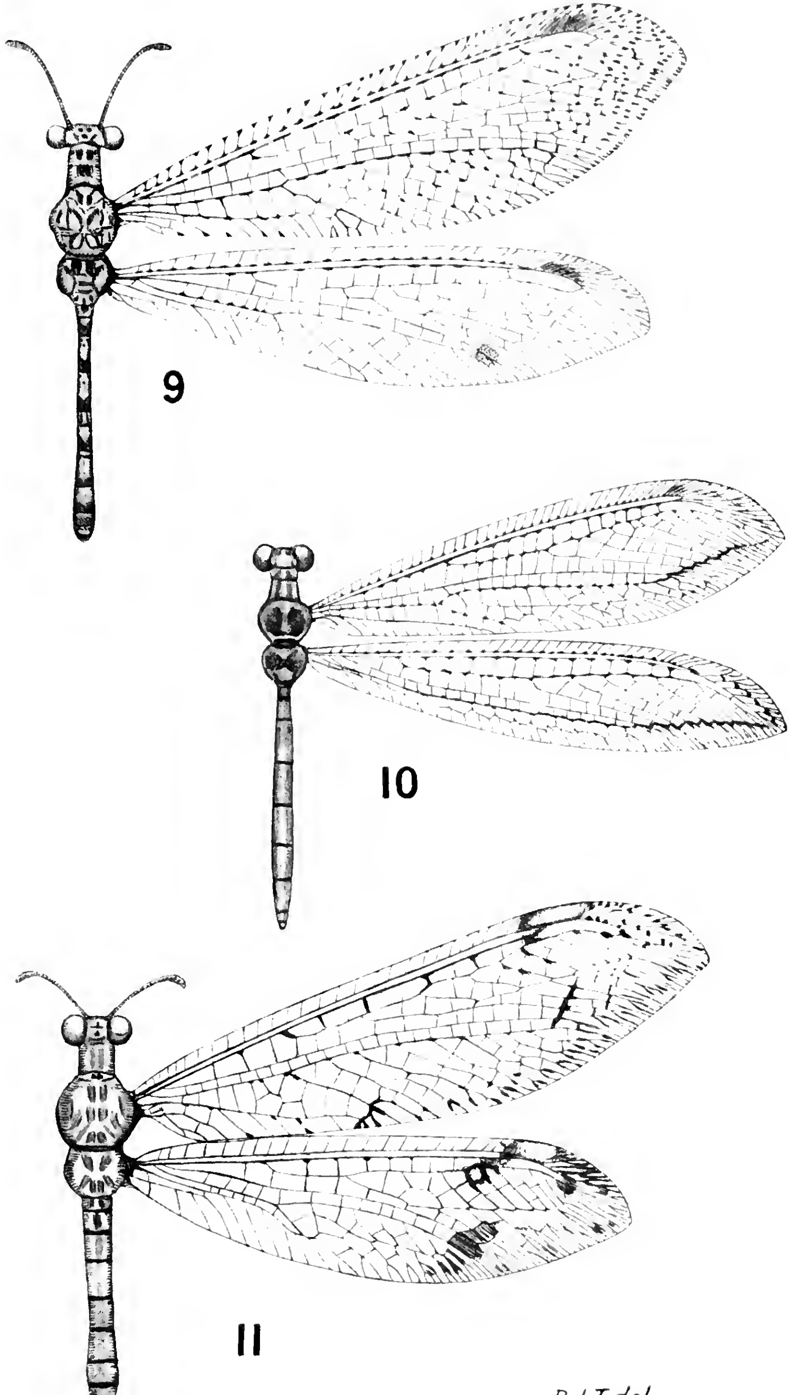
R J T. del

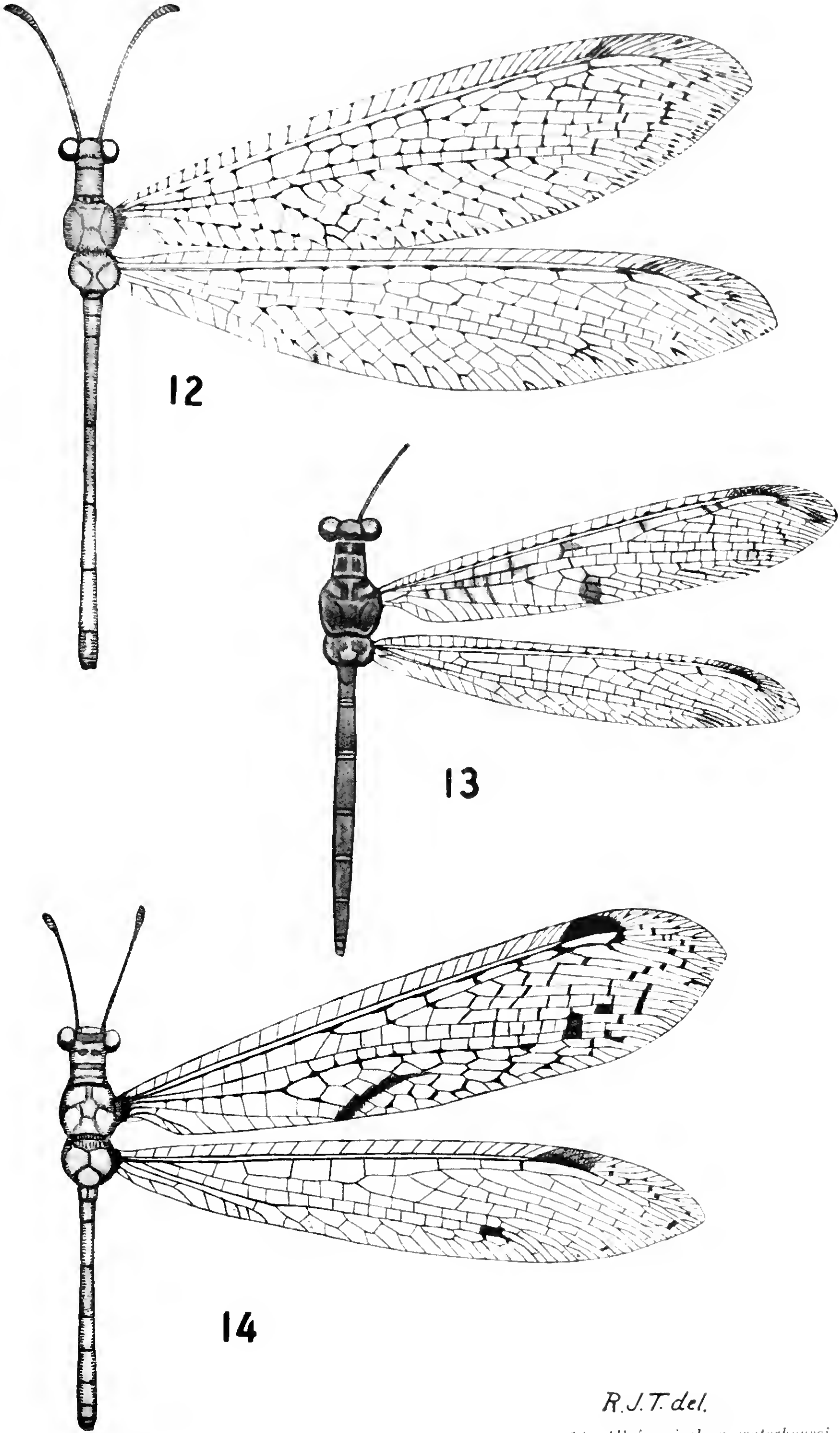
3. *Periclystus aureolatus*, n.sp. 4. *Protoplectron eremiae*, n.sp. 5. *Protoplectron longitudinale*, n.sp.



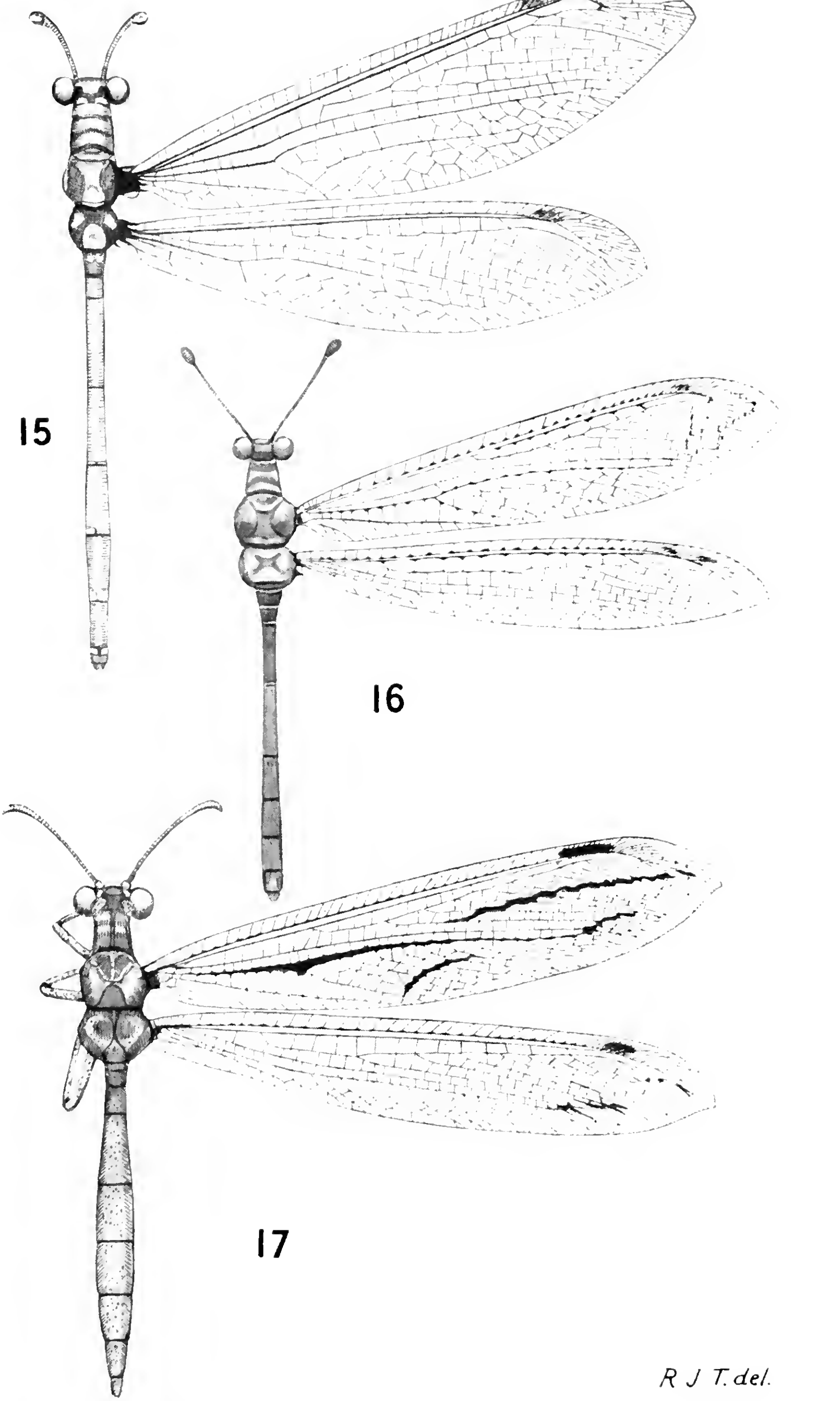
6. *Dendroleon dunnigani*, n.sp. 7. *Dendroleon lambda*, n.sp. 8. *Glenoleon berthoudi*, n.sp.



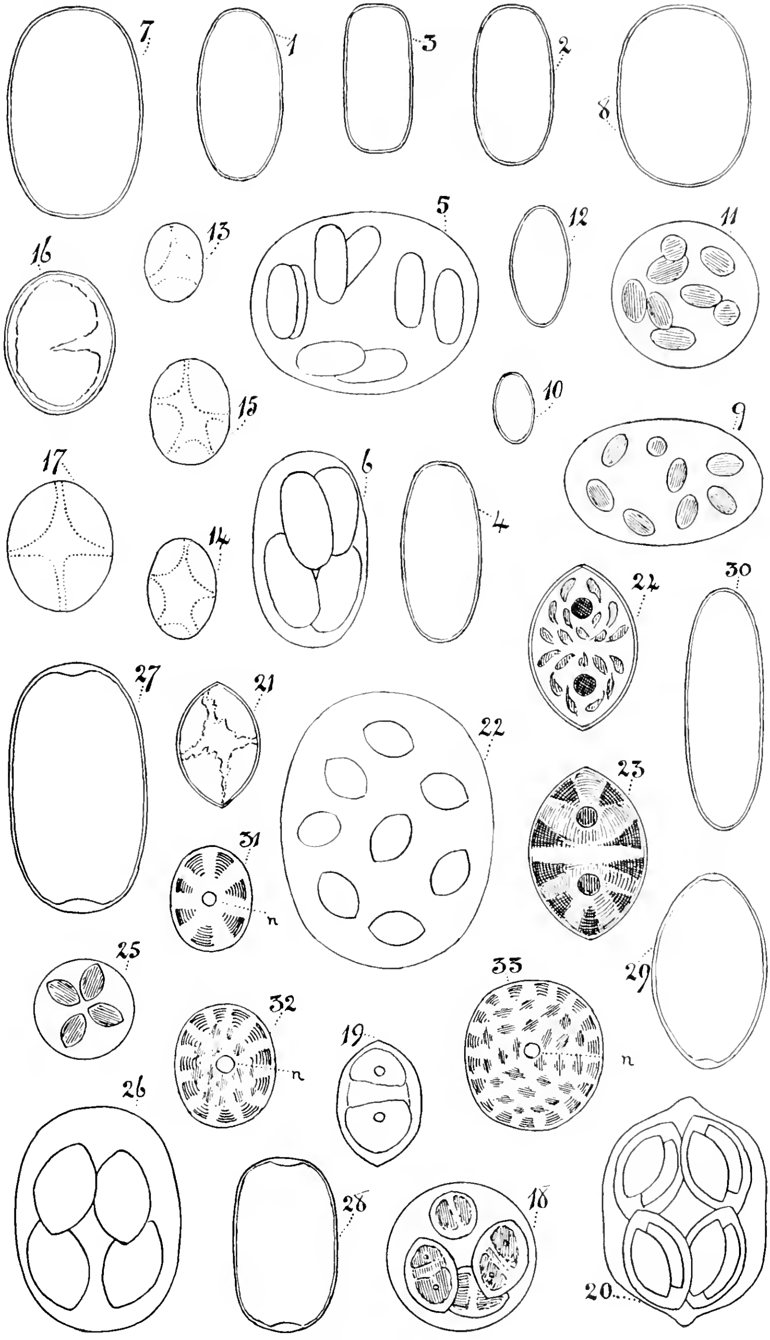
9. *Glenoleon aurora*, n.sp. 10. *Brachyleon Darwini* (Banks). 11. *Gymnocnemia maculata*, n.sp.



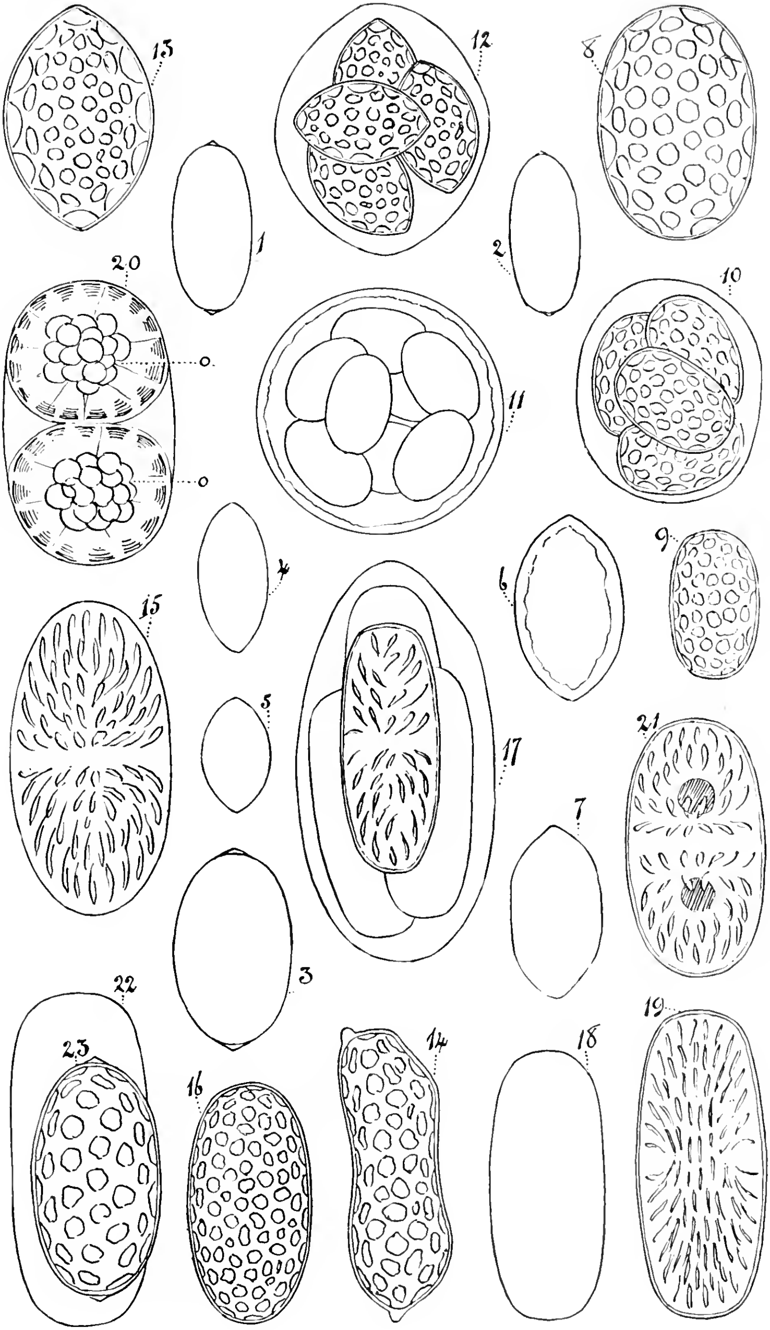
12. *Xantholeon helmsi*, g.et sp.n. 13. *Stenoleon fieldi*, g.et sp.n. 14. *Alloformicaleon waterhousei*, n.sp.



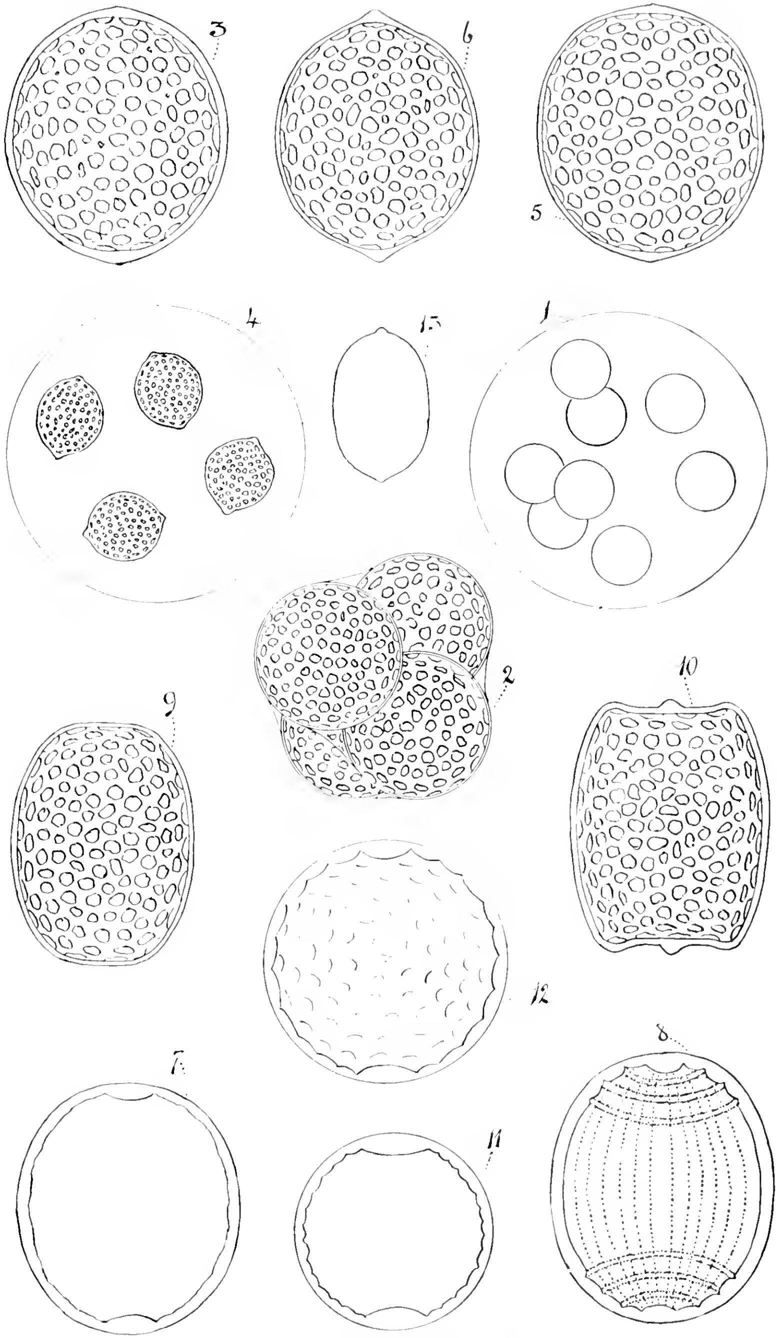
15. *Myrmeleon loweri*, n.sp. 16. *Alloformicaleon hyalinus*, n.sp. 17. *Distoleon nigrosignatus*, n.sp



Species of *Oocystis.*



Species of *Oocystis.*



Forms of *Eremosphæra viridis.*

of "Mutant" were sown, which produced plants with the following characters :—(1) "Mutant" F_1: plants semitrailers, flowers purplish, seeds similar to "Mutant." (2) "Black" F_1: plants semitrailers, flowers purplish, seeds black similar to those of "Black Wax." (3) "Light Brown" F_1: plants mostly dwarf, pods green, seeds light brown. (4) "Dark Brown" F_1: plant dwarf, flowers pale purple, pods green, seed dark brown. Only one plant of this, with one pod and one seed, was raised. (5) "White" F_1: plants mostly semitrailers, with green pods; but four plants were dwarf, with waxy-yellow pods, flowers white, seed white. Among the seeds of "Light Brown" F_1(No.3), a few were noticed with pale brown or stone-coloured markings; these were separated and labelled "Mottled" F_2(No.6). Six of these were sown, all of which produced dwarf plants, but five of them had green pods (not yet ripe), and one had greenish-yellow pods, and light stone-coloured seeds, more or less spotted or splashed with purplish-black colour.

Mr. A. A. Hamilton exhibited the following specimens from the National Herbarium—*Beta vulgaris* L., White (Spinach) Beet, Cult., (Pennant Hills; T. Steel; March, 1916) showing prolification of the inflorescence, accompanied by spiral torsion. The primary branches of the inflorescence have been subjected to an axial strain, owing to extra-floral branching, and consequent reduction of the internodal interstices, which has, in some instances, resulted in a considerable degree of curvature of their extremities. On several of the branches, the outer branchlets are recurved and folded back over the rhachis, giving the branch the appearance of having all the branchlets on one side.—*Grevillea sericea* R.Br., var. *diffusa* Benth., (Gosford; A. A. Hamilton; January, 1916) showing an interchangeable, foliar tomentum, silvery v. brown, a not uncommon occurrence in the N.O. Proteaceæ. Var. *diffusa* is the common form of *G. sericea* found on the Blue Mountains. It was recognised by R. Brown (Prod. Fl. Nov. Holl. Suppt. Prot. Nov., p.17) as a species under *G. diffusa* Sieb., and later also by Meissner (DC. Prod. Syst. Veg., 14, 355). Sieber, whose n.36 is quoted as the type, was one of the earlier collectors on the Blue Mountains. In a footnote to his var. *diffusa*, Bentham (Fl.

Austr., v., 470) says: "This seems to me scarcely to form a distinct variety." Having examined, *in situ*, a series of examples of this form, on the Blue Mountains, over a range extending from Glenbrook to beyond Eskbank, I am of the opinion that varietal rank is an adequate distinction for this form of *G. sericea*. —*Anthocercis Eadesii* F.v.M., (Douglas Park; A. A. Hamilton; December, 1915), an example showing the typical, hoary tomentum on the young shoots, which disappears with maturity. The above habitat adds another specific locality for a plant which is not frequent in New South Wales.—*Kunzea capitata* Reichb., (Medlow Bath; A. A. Hamilton; November, 1914), a small-leaved form connecting *K. capitata* with *K. parviflora* Schau.—*Hakea dactyloides* Cav., (Leura; A. A. Hamilton; November, 1915), a pink-flowered form growing both in swamps and on dry hills (in full flower). The ordinary form had only reached the stage in which the buds remain enclosed in the floral bracts.

Mr. Tillyard exhibited two rare and curious ant-lions, (*a*) the full-grown larva of *Acanthaclisis fundatus* Walker, taken on Stradbroke Island, Queensland, in September, 1915 (about an inch in length); and (*b*) the larva of *Glenoleon pulchellus* Ramb., taken near Hornsby, in April last. Neither of these larvæ makes a pit-fall. They rely for the capture of prey on their ability to move quickly beneath the surface of loose earth or sand. They also possess jaws having a much longer reach than those of pit-forming ant-lions. Both these larvæ are new to science, and the *Glenoleon* is an entirely new type, which may be representative of the tribe *Dendroleontini*.—He showed also a new, bright red, strongly-scented, winter-flowering Spencer Sweetpea, one of the products of the F_2 generation of a Mendelian crossing between the well-known Yarrawa Spencer (pale rose-pink, winter-flowering) and Sun-proof Crimson (bright red, summer-flowering, grandiflora type). The original crossing was made between the last flowers of Yarrawa (♀ parent) and the first flowers of the Crimson (♂ parent) in September, 1913. The F_2 generation was obtained by self-pollination of the F_1 hybrids, all of which resembled Yarrawa in every respect.

By sanction of the Curator of the Australian Museum, Mr. North exhibited the skins of the following Australian Finches:—*Staganopleura guttata* Shaw, and another variety of the same species, for which the name *S. xanthopygia* would be fittingly appropriate, were it not known that the late Mr. J. A. Thorpe shot this bird out of a flock of about twenty, normally plumaged individuals, on the 24th May, 1888, at Como, George's River, N.S.W. This specimen has the rump and upper tail-coverts bright chrome or golden-yellow, instead of rich crimson.—*Bathilda rubricauda* Gould, from Rockhampton and Port Denison, Q., and *B. clarescens* Hartert, from Derby, and the junction of the Fitzroy and Margaret Rivers, N.W. Australia.—Also specimens of *Poëphila gouldiæ* Gould, and *P. mirabilis* Des Murs, from Northern Queensland; and the rare form, *P. armitiana* Ramsay, from the Gulf District and Northern Territory. The latter species, presented to the Trustees of the Australian Museum, in September, 1906, by Mr. Percy Peir, was received by the donor from Port Darwin, when in the young stage, having the usual light-coloured head of the young *P. gouldiæ* and *P. mirabilis*. During the eighteen months Mr. Peir had this bird in his possession, it moulted, assuming, much to his surprise, the chrome-yellow fore-part of the head of *P. armitiana*. Although the red and the yellow-headed forms have had full specific appellations bestowed on them, we now know, since we have gained a knowledge of their habits, that both are merely varieties of the black-headed species, *P. gouldiæ*.

CARABIDÆ FROM THE UPPER WILLIAMS RIVER, N. S. WALES.

[COLEOPTERA.]

By Thomas G. Sloane.

At the end of the year 1915, I was one of a party of naturalists organised by Mr. W. J. Enright, of West Maitland, to examine the part of the Mount Royal Range known as The Barrington Tops; this is the plateau, 5000 feet above sea-level, from which the Barrington, Williams, Allyn, Paterson, and other rivers rise. Our route was north-west from the town of Dungog along the Williams River; after the level of 3500 feet was reached, the track was along the top of the narrow ridge dividing the valleys of the Williams and Allyn Rivers, till (beyond the source of the Williams) we reached Barrington Tops, about 37 miles from Dungog. The geological formation of this part of the Dungog District is Permo-Carboniferous, the Barrington Tops being basalt-capped.

Our camp was at Mr. William Edwards' house on the southern source of the Barrington River, eastward of some open, swampy land known as "the plain." Collecting was done for three days on the plateau, and also on the route-marches there and back, at six localities, which are indicated on the accompanying map by numbers; the figures in brackets, following the names of species in the list which is given below, are those of the numbered localities to show where specimens of each species were found.

The position and description of these localities are as under:—

(1) Fagus*-brush, about four miles from our camp along the track to Stewart's Brook; 5000 feet.

(2) Fagus-brush, about two miles southward from our camp; 5000 feet.

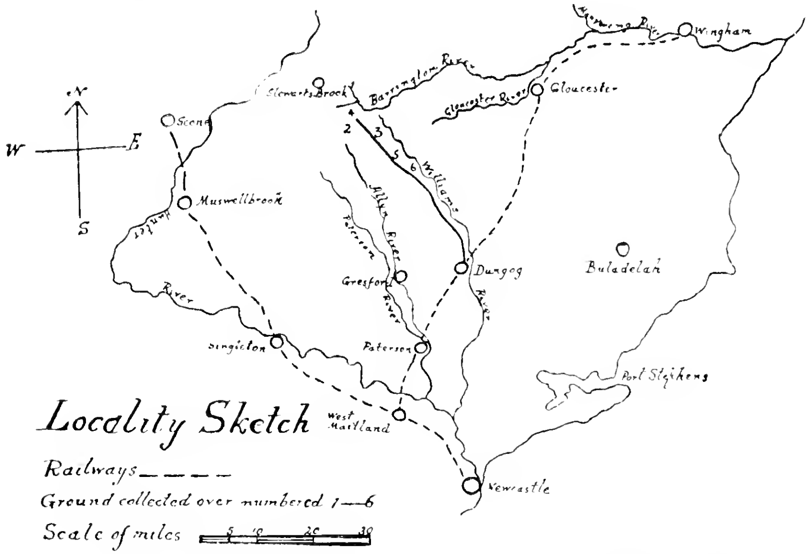
* *Fagus Moorei* F.v.M., is the predominant tree in the brushes at 4100 feet and upwards; but I did not notice it in the brushes below 3500 feet.

(3) Fagus-brush along the Williams River; 4500 feet.

(4) Eucalyptus* forest round the plain; 4800 feet.

(5) Brushes along the Williams River below 3500 feet.

(6) Mr. J. Rumble's farm on the Williams River, 20 miles from Dungog; 600 feet.



List of *Carabidæ* found, numbering forty-six species—including nine species and two varieties described as new.

Pamborus alternans Latr.,(5); *P. pradieri* Chaud.,(1, 2, 3, 5); *Mystropomus subcostatus* Chaud.,(5); *Eurylychnus dyschirioides* Cast.,(2); *E. cylindricus*, n.sp.,(1, 2, 3, 4); *Meonis semistriatus*, n.sp.,(3); *M. minor*, n.sp.,(1, 2); *Mecyclothorax ambiguus* Erichs., (4); *Amblytelus curtus* Fabr.,(4); *A. minutus* Macl.; *Dystrichothorax sloanei* Blkb.; *D. vittipennis* Sl.,(4); *Trichosternus vigorsi* Gory, (5); *T. cyaneus* Chaud., (2); *T.*(?) *australicus*, n.sp., (2); *Ceratoferonia regalis* Cast.,(5); *Notonomus angustibasis* Sl.,(1, 2, 3, 5); *N. johnstoni* Sl.,(5); *N. truncatus*, n.sp.,(1, 2, 3); *N. hedleyi*,

* *Eucalyptus coriacea* A. Cunn., was the most plentiful tree about our camp; all the bark-carabs taken on the plateau were found on this tree.

n.sp.,(1, 2, 3); *N. australis* Cast.,(1, 4); *N. amabilis* Cast.,(5); *N. frontevirens* n.sp.,(1, 2, 3); *Prosopogmus chalybeipennis* Chaud., (1, 2, 3, 5); *Tachys curticollis* Sl., (6); *Lacordairia cychroides* Cast.,(3); *Siagonyx blackburni*, n.sp., (1, 2, 3); *Gnathaphanus pulcher* Dej.,(6); *Gn. melanarius* Dej.,(6); *Diaphoromerus edwardsi* Cast., var. *virescens*, n.var.,(4); *Hypharpax australis* Dej., (6); *Lecanomerus major* Blkb., (1, 2, 3); *Xanthophæa grandis* Chaud.,(4); *X. ferruginea* Chaud.,; *Trigonothops pacifica* Erichs., (4); *Sarothrocrepis corticalis* Fabr., var. *infuscata*, n.var., (4); *S. suavis* Blkb., (4); *Celænephes parallelus* Schmidt-Goeb. (6); *Philophlæus obtusus* Chaud.,(6); *Ph. luculentus* Newm.,(6); *Agonochila ruficollis* Sl.,(4); *A. guttata*(?) Chaud.,(6); *A. macleayi* Sl., (4); *A. fenestrata* Blkb., (4); *A. plagiata*, n.sp. (4); *Silphomorpha ovalis* Cast.,(6); *S. discoidalis* Cast.,(4).

No definite conclusions can be drawn from the small number of Carabidæ which can be collected in any district during one short visit; at most, a fair idea of the species to be found at one period of the year can be gained. Fifteen species are definitely recorded as having been found below the level of 4,000 feet; and to these may be added three, widely distributed species which are without exact locality, but which undoubtedly do inhabit the lower ground; these eighteen species are all known species, which are found in various parts of the coastal districts of New South Wales between Sydney and the Clraence River. Twenty-eight species were collected above the altitude of 4,100 feet; these are of far more interest than those from the lower country, no less than eight of them being undescribed species. One of these, *Trichosternus*(?) *australicus* Sl., is a remarkable and interesting species, evidently an ancient type, which is more allied to New Zealand than to existing Australian species. Another is *Agonochila ruficollis* Sl., hitherto only known to inhabit the forests of South-Western Australia, but which is closely allied to a Tasmanian species, and to *A. binotata* White, of New Zealand; the other species are members of typical genera of Eastern Australia. Altogether, the Carabidæ of the Barrington Tops show a general affinity to those of eastern New South Wales, with some indications of a connection with the south.

EURYLYCHNUS CYLINDRICUS, n.sp.

Elongate-oval, subcylindrical; head stout, one supraorbital seta on each side; prothorax cordate; elytra oval, lightly 8-striate. Black.

Head convex (3·7 mm. across eyes); vertex transversely impressed; frontal impressions strong, curved, diverging backwards; eyes round, prominent. Prothorax broader than long (4·6 x 5 mm.), widest before middle, wider at apex (4 mm.) than base (3 mm.); sides rounded; anterior angles wide, rounded; basal angles rounded; lateral border thick, merging with surface of prothorax at basal angles; a short, deep, foveiform, basal impression connected with posterior extremity of lateral channel on each side; one, setigerous, marginal puncture on each side at about one-half the length of prothorax; median line not strongly impressed. Elytra convex (10·5 x 5·8 mm.): striæ shallow, simple, distinct on disc, faint on sides; interstices depressed. Apex of abdomen with one seta on each side in both sexes. Prosternum bordered along anterior margin. Anterior tarsi similar in both sexes; outer angle of two basal joints prominent. Length 17-20, breadth 5·4-6 mm.

Hab.—Mount Royal Range, N.S.W. Common under logs in the Fagus-brushes, from 4,500 to 5,000 feet.

A distinct species allied to *E. regularis* Sl., but narrower (especially prothorax) and more cylindrical; prothorax smaller, narrower at apex, less ampliate at widest part, anterior angles less distant from head and less marked; elytra far more lightly striate.

MEONIS SEMISTRIATUS, n.sp.

Elongate-oval, convex. Black.

Head ordinary (2·7 mm. across eyes). Prothorax truncate cordate (4 x 3·8 mm.), of nearly equal width at apex (2·75 mm.) and base (2·8 mm.); sides lightly rounded, lightly sinuate to base; base truncate, sloping forward to basal angles, these sharply marked. Elytra oval (8·5 x 5·1 mm.), lightly 3-striate on disc; sides and apical declivity lævigate; humeral angles marked, subdentate. Length 15·5, breadth 5·1 mm.

Hab.—Mount Royal Range, N.S.W. Five specimens were found under logs in the Fagus-brush along the Williams River, at 4,500 feet.

A distinct species, differing from all the species hitherto described by having only the three inner striæ on each elytron present; these striæ are only marked before the apical declivity, which is lævigate, as is also the lateral part of each elytron outside the third interstice; in these respects, it agrees with the small species, *M. minor* described below.

Meonis minor, n.sp.

Elongate-oval, convex. Black.

Head ordinary (1·7 mm. across eyes). Prothorax truncate-cordate, about as long as broad (2·4 × 2·5 mm.), of equal width at apex and base (1·8 mm.); sides lightly rounded, strongly sinuate to base; base truncate; basal angles sharply marked. Elytra oval (4·7 × 3 mm.), lightly 3-striate on disc; sides and apical declivity lævigate; humeral angles marked, subdentate. Length 8·5-9, breadth 3 mm.

Hab.—Mount Royal Range, N.S.W. Three specimens in brushes at the source of the Barrington River, 5,000 feet.

Allied to *M. semistriatus* Sl., but the great difference in size (which is constant in the five specimens of *M. semistriatus*, and the three specimens of *M. minor*, which I have seen), constrains me to regard it as a distinct species. In the case of *M. angusticollis* Sl., of which I found examples of two distinct sizes at Dorrigo, specimens of the different sizes occurred together; but with *M. semistriatus* and *M. minor*, the specimens were found several miles apart, at different altitudes, and on different watersheds; further collecting to ascertain the range and variation in size of these two species is necessary before a definite opinion can be given on the position to be assigned to *M. minor*; that is, whether, or not, it is merely a variety of *M. semistriatus*. Comparing *M. minor* with the smaller form of *M. angusticollis*, it is noticed that the prothorax is shorter, wider, less strongly rounded on sides, basal sinuosity shorter, elytra less rounded on sides, less strongly striate, fourth stria not marked, apical declivity non striate.

Table of species of the genus *Meonis.*

1(6) Elytra with fourth and fifth striæ well developed on apical declivity.
2(3) Elytra 5-striate on disc.. *M. niger* Cast.
3(2) Elytra 4-striate on disc.
4(5) Striæ of elytra deeply impressed, prothorax strongly rounded on sides.. *M. convexus* Sl.
5(4) Striæ of elytra lightly impressed, prothorax lightly rounded on sides.. *M. angusticollis* Sl.
6(1) Elytra with apical declivity and sides beyond fourth interstice lævigate.
7(8) Elytra deeply 4-striate, prothorax with sides strongly rounded and strongly sinuate posteriorly........................ *M. amplicollis* Sl.
8(7) Elytra lightly 3-striate, prothorax with sides lightly rounded and lightly sinuate posteriorly.
9(10) Size large (15·5 mm.)....................................... *M. semistriatus* Sl.
10(9) Size small (9 mm.)... *M. minor* Sl.

Note.—No specimen of *M. ater* Cast., is available to me at present. It is said by Castelnau to differ from *M. niger* Cast., by having four striæ on the elytra, not five as in *M. niger.* It is allied to *M. angusticollis* Sl., from Dorrigo, N.S.W., which requires comparison with it; specimens of *M. niger* are in the Howitt Collection at the National Museum, Melbourne, ticketed "Brisbane."

TRICHOSTERNUS(?) AUSTRALICUS, n.sp.

Elongate; head large, mentum with sinus parallel on sides, median tooth bifid; palpi elongate, slender; antennæ slender, setaceous; prothorax subcordate, lateral margins wide, basal angles obtuse, posterior marginal seta a little before base; elytra oval, strongly striate, interstices lightly convex, 3, 5, and 7 seriate-punctate, basal border a little raised at humeral angles, lateral margins wide; prosternum glabrous between coxæ; met episterna short; legs long, light; posterior trochanters long, narrow, depressed on posterior side; anterior tarsi in ♂ with three basal joints dilatate and biseriately squamose beneath. Nitid, occiput and disc of pronotum dark copper; front and sides of pronotum brassy; elytra dark copper with bright cupreous margin; under surface piceous; trochanters, tarsi, and mouth parts reddish-piceous.

Head a little narrowed behind eyes (4·25 mm. across eyes); front widely biimpressed. Prothorax broader than long (4·5 × 5·3 mm.), widest before middle, wider at apex (4·15 mm.) than base (3·6 mm.); sides lightly rounded at anterior marginal puncture, obliquely narrowed to base (subsinuate before base from some points of view); apex lightly emarginate; anterior angles obtuse, hardly advanced; base lightly emarginate above peduncle; lateral border strongly reflexed on basal half, particularly towards basal angles; lateral basal impressions wide. Elytra much wider than prothorax (11 × 7 mm.); sides strongly rounded to peduncle; striæ a little crenulate; striole at base of first interstice short; interstices 1-8 equal, ninth depressed, third 3- or 4-punctate, fifth and seventh 2-punctate on basal half. Prosternum, mesosternum, and metasternum glabrous. Ambulatorial setæ of ventral segments present; apex of abdomen unisetose on each side, a slight notch in middle. Length 20·5, breadth 7 mm.

Hab.—Mount Royal Range, N.S.W. One specimen (♂) was found by me on the steep escarpment at the source of the Allyn river, 400 feet from the summit, under a log on the stony bank of a rivulet, in a very damp situation.

This species is an isolated one in the Australian fauna, and is not truly congeneric with the other Australian species which have been referred to the genus *Trichosternus.* It has not the interstices of the elytra costate, as have all our other species. It is more allied to New Zealand species, for which the late Tschitscherine proposed (though without diagnosing it) a new genus, *Nesopterostichus*, with *Trichosternus guérini* Chaud., for the type.* I do not know *T. guérini* in nature, nor have I sufficient knowledge of the species of New Zealand to say definitely that *T. australicus* is actually congeneric with them; but I cannot think it will remain in the same genus with the costate Australian species of *Trichosternus*, when the classification of the *Pterostichini* is revised.

* *Cf.* Hor. Soc. Ent. Ross., xxxv., 1902, p.521, *note*.

NOTONOMUS TRUNCATUS, n.sp,

Elliptical-oval, convex; prothorax rounded on sides, angles not marked, posterior marginal seta before basal angle, not on border; elytra oval, fully striate, interstices depressed, third 3-punctate, eighth and ninth subequal on basal half, basal border not raised above lateral border at humeral angles, apex truncate: hind tarsi elongate, narrow. Black.

Head convex (3·5 mm. across eyes). Prothorax broader than long (4 × 4·5 mm.), convex, a little narrower at base (3 mm.) than apex (3·5 mm.), lævigate; sides rounded; anterior angles close to head; basal angles obtuse; lateral marginal channel not defined near base; lateral basal impressions short, wide; lateral border narrow. Elytra oval (10 × 5·8 mm.); lateral apical sinuosities well developed; striæ decided, less strongly impressed in ♀ than in ♂; interstices depressed on disc, eighth depressed, rather narrow, hardly as wide as ninth on basal half, tenth moderately developed, extending forward from apical sinuosity for one-third the distance to base of elytra. Intercoxal declivity of prosternum wide, rounded; of mesosternum, concave. Four posterior tarsi without spinules beneath costa of external side of basal joint. Length 16-18·5 mm., breadth 5·3-6·4 mm.

Hab.—Mount Royal Range, N.S.W. Plentiful under logs in the Fagus-brushes, at the sources of the Williams and Barrington Rivers, 4,500 to 5,000 feet.

Allied to *N. johnstoni* Sl., and a member of the *crenipennis* group; but sharply differentiated from all the other species of the genus *Notonomus* by the truncate elytra, which have the apex truncate opposite the four, inner striæ of each elytron, so as to expose the apex of the abdomen.

NOTONOMUS HEDLEYI, n.sp.

Elliptical-oval, subdepressed; prothorax rounded on sides, basal angles rounded off, posterior marginal seta on border at base; elytra oval, strongly and fully striate, third interstice 3-punctate, eighth and ninth rather narrow, subequal, basal border raised above lateral border at humeral angles. Black.

Head ordinary (2·5 mm. across eyes). Prothorax broader than long (3·25 × 3·7 mm.), a little wider at apex (2·8 mm.) than base (2·6 mm.); sides lightly rounded, roundly angustate to base; border extending round basal angles (which are indicated by the presence of the posterior setigerous puncture on the border) to lateral basal impressions, these short and wide. Elytra truncate-oval (8 × 4·5 mm.): lateral apical sinuosities wide, weakly developed: tenth interstice moderately developed near apex. Intercoxal declivity of prosternum flat, of mesosternum a little concave. First joint of four posterior tarsi without spinules beneath costa of outer side. Length 12·5-14·8, breadth 4·2-5 mm.

Hab.—Mount Royal Range, N.S.W.

Not uncommon under logs in the Fagus-brushes, at the sources of the Williams and Barrington Rivers; 4,500 to 5,000 feet. I have dedicated it to Mr. C. Hedley, conchologist, in whose company I found it.

I place it next *N. marginatus* Cast., and *N. fergusoni* Sl. It has the facies of *N. marginatus*, var. *sydneyensis* Sl., but differs conspicuously by its black colour; prothorax with basal angles far less marked; elytra with third interstice 3-punctate, lateral apical sinuosities less strongly developed; intercoxal declivity of prosternum flat, It resembles *N. fergusoni* by colour, and the obtuseness of the basal angles of the prothorax, but differs by all the other characters given above as differentiating it from *N. marginatus*, var. *sydneyensis* in facies, it is much less robust than *N. fergusoni*.

NOTONOMUS FRONTEVIRENS, n.sp.

Elliptical oval, convex; prothorax subcordate, rounded on sides, narrower across base (3·5 mm.) than apex (4 mm.), posterior marginal seta on border at basal angle; elytra oval, strongly striate, interstices convex, third 4- or 5-punctate, basal border not dentate at humeral angles. Head bright green on upper surface; pronotum nitid, bronze-copper; elytra bronzy, ninth interstice and marginal channel brighter (greenish or cupreous); undersurface and legs black; antennæ with basal joints black.

Head convex (3·65 mm. across eyes); eyes convex. Prothorax broader than long (4 × 5 mm.); sides strongly rounded, roundly angustate to base; border wide, reflexed; lateral basal impressions short, wide. Elytra oval (11 × 6·5 mm.), convex; lateral apical sinuosities wide, feeble; striæ subcrenulate; eighth and ninth interstices short, well developed towards apex. Intercoxal declivity of prosternum flat, of mesosternum lightly concave. Four posterior tarsi costate on external side without spinules beneath costæ. Length 19-23, breadth 6·25-7·4 mm.

Hab.—Mount Royal Range, N.S.W. Not uncommon under logs in the Fagus-brushes, at the sources of the Williams and Barrington Rivers, 4,500 to 5,000 feet. Seven specimens have been examined.

Belongs to the *australis*-group. It is allied to, and resembles *N. colossus* Sl., but differs by form more convex; prothorax smaller, narrower across base, more strongly rounded on sides (particularly towards base), anterior angles more rounded and nearer to head; elytra more oval, border narrower; posterior femora less swollen in middle; upper surface of head bright green, prothorax cupreous, elytra coppery-bronze, antennæ black (not reddish).

SIAGONYX BLACKBURNI, n.sp.

Siagonyx angustata Blackb., (not *Lacordairia angustata* Cast.), Trans. Roy. Soc. S. Aust., 1901, p.116.

Elliptical-oval, depressed; labrum bisinuate; prothorax very little broader than long (2·8 × 3 mm.). Black.

Prothorax narrow, strongly narrowed to base, widest before middle; apex and base of equal width (2 mm.), apex lightly emarginate, narrowly bordered; anterior angles rounded; base emarginate, rounded at basal angles; lateral margins wide. Elytra much wider than prothorax, oval (9 × 5·5 mm.), strongly striate; a short, distinct striole at base of first interstice; third interstice bipunctate near second stria. Length 12·5-15·6, breadth 4·5-6 mm.

Hab.—N.S.W.: Fagus-brushes at the sources of the Williams and Barrington Rivers, Kiama, Burrawang.—Victoria: Wood's Point, Marysville, Warburton, Yarragon, Ballarat, Princetown.

This is the species which Blackburn regarded as *Lacordairia angustata* Cast., but, with this opinion, I cannot agree. I regard *L. angustata* as a true *Lacordairia*, in all probability conspecific with *L. cychroides* Cast., which I have from Raleigh, Comboyne, Williams River, and Gosford, N.S.W. *L. blackburni* is common in collections; it is over thirty years ago since I first found it in the Otway forest, but it has never been described. In the proportions of the prothorax, it varies considerably; a specimen from Kiama, in my collection, has the dimensions of the prothorax as follows—3·5 × 3·6, apex 2·5, base 2·7 mm. It differs from *S. amplipennis* Macl., (which extends as far south as Dorrigo) by labrum not rather deeply emarginate, but bisinuate (middle more prominent than anterior angles), prothorax more elongate and narrower, elytra less deeply striate, etc.

DIAPHOROMERUS EDWARDSI Cast., var. VIRESCENS, n.var.

Oval, convex; prothorax transverse, much wider at base than apex, basal angles obtuse; elytra truncate-oval, striate, interstices depressed, second with an elongate striole at base, third unipunctate at beginning of apical declivity, humeral angles subdentate. Nitid, minutely shagreened; upper surface rather bright green; undersurface virescent; labrum, legs, antennæ after second joint, and palpi (excepting their apices) black; first joint of antennæ reddish-testaceous. Length 7·7-8·5, breadth 3·2-3·5 mm.

Hab.—N.S.W.: sources of Barrington River (Sloane), Ebor (Tillyard).

A single specimen (♀) occurred to me in open country near Mr. Edwards' house (5,000 feet). Mr. Tillyard had formerly found it at Ebor. It seems a variety of *D. edwardsi* Cast., which is said by Chaudoir to be shining olive-bronze; by Castelnau, "dark æneous-green, with a bluish tinge."

SAROTHROCREPIS CORTICALIS Fabr., var. INFUSCATA, n.var.

Differs from *S. corticalis* Fabr., by pattern of elytra; the black apical patch extends forward along interstices 6-8 to the base, and near the base overspreads interstices 2-5, with the result that a dull testaceous, sutural space on the basal half of the elytra is enclosed: at its widest part, this basal plaga extends outwards to the fifth or sixth interstice on each elytron, is divided posteriorly by a forward prolongation of the ante-apical black area, and extends along the first interstice to the base. The dark basal part of the elytra is infuscate, not nearly as black as the ante-apical patch. The abdomen is slightly more setulose than in *S. corticalis*, but less so than in *S. setulosa* Sl. As in *S. corticalis*, the interstices are non-setulose, but have minute punctures along the course of the fifth as in *S. corticalis* (these punctures being most noticeable towards the apex). Length 9-10·3, breadth 4·5-5 mm.

Hab.—Mount Royal Range, N.S.W.

Common under loose bark on the trunks of *Eucalyptus coriacea*, at 5,000 feet.

I have specimens of this variety from Sydney, Victoria, and Tasmania.

AGONOCHILA PLAGIATA, n.sp.

Depressed: elytra wide in proportion to prothorax; head finely shagreened, sparsely punctulate; prothorax transverse, apex lightly emarginate, base strongly bisinuate, posterior angles marked, but obtuse, one or two marginal setæ on anterior half; elytra broad, densely and rather coarsely punctate, striæ and interstices indistinct, third interstice 3-punctate. Legs, antennæ, mouth-parts, lateral margins of prothorax, a wide posthumeral plaga on each elytron, and undersurface testaceous (sides of abdomen fuscous); head and disc of prothorax usually brownish; elytra brownish with a variable pattern—usually a wide, testaceous, posthumeral plaga on each elytron and an indefinite apical patch; sometimes the posthumeral plagæ join the apical patch by a narrow, ill-defined extension along the fourth interstice.

Head stout (1·3 mm. across eyes), minutely shagreened, and sparsely punctate under a lens; eyes prominent. Prothorax wide (1·2 × 2 mm.), widest before middle, a little narrower at apex (1·4 mm.) than base (1·5 mm.), finely setulose-punctate under a lens; disc rather convex; margins wide, depressed; sides rounded anteriorly, narrowed and subsinuate posteriorly; apex lightly emarginate, anterior angles rounded; base shortly lobed in middle, basal angles obtuse, median line strongly impressed. Elytra broad (4 × 3 mm.), widest about posterior third, a little narrowed to base, rounded on sides; humeral angles widely rounded. Length 7-7·5, breadth 3-3·5 mm.

Hab.—Mount Royal Range, N.S.W. Common under loose bark on trunks of *E. coriacea*, at 5,000 feet.

This is one of the largest species which has been attributed to the genus *Agonochila*. Its distinguishing characters are its broad elytra, with a wide, posthumeral, testaceous plaga on each elytron. The pattern of the elytra varies a good deal:—taking the ground-colour as pitchy-brown, there is usually a wide, testaceous, post-humeral plaga on each elytron, and an apical, duller-coloured patch (more or less common to both elytra); sometimes the post-humeral and apical markings are widely separated by the brown ground-pattern; sometimes the plagæ extend backwards and join the apical mark, so that the brown parts of the elytra become arranged in three, irregular stripes, viz., a sutural stripe and one near each side, these stripes being wide and near together about the apical third of the elytra. Compared with *A. corticalis* Erichs., *A. plagiata* is larger and differently marked; prothorax with sides more strongly narrowed to base, elytra more strongly punctate. It is remarkable to find, in this species, the prothorax with either one or two, anterior, marginal setæ on each side; where there are two setæ, these are wide apart, the posterior one situated as usual, the anterior one a little less than half-way between it and the anterior angle. Twenty-six specimens have been examined; of these, seventeen had one seta, and nine two setæ. Specimens of both sexes occurred with one and two setæ.

DESCRIPTIONS OF A NEW GENUS AND THREE NEW SPECIES OF AUSTRALIAN *TENEBRIONIDÆ* FROM BARRINGTON TOPS, NEW SOUTH WALES.

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

A week's visit at Christmas, 1915, to a region new to the collector, and little known to the tourist—Barrington Tops—revealed a mountain-district of above 5,000 feet altitude, that combines many of the characters of Koscinsko and Dorrigo. Situated some thirty-seven miles north-west of Dungog, this highland should prove an interesting field to the naturalist. Of volcanic origin, the rich soil possesses a magnificent forest, in parts approaching jungle, the higher slopes containing a rich brush, mainly composed of the beautiful *Fagus Moorei*. While the general collecting was a little meagre, due to the long preceding dry weather, the results were specially rich in Carabidæ, while three new species of Tenebrionidæ were taken, including one which requires a new genus for its reception.

Sloanea, n.gen. Tenebrioninarum.

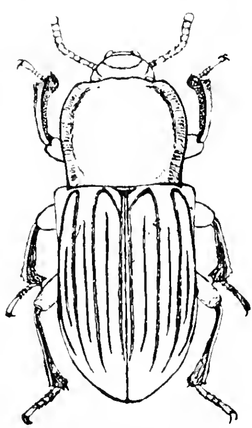
Wide, depressed, with the facies of *Cryptodus*. Labrum emarginate and ciliate; mentum cordate, last joint of all palpi securiform; mandibles grooved, forked at apex. Eyes small and transverse. Antennæ with the last four joints flattened and successively wider, the three penultimate joints transverse, last joint subcircular. Prosternum convex, its process arched downwards at apex, and received into a triangular receptacle of the mesosternum: mesosternum short, body apterous; elytra costate, widely rounded behind, epipleuræ wide and horizontal; precoxæ globose, middle coxæ rounded. Legs short and stout; tibiæ much enlarged at apex, fore- and midtibiæ serrated externally. In the ♂, the tibiæ, especially the foretibiæ, strongly bent inward at apex. Tarsi tomentose, the claw-joint nearly as long as the rest combined, the first longer than the second, intercoxal process wide, rounded in front and carinate at margins.

A genus not very near any existing Australian genus of the Tenebrionidæ. The head and thorax are somewhat as in *Asphalus* Pasc., but with a very different structure of leg, and elytral sculpture.

SLOANEA COSTATA, n.sp.

Ovate, depressed, glabrous, opaque brownish-black above, nitid beneath; palpi, tarsi, and apical joints of antennæ reddish, the tarsi clothed with red tomentum.

Head trapeziform, densely and finely punctate, the sides slightly raised behind and arcuate; epistoma convex, straight in front and limited behind by a straight, obscure depression; antennæ with basal joints nitid and bead-like, third joint slightly longer than fourth, the last four opaque and hairy. *Prothorax* 6·5 × 7 mm., widest in front of middle, trisinuate at apex, the middle with a wide triangular insertion, anterior angles widely rounded and feebly produced, sides slightly rounded on anterior half, sinuately narrowed behind, posterior angles acute, a little deflexed and produced, base bisinuate; foliate margins concave within, extreme border narrowly raised, continued on apex, widened at the posterior angles, obsolete at base, surface finely and closely punctate on disc, the punctures subobsolete in the middle, coarser on sides and base, the foliate margins and regions near posterior angles coarsely rugose, a fine medial line sometimes traceable. *Scutellum* forming a strongly transverse, smooth ridge. *Elytra* wider than prothorax at base and not quite twice as long; shoulders prominent, squarely rounded and formed by the reflexed epipleural fold, sides feebly widened



Text-fig. 1.
S. costata, n.sp.

behind, apex widely rounded; each elytron with seven, shining, very slightly crenulate costæ, the first (sutural), third, fifth, and seventh wider than the others, terminating before the apex, the second, fourth, and sixth narrower and terminating considerably in front of these, the first, third, and seventh only extending to base, the sutural costæ bifurcating some distance behind the scutellum to meet the third costæ, but also narrowly extending in a straight line to the middle of the scutellum; on the wide interval between the seventh costæ and the margin a further, short, ill-defined ridge; all intervals opaque and rugose-punctate. Underside glabrous, submentum and prosternum coarsely, abdomen more finely but densely punctate. Femora stout, finely punctate, tibiæ rugose. In the ♂, the fore-tibiæ bent at right angles inwards near apex, with a triangular external emargination, all tibiæ sulcate externally, and with two short spines at apex. Tibiæ of ♀ nearly straight. *Dimensions:* ♂, 17 × 8; ♀, 20 × 9 mm.

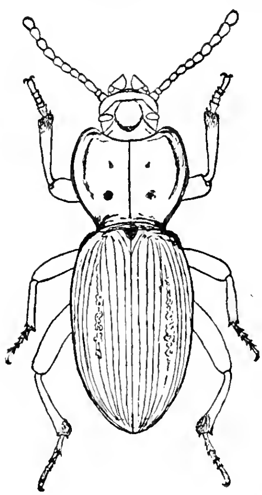
Hab.—Barrington Tops, 37 miles north-west of Dungog; altitude, 4,000-5,000 feet.

Seven specimens of this interesting insect taken by Messrs. Sloane, Musgrave, and myself in the beautiful beech-forests (*Fagus Moorei*) that clothe the basalt mountain. In occurred in company with *Pamborus pradieri* Chaud., and *Lissapterus pelorides* Westw., in or under the rotten logs of the Fagus; and seems to be peculiar to this district. I know nothing very near it, and place it with some diffidence in this subfamily. I have much pleasure in giving the generic name in honour of my friend and frequent companion on entomological quests, who found the first specimen. Type in the author's Coll.

CARDIOTHORAX INTERSTITIALIS, n.sp.

Elongate-ovate; head and thorax subopaque bronze-black; elytra dark bronze, underside and legs nitid-black, tarsi and apex of tibiæ with short, red hairs.

Head wide, smooth; epistoma rounded in front, its suture straight, the usual frontal impression well marked; widened and raised in front of eyes, antennæ very stout, joints pear-shaped, 8-10 gradually wider and rounded, eleventh ovate, acuminate. *Prothorax* 5 × 7 mm., cordate and flat, widest at middle; apex semicircularly emarginate, anterior angles strongly produced and rounded; sides well rounded, strongly narrowed behind and sinuate before the dentate posterior angles, these deflexed and outwardly directed, base arcuate; foliate margins wide and a little upturned, with a wide, shallow, separating sulcus on anterior half, extreme border narrow and reflexed throughout; disc smooth, with four small foveæ, two on each side of the thin, well defined, medial channel; sometimes with other irregular impressions. *Scutellum* triangular, smooth. *Elytra* considerably wider than prothorax at base, and nearly thrice as long, shoulders rather squarely rounded, the epipleural fold well raised in this region, extreme margin sharply raised, with an irregular row of large punctures within this; sulcate, each elytron with nine subcostate intervals, continuous to and sharply ridged on apex, *the sixth interval always broken near the middle*, either flattened, with a few large punctures, or with a chain of irregular ocellate pits formed, the seventh and eighth intervals narrower than the rest. Prosternum transversely wrinkled, abdomen and femora quite smooth, tibiæ strongly punctate near apex, legs without sexual differentiation. *Dimensions:* 19-21 × 6·5-8 mm.



Text-fig. 2.
C. interstitialis, n.sp.

Hab.—Barrington Tops, N.S.W. (Messrs. T. G. Sloane, Musgrave, and the author).

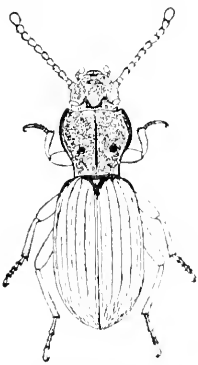
A species occurring very commonly in this region above the 4,000 feet level. I have 30 specimens before me, all of which have the peculiar elytral sculpture noted above, *e.g.*, strongly sulcate, with the sixth interval broken. The species forms a link between some of the more nitid species, like *C. æripennis*

Blackb., and the subopaque species like *C. Haagi* Bates, with the prothorax similar to the latter, and the elytra more like the former; but it is very distinct from any described species, and is one of the largest in the genus. Types in the author's Coll.

CARDIOTHORAX ASPERATUS, n.sp.

Elongate-ovate, brownish-black, opaque.

Head and thorax densely rugosely shagreened; labrum prominent, epistoma incurved in the middle, oblique on sides; suture straight; frontal impression obscure (only indicated by basal ridge); antennæ with joint 3 nearly as long as 4-5 combined, 3-7 subconic, 8-10 oval, 11 very large, ovoid. *Prothorax* 5 x 5 mm., scutiform, widest in front of middle, bisinuate at apex, anterior angles moderately produced and rather sharply rounded, sides slightly rounded anteriorly, then widely sinuately narrowed behind, posterior angles acutely dentate and pointing obliquely outward, base truncate, much narrower than apex, disc with two, wide, shallow depressions and a depressed middle line, the sculpture somewhat reticulate rugose, coarsely so at sides and base. *Scutellum* triangular. *Elytra* ovate, wider than prothorax at base and twice as long, shoulders rounded, epipleural fold reflexed in this region and forming a sharply defined border throughout; punctate-striate, five alternate intervals (including the sutural) finely costate, the edge of costæ very finely crenulate or subnodulose, the latter structure evident in the two sutural costæ, the second, fourth, sixth, and eighth intervals also slightly raised, more distinctly so on apical half, the interspaces filled with rather large, close, transverse punctures; submentum and prosterna very coarsely punctate, the latter bearing scattered setæ, abdomen finely and sparsely granulose and opaque, legs with short, dense hairs, tibiæ scarcely enlarged at apex, with short terminal spines. *Dimensions:* 14-18 x 5-6·5 mm.



Text-fig. 3.
C. asperatus, n.sp.

Hab.—Barrington Tops, N.S.W. (Messrs. Sloane, Musgrave, and the author).

Sixteen specimens taken by the above, belong to the sub-squamose group, *C. egerius* Pasc., *C. mimus* Cart., *C. undulatus* Cart. In form, it is nearest the last of these (from an adjacent region), but it is at once separated from it by the coarsely rugose prothorax and punctate elytra. In the latter character, it is near *C. mimus* Cart., which differs widely in size, form, and prothoracic structure. Types in the author's Coll.

Meneristes proximus Cart.—In these Proceedings for 1914 (p.75), I described this as a possible variety of *M. tibialis* Cart. With a number of fresh specimens from Barrington Tops before me, I am convinced that this is a good species, clearly separated from *M. tibialis* by the *nitid, impunctate prothorax and elytral intervals* besides the distinctions noted in the description.

A NEW SCALE-INSECT AFFECTING SUGAR-CANE IN NEW GUINEA.

By the late Dr. A. Rutherford: with a Note by Edmund Jarvis, Entomologist.

(Communicated by W. W. Froggatt, F.L.S.)

Aulacaspis major, n.sp.

Female scale thin, greyish-white, somewhat uniform, large (longer diameter 3-3·25 mm). Exuviæ pale yellow, the first projecting, the second submarginal.

Adult female broadest in the cephalo-thoracic region. Cephalic end broadly rounded, sometimes with a slight median notch. Pygidium hyaline with several strands of chitin running cephalad from the apical margin.

Antenna: a small tubercle of irregular shape, and bearing a stout, curved seta.

All stigmata with parastigmatic pores in a compact group. Three pairs of prominent, hyaline lobes. Median lobes not sunk, slightly expanded distally, apex broadly rounded, about one-quarter of their own width apart. A prominent chitinous area of the pygidium between the lobes.

Second lobes duplex, the mesal half expanded distally, broadly rounded at apex; lateral half with the mesal side straight, the lateral side oblique.

Third lobes of much the same shape, and quite as broad as the second. Laterad of the third group of plates are several broad, serrated projections associated with marginal gland-pores.

Plates: none between median lobes; thereafter in the usual positions 1, 1-2, 1-2, 2, 6-10. The penultimate segment bears 7-11, and the antepenultimate 5-8 similar plates. All plates stout, tapering, a few slightly pectinate at apex.

A *seta* on the base of the median lobes laterally, one between the halves of the 2nd and of the 3rd lobes, and one mesad of each of the fourth and fifth groups of plates.

Dorsal pores in three longitudinal rows, the row immediately laterad of the level of the circumgenital pores of some 7-9 pores, and not reaching to the margin of the pygidium. A few, small, ventral pores. Anus circular, situated at the level of the caudo-lateral groups of circumgenital pores.

Circumgenital pores in 5 compact groups. Pores numerous; approximately 33 (49 and 52) (42 and 45).

Hab.—New Guinea; on stems of Sugar-cane.

The specific name has reference to the size of the female scale.

Note by E. Jarvis.—Whilst inspecting sugar-cane procured from New Guinea, I noticed several sticks infested with a scale-insect, and forwarded specimens of them to the Botanic Gardens, Ceylon, for determination. The coccid was examined by the late Dr. A. Rutherford, who referred it to the genus *Aulacaspis*, and, believing it to be a new species, named it *A. major*. In a letter enclosing the description given above, Dr. Rutherford said:—"I think there can be no doubt that the insect falls in the genus *Aulacaspis*. It does not agree with any species known to me. Perhaps it might be described under the genus *Chionaspis*, though it would not fall into that genus as at present understood, Froggatt, in his review of the Australian Coccidæ (Agric. Gazette N. S. Wales) refers to two species only of *Aulacaspis*, viz., *A. pentagona* Targ., and *A. roseæ* Bouché. Yours is neither of these. Quite possibly it is a new species. I append a technical description, which you are quite at liberty to publish."

ORDINARY MONTHLY MEETING.

June 28th, 1916.

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

The Donations and Exchanges received since the previous Monthly Meeting (31st May, 1916), amounting to 15 Vols., 112 Parts or Nos., 61 Bulletins, 2 Reports, and 8 Pamphlets, received from 47 Societies, etc., and one private donor, were laid upon the table.

NOTES AND EXHIBITS.

Mr. T. Steel exhibited the femur of an ox showing natural knitting of a very severe sliding fracture, the reunited bone being much shortened and thickened by deposit of fresh bone.

Mr. Fred Turner exhibited the following indigenous grasses, being portion of a remarkably fine collection made on Kilmorey Station, Maranoa district, Queensland, by Mr. J. B. Thomson, who forwarded them to Messrs. Anderson & Company, Seedsmen and Plant Merchants, Sydney, with a request that they should be sent to Mr. Turner for accurate botanical determination, and for reliable information as to their economic importance: *Andropogon erianthoides* F.v.M.; *A. intermedius* R.Br.; *A. sericeus* R Br.; *Anthistiria ciliata* Linn.; *Chloris divaricata* R.Br.; *Eriochloa punctata* Hamilt.; *Panicum decompositum* R.Br.; *P. divaricatissimum* R.Br.; *P. flavidum* Retz.: *P. leucophæum* H.B. et K.; *P. trachyrhachis* Benth.; *Pappophorum nigricans* R.Br.; *Perotis rara* R.Br.; *Setaria glauca* Beauv.; *Triraphis mollis* R.Br. Owing to the prolonged and disastrous drought in the northern State, the country where the grasses had been collected was absolutely destitute of pasture-herbage for months until the bountiful rainfall of December last. Since the beginning of this year, the country has made wonderful recovery, and grasses and herbage are now abundant, giving a verdant appearance to immense tracts of country. The grasses exhibited were an excellent illustration of the remarkable recuperative properties of the herbage composing Australian pastures. No other vegetation, of an equal economic value, in the world could have recovered in a shorter space of time than those indigenous grasses. Mr. Turner also showed 18 photographs, taken last month by Mr. Thomson on different parts of Kilmorey Station, showing the luxuriant grasses and forage plants now growing there.

Mr. A. A. Hamilton exhibited specimens from the National Herbarium, and contributed notes thereon, comprising a series of examples of the fruits of *Angophora cordifolia* Cav., Killara (A. A. Hamilton; December, 1915), showing divergence in shape and size, apical and basal, together with variation in the degree of pilosity and calyceal ribbing. The capsules range from quadrangular to orbicular at the apex, and from broadly turbinate to attenuate at the base, the vestiture of the fruit-calyces varying from smooth to hispid, or rough and bristly. The rim of the capsule is seen, in some examples, to be more or less deeply sunk; in another group it is parallel to the border of the calyx-tube; while a further series shows a broad, conspicuous rim, recurved and folded outwards, overlapping the sides of the calyx-tube. The primary ribs of the fruit-calyx are 4 or 5 in number, in conformity with the angularity or degree of rotundity of the fruit, and they exhibit a marked variation in the measure of prominence attained. A range of dimension from 1-2 cm. in diameter occurs at the apex of the fruit, with a similar variation in length from apex to base. The pedicels vary in length from 1-3½ cm.; they are stout, slender, terete, angular, or more or less dilated. The series was gathered from a clump of apparently healthy plants growing in a sheltered position on a rocky (sandstone) hill-side, under normal conditions (as far as could be ascertained).—*Lambertia formosa* Sm., Leura (A. A. Hamilton; November, 1915), showing variation in the fruit-appendages. The follicles vary from 1-1½ cm. in length, with a similar range in breadth; the horn on the dorsal margin varies from broadly obtuse and 3 mm. long, to narrow-linear and 2 cm. long, straight or curved; that on the upper angle of the valve is from barely produced to 5 mm. long. Both young and old fruits were exhibited for comparison.—*Siebera Stephensoni* Benth., La Perouse (A. A. Hamilton; January, 1916), showing aphylly due to environment. The specimens exhibited were taken from a shrub about 1 m. high, which had shed its leaves to within some 15 cm. of the tips of the flowering branches. The shrub was growing on flat, rocky country, subject to direct insolation, and it also suffered from the effects of bad drainage.

Mr. E. Cheel exhibited fresh flowering specimens, together with coloured drawings of *Callistemon*, raised from seed received from a European firm of seedsmen, under the name of *C. lanceolatus* var. *lilacina*. From the same batch of seedlings, the plants show two distinct shades of colour. (*a*) Filaments deep carmine-violet to reddish-violet or pure mauve, anthers light reddish-brown. (*b*) Filaments reddish-purple, anthers a shade darker than the filaments. The general habit of the plants, and the shading of the colours seem to indicate that they are intermediate forms between *C. rugulosus* DC., (*C. coccineus* F.v.M.) and *C. lanceolatus* DC., both of which are frequently cultivated in Europe, the former having prawn-reddish filaments, and yellowish anthers, and the latter reddish-purple filaments and anthers. *C. rugulosus* is common in the interior of this State, and South Australia, but rare in the Sydney district (*vide* Proc. Linn. Soc. N.S. Wales 1903, xxviii., p.884); and *C. lanceolatus* is very common along the coastal districts of this State. He showed also a branch from another plant of the same batch of seedlings, having solitary flowers in the axils of the leaves, an extreme departure from the normal, dense, cylindrical spike usually seen in this genus.

Mr. North, with the sanction of the Curator of the Australian Museum, exhibited four specimens of the Regent Bower-bird (*Sericulus melinus*), showing the various stages of the young male, from youth to maturity. The young male, as is so frequently the case in birds, closely resembles the adult female. One received in the flesh from the Council of the Royal Zoological Society of New South Wales on the 30th May, 1916, which the Director, Mr. A. S. Le Souëf reported as received from

Brisbane in October, 1913, among others, had lived in the aviary ever since—a period of two years and seven months, or thereabouts—precise date not given. This specimen exhibits the first indications of its approach towards maturity, having the feathers of the nape and hind-neck distinctly shaded with yellow on the apical portions, and around the tip with black; a few feathers on the centre of the throat also being black. A further advance towards maturity is shown in a specimen presented by Mr. J. T. Cockerell, and procured by him at Lismore, Richmond River, N.S.W., on the 2nd August, 1899, which has the general plumage black; the base of the forehead, a patch of feathers on the hind-neck, some on the centre of the nape, and the central portion of the secondaries and innermost primaries orange-yellow, the patch of feathers on the hind-neck having blackish tips. The only trace of the plumage of the adult female is exhibited in the feathers of the centre of the breast, the abdomen and the under wing, and under tail-coverts. A still closer approach to the fully adult plumage, in the amount of orange-yellow on the top of the head, centre of nape and hind-neck, is seen in a third specimen, collected by Mr. Robert Grant in November, 1895, in the Bellingen district, further indications of the adult female also being exhibited in the lesser and median upper wing-coverts, and the feathers of the lower back and rump. The fourth specimen, a fine, old, fully adult male, with its rich and strikingly contrasted velvety-black and orange-yellow plumage, was procured by Mr. J. Beveridge on the Richmond River, and was received from him in December, 1886. It will be noted that the fully adult, male plumage of the Regent Bower-bird is first assumed, not by a moult, but by a gradual change in the colour of the feathers.

The Secretary called attention to a very interesting portrait of the late Sir Richard Owen, for many years an Honorary Member of the Society, kindly presented by Mr. C. Hedley, on behalf of Mr. G. F. Bennett, of Brisbane, whose father, the late Dr. George Bennett, of Sydney, received the original portrait from his friend, Sir Richard, many years ago.

STUDIES IN AUSTRALIAN NEUROPTERA.

No.3. The Wing-venation of the *Chrysopidæ*.

By R. J. Tillyard, M.A., B.Sc., F.L.S., F.E.S., Linnean Macleay Fellow of the Society in Zoology.

[Plates x., x. *bis* (Transparency), xi.; and eight Text-figures.]

Next to the *Myrmeleontidæ*, whose wing-venation I have dealt with in No.1 of this series of Studies,* the most striking and dominant group of Planipennia is undoubtedly the family *Chrysopidæ*. The type-genus *Chrysopa* is represented by a large number of species throughout all parts of the world, which are known to English-speaking naturalists as "Green Lacewings," "Golden Eyes," or "Stink-flies"—the last name on account of the abominable odour which a number of the species give out. These numerous species are all very closely related, and are often only to be distinguished by small but constant differences in the wing-venation. Thus, on the one hand, the genus *Chrysopa* has all the marks of being a fairly recent, highly specialised, and dominant genus (and hence one in which specialisations in the wing-venation might reasonably be looked for); while, on the other hand, the very importance of the venation in the study of the genus demands that slipshod and haphazard ideas of the wing-structure ought to cease, and give place to a system based on sound homologies.

Those workers who have been busy during the last ten years or so, adding numerous species of *Chrysopidæ* to the list, all appear to have been content to regard the wing-venation in this family as easy of interpretation along typical Neuropterous lines, *i.e.*, they recognised, without any questioning, a radial sector with a number of branches, two series of gradate veins, a straight

* These Proceedings, 1915, xl., Part 4, pp.734-752.

unbranched media, a forked cubitus, and two or three short anal veins. Right through the family there is so little variation, except in minor details, that the limits of these veins, having been assigned without any sufficient reason to one species, soon became applied equally readily to all. From one point of view, it may be argued that it did not matter that the determinations of the venation were wrong, since they were all *consistently* wrong, and so the numerous descriptions of new species all conform to a single plan, and are easy to follow.

Why is it necessary to disturb them? The answer is a very obvious one. It is not only that false homologies are not to be tolerated by anyone with the true scientific spirit, but also that they actually seldom work well in practice. It is only by pure chance that some genus of *Chrysopidæ* has not turned up which would not have fitted in with the accepted venational plan, and would thus have started a series of evasions and explanations, on whose heels confusion might have followed fast. More than that, again, we can never hope to understand the phylogeny of such a group as the *Chrysopidæ*, unless we really understand its wing-structure, and its relationship to the general venational plan in the Neuroptera Planipennia.

The present paper was undertaken in the strong belief that the accepted venational scheme for the *Chrysopidæ* was wrong in certain particulars. I was not prepared to admit (after my experience in the *Myrmeleontidæ*) that the media, in the forewing at any rate, was an unbranched vein. I could not find any satisfactory explanation of the persistence of the peculiar "divisory veinlet" in the forewing (Text-fig.4, *dv*), since it is obviously not in a position of maximum effect as a support to any main vein. It seemed to me that this veinlet must be some remnant of the lost lower branch of the media, and its absence in the hindwing further strengthened this belief. Finally, I realised that the connection between the venational plans of the *Chrysopidæ* and *Apochrysidæ* was still entirely missing, and that we could never hope to offer any adequate phylogeny of the *Chrysopidæ* until this was cleared up. Such beliefs and suspicions as these determined me to undertake a study of the pupal wing-tracheation at the earliest favourable moment. The chance occurred during my recent visit to South Queensland. *Chrysopidæ* were quite common, and it was easy to obtain, not only larvæ from citrus trees and various conifers, but also eggs in great abundance from mature females confined in pill-boxes. On my return to Sydney at the end of October last, I brought with me a number of eggs and larvæ. I also arranged with various correspondents to keep up the supply by post. In this connection, I desire to thank Miss C. Jensen, of Caboolture, Queensland, and Mr. Luke Gallard, of Epping, near Sydney, for maintaining a plentiful supply of larvæ throughout an exceptionally dry period of the year, during which the scarcity of aphides made the rearing of these little creatures a very difficult matter.

Most of the Australian species of *Chrysopidæ* are not named. I had four species to work on, three belonging to the genus *Chrysopa*, and one to *Nothochrysa*. This last was of large size, and promised fine results. Unfortunately, of all the pupæ obtained (mostly from Mr. Gallard), not a single one was suitable for the work. About sixty per cent. of them were ichneumoned; the remainder were far too advanced towards the imaginal instar to be of any value. The next most promising was a moderately large species of *Chrysopa*, not uncommon both in Brisbane and Sydney, which I shall designate *Chrysopa* A, for the purposes of this paper. Two broods of this species were reared from eggs laid in Brisbane. But owing to the extreme drought, I failed to find enough aphis to keep them alive, and only three pupated. From one of these, the photomicrograph in Plate xi., fig.3, was obtained.

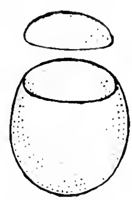
An exceedingly small species, *Chrysopa* B, pupated in numbers. But the cocoons were so small (diameter 1·4 mm.), and the pupæ so delicate, that only moderate results were obtained with them. These results helped materially in the successful solution of the problem in hand, but none of the photographs taken were good enough to publish.

Finally, I had a large supply of larvæ and pupæ of a common species whose larva is found in all citrus-orchards around Sydney, as well as on rose-bushes. The cocoons were smaller than I could have wished, and the pupæ delicate enough to give me much trouble and many failures before good results could be obtained. But I was able to breed a number out, so as to obtain an imaginal venation-scheme *exactly* corresponding with the pupal wing-tracheation studied; this was, indeed, an essential condition for a successful result. This species proved to be one which had previously been determined for me by Mr. Esben Petersen as *C. signata* Walker. It turned out, therefore, very fortunately, that I am able, after the comparative failure of the work done on the unnamed species, to offer a result based in almost every detail of completeness upon the venation of a single, common, named species.

Methods of Study.

The problem was first attacked along the exact lines already laid down for the study of the tracheation of the pupal wing in the *Myrmeleontidæ*. First of all, the exact date of the spinning-up of each larva was recorded, and the cocoons arranged according to date. Here, at the very start, an attempt to use the knowledge gained in the case of the *Myrmeleontidæ* led to disaster. It will be recalled that the Ant-lion larva does not pupate at once after spinning its cocoon, but remains quiescent within it for seven or eight days. I therefore kept a number of cocoons of the large *Nothochrysa* for several days, examining them carefully in a strong light each day. After four or five days (by which time the cocoons must have been seven or eight days old, since they had spun up before Mr. Gallard posted them to me), the contents began to darken in colour. The larva being covered with a white powdery bloom, I concluded that pupation had taken place. This was, alas, not the case: the darkening was due, not to the pupation of the larva, but to the pupation of half-a-dozen or more ichneumon-grubs within it. Thus several valuable days were lost: so that, when at last a cocoon was opened which revealed a Chrysopid pupa, it was much too far advanced towards the imaginal stage to be of any use. In this way the most promising cocoons (*i.e.*, the largest) were all wasted.

By this time both *Chrysopa* A and *Chrysopa* B were spinning up, so I turned my attention to the larger of the two (A). Here an additional difficulty presented itself in the smallness and greater delicacy of the cocoon, and the activity of the pupa within it. The cocoon could not be cut open with fine scissors, owing to the fact that the pupa would keep wriggling round so as to face the cut, and thus sooner or later the delicate wing-cases became damaged, either by pressure or by the lower point of the scissors. I next tried to open a cocoon by means of a fine sharp needle, and was delighted to find that this could be done without damaging the wings of the pupa, if certain rules were adhered to. Firstly, owing to the method of spinning the cocoon, it appeared that the silken envelope does not tear unevenly in all directions, but can be made to split exactly along any parallel of latitude (taking the ends of the longest axis as the poles) if the point of the needle is exerted in that direction. Secondly, if the point selected to start on is at about the level of the lid of the cocoon when opened by the pupa itself naturally, the split comes very readily, and the point of the needle is not likely to touch the wings of the wrigglesome pupa. This position is about the same as that selected when "topping" a boiled egg at breakfast, and is shown in Text-fig. 1.



Text-fig. 1.

Having solved the problem of how to open the cocoon without damaging the pupal wings, the next difficulty was to extract the pupa, which, as soon as the lid of the cocoon was lifted, became very active, and kept wriggling round from side to side, so as always to face the point of the needle. I found the best plan was to continue the cut until the lid could be either taken completely off, or turned over backwards, so as to expose the head of the pupa. If now the pupa, as it generally did, resolutely re-

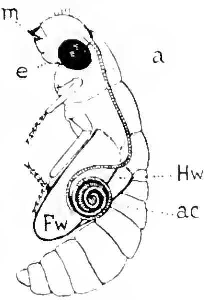
* Cocoon of *Chrysopa signata* Walk., correctly opened; (6).

fused to leave the cocoon, I took a pair of fine forceps, seized it quickly just below each projecting eye, and so lifted it out bodily. This operation may flatten one or both eyes, but it will not damage the wings.

Pupæ of *Chrysopa* A were extracted from cocoons seven or eight days old. The wings were pale whitish, and appeared at the first glance to be in every way suited for my purpose. But, under a lens, it was seen that the imaginal wings were, in nearly all cases, strongly rucked or crumpled within the wing-sheath, so that the tracheation could not be properly followed out. Hence the whole of this batch of valuable larvæ and pupæ had to be sacrificed, in order to discover, firstly, how long the larva remained in the cocoon before pupating, and secondly, how long it was before rucking of the imaginal wing in the pupal wing-sheath began to occur. In the course of these trials, I was fortunate in obtaining a photograph of the hindwing of a pupa of this species which I determined as being nearly three days old (the cocoon was over six days old, and the average duration of larval life, before pupation occurred, had been determined as three and a half days in the case of this species). In this photograph the rucking had just begun (Plate xi., fig.3), and this condition helped to elucidate a knotty question of venation, as I have explained below on p.240.

By this time I had hopes that my difficulties were at an end, as I now had left over only material of the two smallest species, *Chrysopa* B and *C. signata*. The larvæ of *Chrysopa* B fed up at a great rate, and spun up well ahead of those of *C. signata*, although most of the eggs of both species hatched at about the same time. The weather was very hot and dry, and this may have been one cause of their activity. One larva actually spun its cocoon on the *eighth* day after hatching from the egg, and emerged as an imago six days later! I found the cocoons and pupæ of *Chrysopa* B most difficult to handle, since they were so small and delicate. However, one was extracted just after the act of pupation (the larval skin being even not fully cast off). This was killed by being dropped into a tube of water, in which a drop of chloroform had been shaken up, and was then placed on a slide on its side, so that its wings could be examined.

A further crop of new difficulties now arose. The hindwing could not be examined because the forewing covered it almost completely, lying obliquely across it; while the forewing in its turn was partly covered by the large spiral coil of the immensely long antenna, which was pressed down flat upon it. (see Text-fig. 2). Moreover, both antenna and wings were sticky, and could not be persuaded to separate, except by inserting the point of a needle between them — a proceeding which seemed bound to cause some dislocation of the delicate tracheal plan. After this separation had been effected, the long antenna was cut off close to the base, and removed. The two wings were then dissected away with fine scissors, and floated off on to a glass slide. They were then examined under a low power, when it was seen that considerable displacement of the tracheation had taken place. Enough of the main plan, however, could be made out to show how remarkably specialised it was, and how important it would be to obtain an absolutely perfect record of it.



Text-fig. 2.*

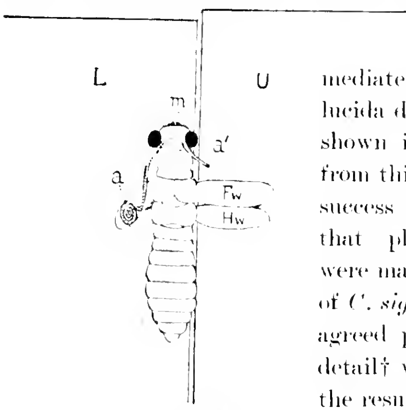
By this time I was reduced to a single source of supply, viz. *Chrysopa signata*. Fortunately my own larvæ were supplemented by two batches of larvæ received from Mr. Gallard, so that, in all, I still had some two dozen larvæ available. These began to spin up about the middle of November, and had all completed their cocoons within a few days of one another. After waiting three days, I opened two cocoons, and found that they still contained larvæ. These cocoons were closed up again, the lids being held in place by cotton-wool. The following day, one of the larvæ pupated. This pupa was taken when less than one day

* Pupa of *Chrysopa signata* Walk., after extraction from cocoon; (×9). *a*, antenna; *ac*, its spiral coil adhering to the forewing; *e*, eye; *Fw*, forewing; *Hw*, hindwing; *m*, pupal mandibles.

old, and was treated as explained for the pupa of *Chrysopa* B above. The dissection was carried out with the greatest care. But though there was scarcely any displacement of the tracheation, it was found that a certain amount of blood-plasma, and some fatty tissue, had found their way into the bases of the wings, rendering them too opaque for observation.

Further pupæ were now taken, all about one day old, since it appeared that only on the first day or two were the wings free from rucking within the wing-sheath. The wings were carefully dissected off, but in no case could I obtain a satisfactory result. The wing-sheaths were so delicate that the use of a cover-slip completely upset the tracheation; also it seemed quite hopeless to use the scissors wlthout causing some alteration in the positions of the main tracheal stems.

I now tried the following plan, which I am glad to say proved entirely successful, and enabled me to obtain the results shown in this paper. Having determined that the tracheation must be studied without the use of any dissecting methods, I took a pupa of *C. signata* about one day old, and killed it in the usual manner. I then took two glass slides, and moistened them so as to make them cling firmly together. The upper slide was selected so as to be as near as possible of a thickness equal to the height of the pupal thorax up to the wing-base. This slide was then slipped back along the lower one, so as to leave nearly an inch of the latter exposed. I then took hold of the pupa by the legs with a fine forceps, cut off and removed the right antenna, and carefully separated the two wings on the right side, with the point of a fine needle. (The mark made by the needle can be seen as an oblique depression running in from near the middle of the posterior border of the hindwing in Plate xi., fig.1). The pupa was then placed carefully down, dorsum upwards, on the free portion of the lower slide, the right pair of wings being raised up so as to project at right angles to the body-axis, supported upon the upper slide. The pupa and its wings were kept thoroughly wet with water during this operation. Finally, the body of the pupa was gently pressed until it came to lie close up to and parallel with the free edge of the upper slide, so that the whole of the two wings lay flatly out over this slide (Text-fig.3). No cover-slip was used. (This same operation was afterwards performed on other pupæ, with the addition of a cover-slip let down gently upon the wings; but this was found to cause displacement of some of the tracheæ). The wings were then photographed by means of Reichert's photo-micrographic apparatus, and the results obtained which are shown in Plate xi., figs.1-2. Immediately afterwards, the camera-lucida drawing of the tracheation, shown in Text-fig.5, was obtained from this same pupa. Thus at last success was obtained. I may add that photographs and drawings were made from several other pupæ of *C. signata*, and that all of these agreed practically in every single detail† with the one figured. Thus the results do not rest upon a single observation, but are based upon a considerable mass of evidence.



Text-fig.3.*

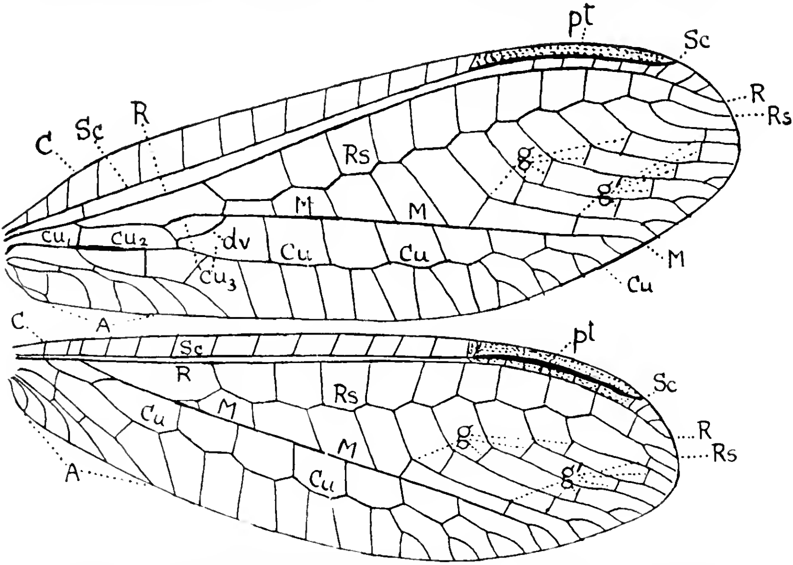
Critical Study of the Wing-Venation of Chrysopa signata Walker.

We can now pass to the study of the tracheation of the pupal wing, with a view to elucidating the venation of the imaginal wing. This latter is shown in Text-fig.4 (p.230), with the usually accepted nomenclature of the veins, according to the Comstock-Needham notation. This nomenclature has been employed by Banks, Petersen, Navás, and other systematists for the past ten years or more. As far as I can gather, nobody has yet doubted

* Diagram to show method of studying the pupal wings of *Chrysopa*; (×8): *a*, coil of left antenna; *a′*, cut end of right antenna; *Fw*, forewing; *Hw*, hindwing; *L*, lower glass slide; *m*, pupal mandibles; *U*, upper glass slide.

† In some specimens, there may be a small fork at the extreme tip of Rs or S_2.

its general accuracy. Petersen, however, has recently stated to me (in litt.) his conviction that the venation of the *Chrysopidæ* is "the most abnormal of all the families"—a statement which certainly implies a strong suspicion that this venation is not quite as simple as the accepted scheme would make it appear to be.



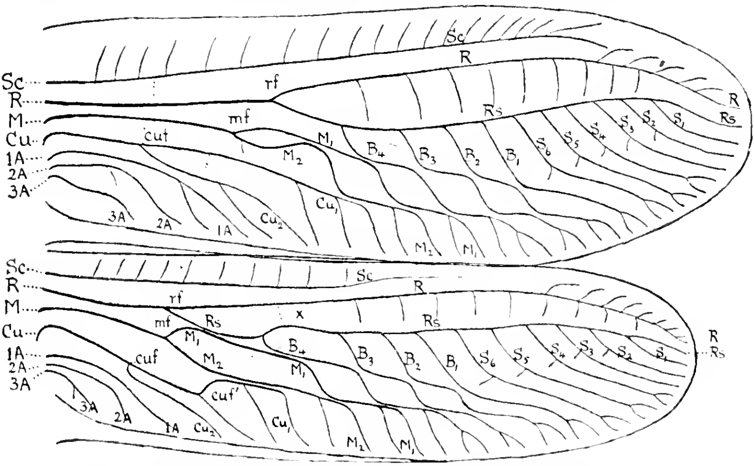
Text-fig.4.—Wings of *Chrysopa signata* Walk.; imago, (× 9), with the generally accepted notation: cu_1-cu_3, the three "cubital cells" of Banks; *dv*, "divisory veinlet" of Banks; *g*, inner, and *g'* outer series of gradate veins; *pt*, pterostigma. Other letters as usual in the Comstock-Needham notation.

The most striking feature of the Chrysopid wing, if we accept the usual notation (Text-fig.4) is the fact that it is divided longitudinally by a remarkably strong, straight, median vein (M), terminating on the posterior border, below the level of the pterostigma, some distance before the apex. In the hindwing, this vein leaves the radius (R) close to the base, and runs absolutely straight through the wing. In the forewing, however, it shows a slight kink not far from its origin, at a point where an oblique cross-vein descends to Cu. The curved portion of the vein M hereabouts is supported underneath by a small vein placed concavely to it, arising from the cross-vein, and curving up to join the media itself at or near the foot of the first cross-vein descending from the radial sector (Rs). This small concave vein has been termed the *divisory veinlet* (dv) by Banks, as it is supposed to divide the complete "third cubital cell" (cu_3) into two unequal parts. The exact shape and position of this divisory veinlet have been used by Banks with considerable success in diagnosing the differences between numerous closely related species. The two undivided cells lying between M and Cu proximad to the "kink" are termed by Banks the *first* and *second cubital cells* respectively (cu_1, cu_2). As it is usual, in the Comstock-Needham terminology, to name the basal spaces after the main veins bounding them *above*, and not below, it would have been more consistent to have termed these three cells the "median cells," reserving the term "cubital cells" for those in the row below them.

The *gradate veins* (g, g') are very constant in position in the *Chrysopidæ*, forming two series of cross-veins rising, as it were, in a series of steps from the media upwards through the parallel branches of the radial sector. Often, as in the species under discussion, the *inner* series of gradate veins (g) is one less in number than the *outer* series (g'): sometimes the inner series is much reduced in number.

The form of the *pterostigma* (*pt*) varies greatly in the different species, and is never of more than specific value. In *C. signata*, there is a distinct greenish pterostigma on both wings. That of the forewing is confined between C and Sc, and supported beneath by six cross-veins between Sc and R. In the hindwing it is denser, and is continued into the space between Sc and R. The cross-veins in this space are, however, present, though not easy to see.

The result of a study of the pupal wing-tracheation (Text-fig. 5) shows us that the accepted interpretation of the imaginal venation is quite incorrect as regards the media and cubitus of both wings, and also as regards the origin of the radial sector in the hindwing. The supposed media and cubitus prove to be two excessively complex veins peculiar to the *Chrysopidæ*. The original media and cubitus of this extraordinary wing-venation have become reduced and contorted, so that their courses could not even be guessed at without reference to the pupal tracheation. The two new complex veins do indeed more or less fill



Text-fig.5.—Tracheation of wings of pupa of *C. signata* Walk., (× 54). For lettering, see Explanation of Plate x. (Camera-lucida drawing from freshly-killed pupa).

the places usually occupied by the media and cubitus in unspecialised Neuropterous wings. Therefore, as it is quite impossible to give to these veins the complex names that would indicate their true nature, I propose to name them at once the *pseudo-media* and the *pseudo-cubitus* respectively, in order to facilitate discussion, and to distinguish them clearly from the true media and cubitus. I suggest also the notation M′ for the pseudo-media, and Cu′ for the pseudo-cubitus, as shown in Plate x.

In order to trace the courses of the true media and cubitus, and to understand how the pseudo-media and pseudo-cubitus have supplanted them in the Chrysopid wing, let us turn now to the study of the pupal tracheation, as shown in Text-fig.5 and in Plate xi., figs.1-2. As a further aid to this study, I have given the correct interpretation of the imaginal wing-venation in Plate x., overlaid in red, on transparent paper, by a diagrammatic representation of the pupal tracheation, to show the part played by each trachea in the formation of the veins. We shall divide our study up into three parts, viz., (1) the radial sector and its branches, (2) the true media, and (3) the true cubitus. Having traced these out, we can then visualise the extraordinary structure of the pseudo-media and pseudo-cubitus.

(1) *The Radial Sector* (Rs) *and its Branches.*—The radial sector (Rs) arises from R, in the forewing, at a considerable distance from the wing-base, at a point called the *radial fork* (*rf*). Pupal tracheation and imaginal venation agree on this point. In the hindwing, however, the supposed origin of Rs in the imaginal venation (the point *x*) is seen by reference to the pupal tracheation to be a false origin, and really represents the origin of the first cross-vein between R and Rs. The true origin lies much closer to the base, at the point marked *rf*, which has up till now been taken as the origin of M.

In both wings, if we look at the tracheation, Rs gives off *ten* posterior branches. These I have named S_1, S_2 . . . S_{10} for convenience of reference (instead of the more cumbrous Rs_a, Rs_b, etc.), S_1 being the most distally placed. Turning to the imaginal venation, we see that only *six* branches of Rs are visible, viz., S_1 to S_6. What has happened to the other four, viz., S_7 to S_{10}? The answer is supplied by a glance at Text-fig.5, followed by a reference to the transparency overlying Plate x. These four branches are, in fact, *bent in their middle portions so as to run longitudinally*, and thus give rise to a continuous *Banksian Line*, homologous with that already shown to exist in a number of Myrmeleontid genera.* For this reason, I propose to call these four branches the four *Banksian sectors*, B_1 to B_4. Thus

* See No.1 of these Studies, in these Proceedings, 1915, pp.734-752, Vol. xl., Part 4. Navás has termed this line in *Myrmeleontidae* the "linea plicata," a singularly inappropriate term, it seems to me, for a formation which, though of composite origin, is in its highest expression an absolutely straight line without any folding in its composition.

$B_1 = S_7$, $B_2 = S_8$, $B_3 = S_9$, and $B_4 = S_{10}$. It will be seen at once that the Banksian Line formed by the middle longitudinal portion of these four sectors is the *distal portion of the pseudo media.*

The importance of these four Banksian sectors does not, however, end here. Three of them, viz., B_2 to B_4, after dropping below the level of the pseudo-media, again become bent longitudinally *to form a second Banksian Line.* This is clearly seen to be the *distal portion of the pseudo-cubitus.*

(2) *The true Media* (M).—In the tracheation, the stem of M is distinct from R; in the venation, the two are fused basally for a short distance. The true media then diverges slightly from R, and runs to a point called the *median fork* (*mf*), lying immediately below the radial fork in the hindwing, but a little proximad to it in the forewing. From here onwards, the course of M in the venation is so disguised that it is necessary to turn to the tracheation for elucidation. Then we see at once that M has two branches, M_1 and M_2, arising at *mf*—a fact which could never have been proved from the imaginal venation alone. The problem is also complicated by the very different behaviour of these two branches in fore and hindwing respectively; so that it will be necessary to trace them out in each wing separately.

In the forewing, M_1 on leaving *mf* arches slightly upward, but does not come into contact with Rs, from which it remains separated by a full cell's width. It then runs longitudinally towards the down-curving portion of B_4, and passes close under the sector for a short distance, before it (M_1) turns downwards in a second bend. It then turns to run longitudinally again for a second short distance, and again approaches and runs alongside B_4 Finally, it breaks up into two small branches descending to the wing-border. Thus we see that M_1 performs the part of another Banksian sector, and helps in turn to form both the pseudo-media and the pseudo-cubitus.

The lower branch, M_2, on leaving *mf*, runs concavely to M_1, and then approaches it again, so as to isolate between M_1 and itself a small oval area, which can be recognised at once in the imaginal venation as the cell lying just above the "divisory veinlet"—the latter, of course, being a portion of M_2 itself. After running close below M_1 for a short distance, M_2 drops down to the level of the pseudo-cubitus, and plays a part, in helping to form that vein, exactly similar to the part played by M_1. Finally, it branches into two, and drops to the wing-border.

It will be seen that, owing to the fact that M_1 and M_2 in the forewing twice recede from and approach towards one another, two curved areas are isolated off between them. In the imaginal venation, owing to the fusion of M_1 with M_2 for about half a cell's-length along the pseudo-media, these two cells are widely separated. The first is the small cell above the "divisory veinlet"; the second is the large hexagonal cell lying next distad from the so-called third cubital-cell of Banks (cu_3 in Text-fig.4). These two cells being enclosed by both branches of the true media, I propose to name them the *first* and *second intra-median cells* respectively, with the notation im_1, im_2, so as to distinguish them clearly from the three *median cells*, m_1, m_2, and m_3, which are of course the "cubital-cells" of Banks. As regards the term "divisory veinlet," this is obviously a most misleading and inaccurate term, since it is, firstly, not a veinlet at all, but a portion of the main vein M_2, and, secondly, it does not divide anything, since the true third median cell ("third cubital" of Banks) lies entirely outside it. I propose, therefore, to term this small portion of M_2 the *median loop*, with the notation *ml*. It should not be lost sight of, also, that the upper part of the cross-vein from which *ml* appears to arise is also a portion of M_2, and is therefore *analogous* with the upper part of the well-known formation in the Dragonfly wing, called the arculus. It is not homologous with it, however, since in the Dragonfly wing it is the main stem of M which drops from R to form the arculus, whereas in the present case it is M_2 dropping from M at *mf*. The term *median arculus* (*ma*) is suggested as a suitable name for this formation.

In the hindwing, the behaviour of the true media is different. The main stem M is very short, so that the median fork *mf* comes directly under the radial fork *rf*, not far from the base of the wing. Thus M_1, on arching up from *mf*, comes at once close up under Rs. There follows an extraordinary adaptation on the part of this latter trachea and its most proximal branch B_4. By means of an upward curving of Rs below *x*, and a bending of B_4 convexly to M_1, the triangular area between the three tracheæ Rs, M_1, and B_4 is reduced to a minimum. This area is represented in the imaginal venation by the minute triangle *t*. Several consequences arise at once from this, which can be best noticed by comparing the venation of the hindwing with that of the forewing. Firstly, the portion of B_4 descending from Rs is almost completely obliterated. Consequently, the place of B_4 in bounding the cell marked *b* is taken by the obliquely ascending portion of Rs, which meets the cross-vein below *x*. As a further consequence of this arrangement, the cross-vein from *x* appears to be the real basal part of Rs, and *x* appears to be the radial fork. It is, indeed, no slur on the intelligence of all those who have hitherto worked on this family, that they assumed this to be so without any doubt; for who could possibly have supposed otherwise, unless he had the pupal tracheation before him as convincing proof? A second consequence to be noted is that the true basal portion of Rs, being fused with M_1 for almost its whole length, takes on the appearance of being actually the stem of the media; and this appearance is even more definite when we note how closely the true stem of the media in the forewing resembles this. Thirdly, M_1 itself, being fused with Rs for such a great part of its length, becomes quite lost in the imaginal venation, except indeed for the small vein ascending from *mf* to Rs, which is, of course, its extreme basal portion. Fourthly, the true main stem of the media in the hindwing (as will be more fully seen below) comes into line with the pseudo-cubitus, and forms the basal portion of that extraordinarily complex vein.

The course of M_1 in the hindwing, after it leaves B_4, is similar to that in the forewing, and need not be further discussed. M_2, however, from its origin at *mf*, follows a considerably simpler course than it does in the forewing. There is no median arculus, and no median loop. Indeed, M_2 simply runs parallel to and below M_1 for a considerable distance, finally meeting M_1 where it drops upon the pseudo-cubitus, and dividing to send two branches to the wing-border. Thus, instead of two isolated separate cells being enclosed between M_1 and M_2, as in the forewing, only one elongated cell lies between them. In the imaginal venation, this long cell is divided across the middle by a cross-vein. The two portions may be called the *first* and *second intra-median cells*, with the notation im_1 and im_2, as in the forewing. It will be noticed that M_2 in the hindwing forms about twice as large a portion of the pseudo-cubitus as it does in the forewing.

(3) *The true Cubitus* (Cu).—The course of this trachea, and of the resulting veins in the imaginal wing, is so different in fore and hindwings that these must be dealt with separately. In the forewing, trachea Cu bends sharply up towards M, quite close to the base. It then runs almost straight to the cubital fork, *cuf*, which lies at a level half way between the base and *mf*. From *cuf*, Cu_1 runs almost straight on until it meets M_2 dropping on to the pseudo-cubitus; it then gives off two descending branches, and finally drops to the wing-border. In the venation, the basal approach towards M becomes a fusion, the bend being excessive. Then follows a nearly straight portion, which expands laterally so as to appear almost like two veins running side by side for some distance from *cuf* (shown in Plate x., by a thickening of Cu_1). I do not know the reason for this, and have not been able to detect anything but the single trachea Cu_1 in this region of the pupal wing. The rest of the vein Cu_1 forms a portion of the pseudo-cubitus, together with the three transverse veins descending to the wing-border. Cu_2 diverges slightly from Cu_1, and runs in a gentle curve to the wing-border, ending up just before the most proximal branch of Cu_1. In the venation, two cross-veins connect it with Cu_1, and a short, strong cross-vein descends from it on to 1A, just distad from *cuf*.

In the hindwing, Cu is not fused basally with M. The main stem of Cu is shortened, so that *cuf* comes to lie very close to the base, at a level proximad to that of *mf*. From *cuf*, Cu_1 runs straight on until it gives off its most proximal branch, when it performs the extraordinary evolution of arching up to meet M_2, and so reaches the level of the pseudo-cubitus, of which it now forms a part. I have called the point where the arching begins the *second cubital fork* (*cuf''*). It is clear that we have in the hindwing a more specialised condition of Cu_1 than is shown in the forewing, and that it is correlated with what we may call the shifting of the levels of the basal portions of Rs and M downwards in this wing. In other words, the distal portion of Cu_1 still plays its part in helping to form the pseudo-cubitus, even though the basal part of that vein is no longer formed from Cu (as in the forewing), but from M. Finally, Cu_2 in the hindwing is a simple vein leaving Cu at *cuf*, and connected with 1A basally by a cross-vein. Its actual appearance is rather as if it belonged to 1A than to Cu.

Just as intra-median cells are formed between the two branches of M, so *intra-cubital* cells are formed between Cu_1 and Cu_2. There are three of these in the forewing, viz., icu_1, icu_2, icu_3, owing to the development of two cross-veins. In the hindwing, there is only one narrow undivided cell, *icu*. The *cubital cell* (*cu*) is simple, and lies between the main stems of Cu and 1A.

Having completed our study of the radial sector, the true media, and the true cubitus, we are now in a position to analyse the complex veins which I have called the pseudo-media and pseudo-cubitus respectively. These may be traced out with the aid of Plate x., and the overlying transparency.

The Pseudo-media (M').—In the forewing, this vein arises from R near the base. Up to *mf*, it is formed by M; beyond *mf*, it is formed by M_1 above im_1, then by M_1 and M_2 united for half a cell's length, then by M_1, B_4, B_3, B_2, and B_1 overlapping each other in turn, and finally by B_1 alone. This last vein forks just before reaching the wing-border. In the hindwing, the pseudo-media likewise arises from R close to the base, but it is formed first of all by Rs for a short distance, then by Rs and M_1 united, then by B_4 and M_1 united, then by B_4, B_3, B_2, and B_1 overlapping each other in turn, and finally by B_1 alone, with a distal forking as in the forewing.

The cells formed *above* the pseudo-media between the descending Banksian sectors are four in number in the forewing, three in the hind (omitting the minute triangle *t*, which is the remnant of the fourth). These may be termed the *upper series of Banksian cells* (*b*). The cells formed below the pseudo-media between these same sectors are four in number in each wing, and may be called the *lower series of Banksian cells* (*b'*). They lie distad from im_2.

The Pseudo-cubitus (Cu'). – In the forewing, this vein is formed basally by the main stem of Cu up to *cuf.* It is then continued by Cu_1, M_2, M_1, B_4, B_3, and B_2 overlapping each other in turn, and finally ends on B_2 alone, with a small distal forking. In the hindwing, the pseudo-cubitus arises from R, proximad to the origin of M'. It is formed basally by the main stem of M as far as *mf,* then by M_2 alone, then by M_2 and Cu_1 fused for two cells' length, then by M_2 alone again for a cell's length, then by M_2, M_1, B_4, B_3, and B_2 overlapping each other in turn, and finally by B_2 alone, with a distal forking as in the forewing. The cells between it and the posterior wing-border may be termed the *posterior series of cells* (*p*).

We are now able to realise how exceedingly complex these two apparently simple longitudinal veins really are, and how impossible it would be, by any protracted studies in the comparative venation of the imagines of the family and its allies, to arrive at the solution which was all the time ready to our hands, for anyone who cared to take the trouble to obtain the pupæ in the right stage. That solution shows us, indeed, that the wing-venation of the *Chrysopidæ* is not only, as Petersen suspected, "the most abnormal of all the families," but that it is indeed one of the most abnormal and highly specialised venations to be found within the Insecta. Judged from this standpoint, the *Chrysopidæ* stand far and away above all other Neuroptera in the effect and extent of their wing-specialisation.

One point remains to be mentioned in connection with the complex veins M' and Cu'. If we compare Text-fig.5 and Plate xi, figs.1-2, with the transparency overlying Plate x., we see that, in order to achieve the imaginal result, the *overlapping* of the Banksian sectors, one upon another, needs to be much greater than it is in the pupal wing. In fact, as seen in Text-fig.5, these do not overlap at all, but barely meet. How can we explain this? The answer is that the overlapping is not present in the freshly formed pupal wing, but is formed during the subsequent *rucking* of the wing, which begins on the second or third day of pupal life. In Plate xi., fig.3, I photographed the hindwing of a pupa of *Chrysopa* A, nearly three days old. Here the transverse rucking is plainly to be seen beginning, and the overlapping is already very considerable. In a pupa four or five days old, the rucks are so great that a photograph is useless. However, the final amount of overlapping is easily determined by working back from Rs at the apex of the wing, and counting the number of distal forks (*df*). Thus in both wings of *C. signata* there are no forks on S_1 to S_4; S_5 and S_6 are forked; B_1, B_2, and B_3 are similarly forked; B_4 has a branch as well as a small fork: M_1 and M_2 each send two veins to the border, and Cu_1 three. Counting backwards, therefore, these can all be correctly placed. As the positions of B_1 to B_4 on Rs are known also, it follows that the amount of overlapping of, say, B_3 on B_4, in order to carry each of these veins from its original level on Rs to its final level on the posterior wing-border, must be as shown in the transparency. The result might also have been deduced, with very little doubt, from a study of Plate xi., fig.3, alone.

The Formation of the Pterostigma.—This peculiar, thickened, green patch on the wing is not present in all species. Its formation is rather striking. Instead of running along under the pterostigma to form its base, as we might expect, Sc only penetrates a very short way from the proximal end of the patch. Beyond that, a series of small tracheæ arises from R, and their ends bend over so as to continue roughly the line which we should have expected Sc to follow. This accounts for the presence of the cross-veins between Sc and R in the imaginal venation. It also probably explains why the pterostigma descends to R in the hindwing, since there is no continuous trachea Sc interposed between R and the costal margin.

The Anal Veins.—In the pupal tracheation there are *three* distinct anal veins arising somewhat in a bunch below Cu. In the forewing, 1A is branched; likewise 2A, but the proximal branch descends upon 3A, and appears as a cross-vein in the imaginal venation; 3A is unbranched, but undergoes a double curvature which brings it into contact with the wing-border between the base and the anal angle. In the hindwing, the anal veins are smaller, and quite inconspicuous; 1A and 2A are simple; 3A is short, but sends a small branch to the wing-border above the anal angle. In both wings, 1A is connected with Cu_2 by a cross-vein close to its origin; in the forewing, in addition, a short cross-vein connects 1A with 2A.

It seems probable that very satisfactory, constant, specific characters could, in many cases, be obtained from comparative studies of the anal veins in closely allied species. But the differences in the regions of Rs, M', and Cu' are so numerous and striking that they should always be given preference over the differences in the anal region. The following appear to be the venational differences on which sound species of *Chrysopa* may be based.

(1) General shape of wing (breadth, acuteness or roundness of apex, etc.).

(2) Form of the costa and costal area, especially in forewing, where the costa is often arched upwards, as seen in *C. signata*. Number of costal cross-veins.

(3) Presence or absence of pterostigma; if present, its extent and density; also the number and position of the *hypostigmatic cross-veins* between Sc and R.

(4) Number of free sectors (*e.g.*, S_1 to S_6 in *C. signata*) and of fused or Banksian sectors (*e.g.*, B_1 to B_4 in *C. signata*) given off by Rs. Dependent upon this would be also the number of cells between R and Rs, and the number of upper Banksian cells (*b*).

(5) Number of gradate veins in both inner and outer series.

(6) Form of the median loop and arculus; position of distal end of *ml* upon M', in relation with the foot of the cross-vein depending from Rs.

(7) Number of closed cells beyond arculus, in space between M' and Cu' in forewing; number of same beyond *mf* in hindwing.

(8) Number of distal forks (*df*); number of simple posterior cells (*p*) before the first (most proximal) distal fork.

(9) Differences in the comparative lengths and widths of the three median cells (m_1, m_2, m_3) in the forewing. Amount of separation of im_1 from im_2.

(10) Differences in the form of the three intra-cubital cells (icu_1, icu_2, icu_3) in the forewing.

(11) Differences in the anal region; in particular, the curvature of 3A, and its relationship with the wing-border.

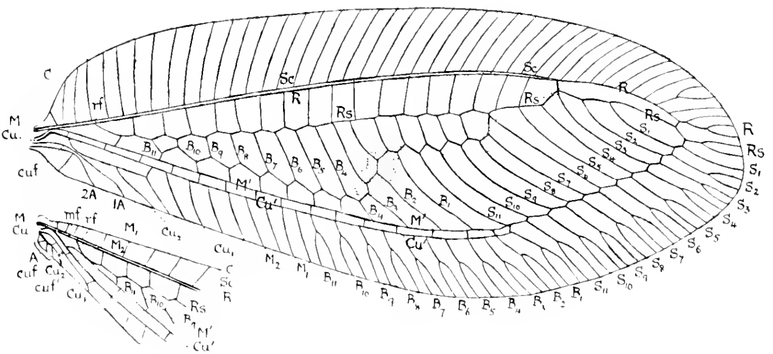
It is possible that a careful study of these points might reveal a satisfactory method of subdividing the genus. No characters which are correlated merely with *size* (*e.g.*, greater or less number of branches from Rs) can legitimately be used in this connection, since species of different sizes are often most closely related.

Phylogeny of the Chrysopidæ.

The results obtained in this paper appear to me to be sufficiently striking and suggestive to enable us to understand the phylogeny of the *Chrysopidæ* along fairly broad lines, if not in every minute detail. We are still unable to make the full comparisons between the scheme of venation in *Chrysopa* and that of allied groups, because we have not yet obtained the scheme of the pupal tracheation in those groups. For example, it would be very instructive to compare the Chrysopid venation with that of the *Apochrysidæ*. But the pupal tracheation of the latter is not known, and indeed is never likely to be discovered, since no larva of this family has yet been found. All we can do is to compare the imaginal venations, using them with the greatest care, and applying stringent tests to our conclusions. The same holds good if we desire to compare the venation of *Chrysopa* itself with that of other genera of *Chrysopidæ*. The nearer the relationship, the closer will be the comparison; but we have to remember that, so far, no other genus except *Chrysopa* has had its scheme of tracheation worked out, so that this final court of appeal is denied to us.

It seems safe to lay down the following rule to enable us to distinguish at sight a true media from a pseudo-media, in whatever wing it might occur:—*The apparent median vein is a true media if the branches of* Rs *nearest the base of the wing do not descend directly on to it, but run longitudinally above and more or less parallel to it. If, however, one or more of these branches* *descend upon the apparent median vein, then that vein must be considered to be a pseudo-media.*

The same test cannot, of course, be applied to the pseudo-cubitus, the only sure arbiter in this case being the pupal tracheation. It seems, however, inherently probable that the two formations – pseudo-media and pseudo-cubitus—must go together; since, if the true media is displaced and reduced sufficiently to allow of the formation of a pseudo-media, it seems almost essential that the true cubitus must suffer displacement and reduction as well.

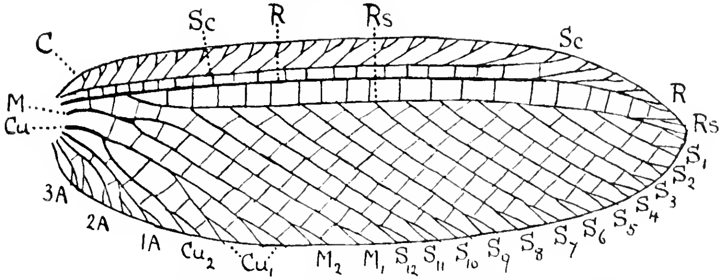


Text-fig.6.—Forewing and basal portion of hindwing of an Apochrysid, *Oligochrysa gracilis* Esb.-Pet.,(× 4½) for comparison with that of *Chrysopa*. The median fork (*mf*) and the limits of M_1 and M_2 in the forewing cannot be clearly determined.

Applying the above rule to the wing of an Apochrysid (Text-fig.6), we see at once that the apparent media must be a pseudo-media. Judged, therefore, on this very important point, the *Apochrysidæ* are true allies of the *Chrysopidæ*, and the two groups might perhaps be regarded as subfamilies within the single family *Chrysopidæ*. The *Apochrysidæ* are in many ways so highly specialised, that they cannot be regarded as standing anywhere near the direct line of descent of the *Chrysopidæ*. They stand in the same relationship with the *Chrysopidæ* that the genus *Psychopsis* does to the rest of the *Osmylidæ*. There is, in fact, a very obvious convergence of venational pattern between the *Apochrysidæ* and *Psychopsis*. In both, the wing is broad, with a central "disc" and a broad rim all round it; in both, Sc, R and Rs unite before the tip of the wing, and the disc is closed distally by a gradate series of cross-veins. All these characters are almost certainly the result of convergence. The only archaic character common to the two groups is the basally-placed origin of Rs in both wings. It seems to me that the *Apochrysidæ* lie far off the main line of descent of the *Chrysopidæ*, and that it is useless to attempt to derive the latter from Apochrysid-like ancestors.

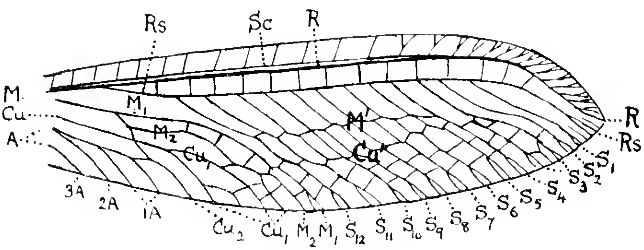
The stages by which the original plan of a true media and cubitus, with branches of Rs running above them, and all more or less parallel (the archaic Osmylid pattern), gave place to the Chrysopid pattern, are quite easily conceived, when it is remembered that the pseudo-media and pseudo-cubitus are, in reality, for all except the most basal portions of their lengths, true Banksian lines. It will not be necessary to repeat the diagrams given in No.1 of this series of Studies (*l.c.*, p.748, Text-fig.10), in which the formation of a Banksian Line in *Myrmeleontidæ* was contrasted with the formation of a Gradate Series in *Chrysopidæ*, and both were developed from the archaic Osmylid formation. It is only necessary to understand that what we have discovered in this paper is the fact that only the *distal* branches of Rs, in *Chrysopa*, develop gradate cross-veins, whereas the *proximal* branches of Rs develop Banksian Lines (M′ and Cu′) and thus behave in the same manner as the *distal* branches of Rs in the *Myrmeleontidæ*. A combination, then, of the two series of diagrams, for the two portions of the Chrysopid wing, will bring about the required result. In this connection, we might also study with profit the irregular series of cross-veins between Rs and M′ in *Oligochrysa*. We must also, of course, allow that, from the very beginning, the true media and cubitus became encroached upon by the branches of Rs, until they finally underwent such reduction and displacement as we now see in *Chrysopa*.

We may postulate, then, for the *Chrysopidæ*, an ancestral wing-form (Text-fig.7) in which the radial sector arose close to the base in both wings, and ran evenly parallel to and under the radius. Sc, R, and Rs did not unite before the tip of the wing. The branches of Rs were numerous, and tended to run downwards obliquely across the wing, rather than to turn and run parallel to and beneath Rs. M was two-branched, as was also Cu. Both were moderately short, and tended to curve downwards to the posterior border of the wing, so as to run parallel with the more proximal branches of Rs. Three anal veins were present, all short. The cross-veins between the branches of Rs tended to become arranged in series, with elimination of those that were unsuitably placed. Text-fig.7 shows a hypothetical ancestral Chrysopid wing conceived on these lines.



Text-fig.7.—Hypothetical ancestral wing-form of the *Chrysopidæ*.

Palæontology here comes in, and affords us valuable proof that our theory of Chrysopid descent has a solid basis of fact. Text-fig.8 shows the wing of *Mesochrysopa zitteli* Meunier, from the Lithographic Chalk of Bavaria (Upper Jurassic). This wing was originally described by Meunier as a Termite (genus *Hagenio-termes*), but was re-studied and figured by Handlirsch ("Die Fossilen Insekten," p.612, and Plate xlviii., fig.14). This author proposed the generic name *Mesochrysopa* for it, and placed it as the unique representative of a new family, *Mesochrysopidæ*. His comment on the character of this family is very instructive, if read in the light of our new knowledge of Chrysopid venation. He says:—"Diese Gruppe bildet zweifellos ein Bindeglied zwischen den Prohemerobiden und Chrysopiden. Mit ersteren hat sie den noch ungebrochenen Radius gemein," (here he undoubtedly intended to say "Radial sector" for "Radius"); "mit letzteren die Bildung des Cubitus und der Analadern, sowie die stufenförmigen Queradern zwischen den Aesten des Sector. Die Medialis ist noch ursprünglicher als bei den Chrysopiden, bei welchen sie in fast gerader Richtung über die Flügelmitte hinaus fortgesetzt und von einer längeren Reihe viereckiger Zellen begleitet ist." It seems clear, therefore, that Handlirsch, if he had known the true structure of the media in *Chrysopa*, would have placed this form considerably closer to the *Chrysopidæ* than he did.



Text-fig.8.—Wing of *Mesochrysopa zitteli* Meunier,(× 2). Lithographic chalk, Bavaria. Upper Jurassic. (Adapted from Handlirsch).

In Text-fig.8, I have copied Handlirsch's figure of this interesting fossil, and have added to it my own interpretation of the venation. Also, as the wing was figured with the apex to the left, I have reversed it, to facilitate comparison with my other figures. There are evidently twelve branches descending from Rs; these are labelled S_1 to S_{12}. The limits of M, Cu, and the three anal veins are clear enough proximally (though the extreme base of the wing is lost), but the actual distal endings are slightly in doubt. What is clear, however, is that both M and Cu are two-branched, and of just about the shape and size postulated in our hypothetical Chrysopid ancestor. Further, the more proximally placed cross-veins between the branches of Rs have begun to arrange themselves into two continuous series, upon which I have placed the labels M′ and Cu′ respectively, since I consider them to represent the primitive formation of pseudo-media + inner gradate series for the upper set, and pseudo-cubitus + outer gradate series for the lower set respectively. They are still very irregular, and one cross-vein appears to be missing between M_1 and S_{12}. But such a cross-vein may well have been present, though not visible in the fossil. If so, then M_1 was already linked up and in line with M'; if not, a very slight bulging of S_{12} downwards would give the necessary connection. Cu_1 is already linked up with Cu', though, it must be confessed, very irregularly But it is just from such irregular and unstable forms as this that the most beautiful and perfect venational specialisations often spring.

The condition of M_1 and M_2 in this fossil is very interesting, and leads me to suggest that the wing was a forewing. For there is already a weak median arculus present between M_1 and Cu_1 (at the point where M_2 leaves M_1). Moreover, M_2 is peculiarly curved, so that, of the three elongated cells marked off by cross-veins between it and M_1, the middle is already the narrowest. If, therefore, at the time when M' definitely junctioned with M_1, a further strengthening were needed, it would only be necessary for the middle cell to close completely up, and we should have the exact formation found in the forewing of *Chrysopa*.

The other obvious points in which *Mesochrysopa* differs from *Chrysopa* are just such as we might expect in an older and more generalised type of wing. The distal veinlets in the costal space are forked, so are the endings of **R**, Rs, and all its branches. Below Cu′, the branches of Rs descend a considerable distance before they reach the wing-border, and are separated by two irregularly-placed rows of cross-veins. These cross-veins must have all disappeared, and the distance between Cu′ and the border must have become considerably lessened, before this portion of the wing could take on the true Chrysopid facies. As for the distal forks, quite a considerable number of them remain in *Chrysopa* (*df* in Plate x.), but they have disappeared in the pterostigmatic region, and from the ends of several of the most proximal and most distal of the branches of Rs, leaving only the middle branches forked. We must note also that, in *Mesochrysopa*, Rs is still "ungebrochenen." The weakly zig-zag course of this vein in *Chrysopa* is a well-known form of specialisation, of frequent occurrence—for instance, in the veins of Agrionid

Dragonflies. Alternation of straight and weakly zig-zagged longitudinal veins is a very advantageous and specialised arrangement, and is developed to perfection in *Chrysopa*, where R is straight, Rs zig-zagged, M′ straight and Cu′ zig-zagged.

We may conclude, then, that *Mesochrysopa* stood very near, if not actually upon, the line of descent of our recent *Chrysopidæ*. As this is an Upper Jurassic form, the rise of the true *Chrysopidæ* probably began in the Cretaceous. About this time, or perhaps in the Eocene, our present *Aphides* became developed (many species are known from the Lower Oligocene). As the Chrysopid larvæ feed upon *Aphides* and similar insects, the evolution of the two groups must have proceeded step by step together, until the present intimate association became fully established.

EXPLANATION OF PLATES X., X. *bis*, XI.

Plates x.-x. *bis* (Transparency).

The imaginal venation of *Chrysopa signata* Walker, is shown, much enlarged, in black, on Plate x. Superimposed upon it, in red, on the transparency, is a diagrammatic scheme of the pupal tracheation, to enable the reader to trace the intricate formation of the pseudo-media and pseudo-cubitus.

1A, 2A, 3A, the three anal veins—B_1-B_4, the four Banksian sectors (= S_7-S_{10})—*b*, upper, and *b′*, lower Banksian cells—C, costa—Cu, cubitus—Cu_1, its upper, Cu_2, its lower branch—Cu′, pseudo-cubitus—*cu*, cubital cell—*cuf*, cubital fork—*cuf′*, second cubital fork—*df*, distal forks—*g*, inner, *g′*, outer series of gradate veins—*icu*, intra-cubital cell of hindwing *icu*$_1$-*icu*$_3$, the three intra-cubital cells of forewing—*im*$_1$, *im*$_2$, first and second intra-median cells—M, media—M_1, its upper, M_2, its lower branch—M′, pseudo-media—*m*$_1$-*m*$_3$, median cells—*ma*, median arculus—*mf*, median fork—*ml*, median loop (= "divisory veinlet" of Banks)—*p*, posterior cells—*pt*, pterostigma—R, radius—*rf*, radial fork—Rs, radial sector—S_1-S_{10}, its branches—Sc, subcosta—*sc.x*, subcostal cross-vein—*t*, minute triangle (= remnant of first upper Banksian cell in hindwing)—*x*, false origin of Rs in hindwing.

Plate xi. (Photomicrographs).

Fig.1.—Tracheation of pupal wings of *Chrysopa signata* Walker, (×40). Pupa one day old.

Fig.2.—Forewing and a small portion of hindwing of same, (×66).

Fig.3.—Hindwing of pupa of *Chrysopa* A, (×27) to show rucking of the wing. Pupa nearly three days old.

A THIRD CONTRIBUTION TO A KNOWLEDGE OF THE LEPIDOPTEROUS FAUNA OF EBOR SCRUB, N.S.W.

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

I paid four visits to this scrub this year, the dates being January 3rd, 5th, 7th, and 11th, and made 128 captures belonging to 40 species. Of these, 22 species have been already recorded by me. Of the remaining 18, there are six species which have been recorded from other localities, and 12 are here described as new. I describe also a very interesting Geometrid captured in 1914, but overlooked in my previous papers; it constitutes a new and primitive genus of the *Acidalianæ*.

This further material confirms without modifying my previous conclusions. We are here dealing with a small but highly peculiar fauna, which has distinct relationship to that of Mount Tambourine in Queensland, and, to a less extent, to that of Victoria. The number of recognised species (excluding those undetermined) amounts to 69, and, of these, only 24 are known from other localities. Of the *Œcophorinæ*, in which the fauna is particularly rich, there are 26 species, of which 21 are not known to occur elsewhere; of the *Tortricidæ*, the corresponding numbers are 13 and 7; of the *Geometridæ*, 10 and 4.

Fam. ARCTIADÆ.

Thallarcha erotis Turn. One ♀ rather rubbed. Expansion 16 mm.

Fam. GEOMETRIDÆ.

Subfam. Larentianæ.

Eulype leucophragma Meyr. One ♂, two ♀.

Diploctena pantœa Turn. One ♂, two ♀, all in poor condition.

Subfam. GEOMETRINÆ.

Prasinocyma lychnopasta Turn. Three ♂; in two of these, 6 is stalked shortly with 7; and, in two, 11 anastomoses first with 12, and then with 10.

Subfam. BOARMIANÆ.

Philolochma celænochroa Turn. One ♂, two ♀, showing no variation in the neuration.

Planolocha autoptis Meyr. Three ♂. This species and the preceding were beaten out of the dead fronds of treeferns.

Fam. PYRALIDÆ.

Aboëtheta pteridonoma Turn. Thirteen ♂, three ♀.

Fam. TORTRICIDÆ.

Capua paraloxa Meyr. One ♀.

Capua hedyma Turn. Two ♂.

Cnephasia thiopasta Turn. Two ♀.

Fam. TINEIDÆ.

Subfam. ŒCOPHORINÆ.

Dasycerca apocrypha Turn. Three ♂.

Ocystola symbleta Turn. Three ♂.

Cæsyra bathrophæa Turn. Six ♀. Apparently the ♂ should be sought for earlier in the season.

Cæsyra syneches Turn. Three ♂.

Protomacha leucophara Turn. Four ♂, one ♀. Antennal ciliations of ♂ 1.

Philobota alypa Turn. One ♂ Antennal ciliations 6.

Philobota isomora Turn. One ♂, one ♀.

Eutorna eurygramma Meyr. One ♂.

Subfam. AMPHITHERINÆ.

Enchoptila idiopis Turn. Thirteen ♂, six ♀. This species was plentiful, and readily obtained by beating the dead fronds of the treeferns. The eyes are not divided as in *Amphithera*, but are strongly indented on their posterior edge by a median process, which reaches about $\frac{1}{4}$ across. The ♂, in addition to a large, abdominal tuft, has a pair of hair-tufts from the undersurface of the penultimate segment.

Subfam. TINEINÆ.

Narycia (Xysmatodoma) polystona Turn. Two ♂; forewings darker than in ♀, being more generally suffused with fuscous, but pale sub-basal dorsal blotch well marked; antennal ciliations 1.

Fam. LYMANTRIADÆ.

PORTHESIA EUTHYSANA.

Porthesia euthysana Turn., Trans. R. Soc. S. Aust., 1902, p.175.

Four ♂ examples. I took also a ♀ at rest on a rock in the gorge beneath Ebor Falls. The species was previously known only from Mount Tambourine, Queensland. The Ebor males have the yellowish dorsal fringe on forewings less marked, and the blackish colour on the dorsum of abdomen restricted to the basal segments.

Fam. GEOMETRIDÆ.

Subfam. ACIDALIANÆ.

EOIS HALMÆA.

Acidalia halmœa Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.846.

I took five ♂ examples of this variable species in the Scrub. A widely distributed species, occurring also in Queensland: Nambour, Brisbane, Mt. Tambourine, Toowoomba.—N.S.W.: Sydney, Bulli, Kiama.—Vic.: Gisborne.—Tasm.: George's Bay.

Gen. PROTOTYPA, n.g.

πρωτοτυπος, primitive.

Face smooth. Tongue well-developed. Palpi moderately long, projecting well beyond frons, shortly rough-haired, porrect; terminal joint minute. Antennæ of ♂ dentate, ciliated. Thorax not hairy beneath. Posterior tibiæ of ♂ slender, with two pairs of spurs. Forewings with 2 from $\frac{4}{5}$, 5 from above middle, 6 separate, 7, 8, 9 stalked from before end of cell, 10 arising from cell and anastomosing with 11 and 9 to form a double areole. Hindwings with 3 and 4 widely separate at origin, 5 well-developed, from middle of cell, 6 and 7 separate, 8 not connected with cell, but closely approximated from near base to middle.

Certainly a primitive genus in this subfamily, probably the most primitive known. The neuration of the forewings and the structure of the male posterior tibiæ agree with *Rhodostrophia* Hb., which, however, has 6 and 7 of hindwings stalked. *Autanepsia* Turn., agrees in antennal structure, but has also 6 and 7 of hindwings stalked, and has lost the middle spurs of the posterior tibiæ in the ♂. Independently of these differences, the structure of 8 of hindwings is more similar to that of the *Monoctenianæ* and *Boarmianæ* than of other *Acidalianæ*; but the neuration of the forewings clearly shows that the genus belongs to the latter group.

PROTOTYPA DRYINA, e.sp.

δρυινος, of the woods.

♂. 25 mm. Head whitish, face pale ochreous. Palpi 1½; pale ochreous, towards base whitish. Antennæ whitish; in ♂ dentate, ciliations 1. Thorax and abdomen whitish. Legs whitish: anterior pair fuscous-whitish. Forewings triangular, costa nearly straight, apex pointed, termen bowed, oblique, whitish: a slender, pale fuscous line from ⅗ dorsum towards, but not reaching, costa a little before apex; a pale fuscous terminal line: cilia whitish. Hindwings with termen gently rounded, whitish; a pale fuscous terminal line; cilia whitish.

One specimen, taken on January 7th, 1914. This species was overlooked in my previous papers on the scrub-fauna.

Subfam. BOARMIANÆ.

Gen. LYELLIANA, n.g.

Frons smooth or with a triangular, anterior tuft of scales. Tongue well-developed. Palpi rather long, porrect, shortly rough-haired; terminal joint short, concealed. Antennæ of ♂ bipectinate, apex simple. Thorax not crested; hairy beneath. Femora smooth-scaled or slightly hairy. Posterior tibiæ of ♂ not dilated. Forewings oblong, base of costa very strongly arched; in ♂ with a well-marked fovea; 10 long-stalked with 7, 8, 9, 11 from cell free or connected with 12. Hindwings broader than forewings; neuration normal.

Characterised by the peculiar shape of forewings, broader hindwings, and the long-stalking of vein 10. I dedicate the genus to Mr. Geo. Lyell, who has given me so much generous help. In addition to the following, I have two undescribed species, one from Mt. Tambourine, Queensland, and one from Victoria.

LYELLIANA PHÆOCHLORA, n.sp.

φαιοχλωρος, dusky green.

♂♀. 42-46 mm. Head fuscous, crown pale green, face with anterior tuft. Palpi $2\frac{1}{2}$; fuscous mixed with ochreous-whitish. Antennæ fuscous-grey; pectinations in ♂ 4, apical $\frac{1}{12}$ simple. Thorax pale green mixed with fuscous. Abdomen ochreous-whitish. Legs fuscous, tibiæ and tarsi annulated with ochreous-whitish; posterior pair wholly ochreous-whitish. Forewings oblong, costa very strongly arched at base, thence nearly straight, apex rectangular, termen strongly bowed, slightly oblique; pale green marked and strigulated with dark fuscous and partly suffused with fuscous; basal arch of costa edged with long scales; an incomplete sub-basal line from costa; a dentate line from $\frac{1}{6}$ costa to $\frac{1}{4}$ dorsum, angled in disc; a dentate line from costa before middle to mid-dorsum; a circular, pale-centred, discal spot beyond middle; a line from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum sharply and finely dentate; a dentate subterminal line; a terminal series of blackish dots; cilia grey. Hindwings with termen rounded, wavy towards apex; grey-whitish, towards termen pale fuscous: an indistinct, fuscous, subterminal line; a blackish terminal line, sometimes obsolete; cilia grey-whitish. Underside pale fuscous.

Two examples, one of each sex, beaten from undergrowth, and taken on the wing.

Fam. TORTRICIDÆ.

Subfam. TORTRICINÆ.

ISOCHORISTA HELOTA.

Isochorista helota Meyr., Proc. Linn. Soc. N. S. Wales, 1910, p.168.

One ♂ example. Also from N.S.W.: Bulli.—Vic.: Healesville.—Tasm.: Deloraine.

CAPUA sp.

One example, apparently of the species noted in these Proceedings, 1915, p 189.

CAPUA EUZONA, n.sp,

εὔζωνος, well girdled.

♂. 10-12 mm. Head and palpi pale brown. Antennæ pale brown annulated with blackish; cilia in ♂ 1. Thorax pale brown, with a prominent, posterior, dark fuscous crest. Abdomen fuscous gradually darkening to apex, extreme base pale brown. Legs fuscous; tarsi annulated with ochreous-whitish: posterior pair, except tarsi, ochreous-whitish. Forewings moderate, somewhat dilated posteriorly, costa rather strongly arched, apex rounded, termen nearly straight, oblique; without costal fold in ♂; pale brown; a dark fuscous line from $\frac{1}{4}$ costa to $\frac{1}{4}$ dorsum, rather acutely angled on fold, outlining basal patch, which is scarcely darker than groundcolour; a well marked, nearly transverse, dark fuscous, median fascia, its anterior edge well-defined, sinuate, its posterior edge suffused; two dark fuscous, costal dots follow this, and then a triangular, costal, subapical spot; a slender, fuscous, terminal line; cilia pale brownish barred with fuscous. Hindwings and cilia fuscous grey.

Distinguishable by the dark, transverse, median fascia. One ♂ example. I also took two examples under a waterfall, six miles from the Scrub. Also from Queensland: Killarney, in November. In all, five examples, all ♂.

CAPUA CRYPSERYTHRA, n.sp.

κρυψέρυθρος, with hidden red.

♀. 17 mm. [Head and thorax rubbed. Palpi broken]. Antennæ whitish, upper surface finely barred with dark fuscous. [Thorax rubbed]. Abdomen pale grey. Legs ochreous-whitish; anterior tibiæ and all tarsi annulated with fuscous. Forewings broad, posteriorly dilated, costa strongly arched, apex rectangular, termen slightly sinuate, rounded towards tornus; dark grey obscurely reticulated with reddish-orange; costa finely strigulated with dark fuscous; a semilunar, whitish blotch on dorsum, not extending to base or tornus, on this the reddish-orange reticulations are conspicuous; cilia fuscous, with an obscure, median, reddish line, apices whitish. Hindwings with termen strongly sinuate; grey-whitish obscurely strigulated with grey; cilia grey-whitish.

One example.

Subfam. COSMOPTERYGINÆ.

MICROCOLONA CELÆNOSPILA, n.sp.

κελαινοσπιλος, dark-spotted.

♂♀. 9-10 mm. Head pale fuscous Palpi whitish; second joint dark fuscous anteriorly except at apex; terminal joint with basal, median, and apical dark fuscous rings. Antennæ fuscous. Thorax dark fuscous, with a posterior whitish spot. Abdomen dark fuscous. Legs fuscous, inferior surface and tarsal annulations whitish. Forewings narrow; whitish suffused with grey, especially towards costa, and with scanty, dark fuscous irroration; a blackish discal dot narrowly ringed with whitish at $\frac{2}{5}$, a second preceding first on fold, a third similar to first in disc at $\frac{3}{4}$: a blackish, apical dot surrounded with whitish; cilia dark grey. Hindwings narrowly lanceolate; grey; cilia grey.

Three examples, two ♂ in good condition, and a wasted ♀.

HOPLOPHANES(?) LITHOCOLLETA, n.sp.

λιθοκολλητος, inlaid with precious stones.

♀. 9 mm. Head and palpi ochreous-whitish. Antennæ grey; basal joint ochreous-whitish. Thorax whitish-ochreous. Abdomen grey. Legs ochreous-whitish ; anterior tibiæ and tarsi fuscous anteriorly; posterior tibiæ grey on upper surface. Forewings rather broadly lanceolate; ochreous, suffused with whitish towards base and before apex; a lustrous, opaline, median streak from base to $\frac{1}{3}$, edged with fuscous; a similar and nearly parallel streak from costa near base extending an equal distance; a short, transverse, opaline mark on midcosta; an opaline spot on dorsum before tornus, and another on tornus, the former thickly edged with blackish; a transverse, dark fuscous line from beneath $\frac{3}{4}$ costa extending $\frac{2}{3}$ across disc; a large, apical, fuscous spot; cilia fuscous, on costa, beneath apex, and on tornus whitish-ochreous. Hindwings lanceolate, acute; grey; cilia grey.

I doubt whether this is a true *Hoplophanes*, but think it best included in this genus provisionally. One example, taken flying in the sunshine.

Subfam. XYLORYCTINÆ.

Gen. XYLOMIMETES, n.gen.

ξυλομιμητης, an imitator of wood.

Palpi moderately long, ascending, recurved; second joint long, reaching base of antennæ, thickened with closely appressed scales, rather strongly expanded at apex; terminal joint about $\frac{1}{2}$ second, more slender, smooth, acute. Antennæ of ♂ slightly serrate, shortly ciliated. Thorax not crested. Forewings with tufts of raised scales in disc on upper surface; 2 from $\frac{3}{4}$, 7 absent, 8 and 9 short-stalked, or closely approximated at base and for some distance. Hindwings with 3 and 4 connate, 5 weakly developed, 6 and 7 connate. Anterior tibiæ expanded with dense hair-scales.

Type *Pilostibes trachyptera* Turn., (Trans. Roy. Soc. S. Aust., 1900, p.6). A very distinct genus, most nearly allied to *Pilostibes* Meyr.

XYLOMIMETES SCHOLASTIS, n.sp.

σχολαστις, sluggish.

♂. 40 mm. Head white, base of sidetufts and face brownish. Palpi brownish, terminal joint and apex of second joint white. Antennæ brown-whitish; ciliations in ♂ $\frac{1}{2}$. Thorax whitish, posteriorly brownish-tinged. Abdomen whitish; second segment and bases of succeeding segments on dorsum ferruginous irrorated with whitish. Legs brown-whitish; posterior pair whitish. Forewings oblong, somewhat dilated posteriorly, costa moderately arched near base and apex, in middle nearly straight, apex rounded, termen slightly oblique, rounded beneath; four, strong tufts of raised scales, one at base of dorsum, one on fold about middle, and one at each posterior angle of cell; pale whitish-brown; a broad, suffused, white, costal streak, narrow at base, and not reaching apex; a fine, blackish, longitudinal streak from $\frac{1}{4}$ to middle along upper edge of cell; two or three, fine, short, similar streaks on veins beyond middle; cilia pale brownish barred with whitish. Hindwings considerably broader than forewings; ochreous-whitish; cilia ochreous-whitish.

Closely allied to *X. trachyptera*, which is also a scrub-species.

One example, beaten from undergrowth. It fell to the ground and remained motionless, exactly resembling a fragment of dead wood.

Subfam. ŒCOPHORINÆ.

EULACHNA XANTHOSPILA, n.sp.

ξανθοσπιλος, yellow-spotted.

♂. 9-12 mm. Head blackish, lower edge of face ochreous. Palpi ochreous; terminal joint dark fuscous. Antennæ blackish; ciliations in ♂ $1\frac{1}{2}$. Thorax and abdomen blackish. Legs blackish; coxæ and femora ochreous; tibiæ and tarsi annulated with ochreous. Forewings narrow, posteriorly somewhat dilated, costa slightly arched, apex round-pointed, termen very obliquely rounded; blackish; markings ochreous-yellow, a narrow, oblique, sub-basal fascia from base of costa gradually expanding towards dorsum; a costal spot just beyond $\frac{1}{3}$, and another just beyond $\frac{2}{3}$; a larger spot on $\frac{3}{4}$ dorsum, with an acute apex reaching mid-disc; cilia blackish. Hindwings ovate-lanceolate; dark fuscous; cilia dark fuscous.

Two ♂ examples.

OCYSTOLA OXYTONA, n.sp.

ὀξυτονος, sharp.

♂. 12-14 mm. Head and thorax yellow. Palpi ochreous, terminal joint and a broad subapical ring on second joint dark fuscous. Antennæ pale yellow annulated with blackish; ciliations in ♂ 6. Abdomen grey. Legs grey; anterior coxæ, middle, and posterior femora ochreous-whitish; anterior tarsi annulated with ochreous-whitish. Forewings narrow, costa gently arched, apex acute, termen very obliquely rounded; yellow; a broad, fuscous, terminal band; a transverse, dark fuscous, discal mark at $\frac{2}{3}$, confluent with terminal band; cilia yellow, on tornus fuscous. Hindwings ovate-lanceolate; dark grey; cilia dark grey.

Two ♂ examples.

CŒSYRA BASILICA Meyr.

Cœsyra basilica Meyr., Proc. Linn. Soc. N. S. Wales, 1884 p.770.

One ♀ example in poor condition, probably referable to this species.

Also from N.S.W.: Sydney, Kiama.—Vic.: Melbourne.—Tasm.: Hobart.—S.A.: Wallaroo.

PHILOBOTA ANARRECTA Meyr.

Philobota anarrecta Meyr., Proc. Linn. Soc. N.S. Wales 1888, p.1620.

Antennal ciliations of ♂ 6. Two examples, one of each sex. Also from N.S.W.: Mt. Kosciusko(4,000 ft.).—Vic.: Melbourne, Gisborne.

EULECHRIA EMBOLOGRAMMA, n.sp.

ἐμβολογραμμος, wedge-marked.

♂. 12-14 mm. Head whitish-ochreous. Palpi dark fuscous; terminal joint and apex of second joint whitish-ochreous. Antennæ fuscous, ciliations of ♂ 1. Thorax whitish-ochreous; patagia dark fuscous. Abdomen grey, apices of segments whitish, tuft whitish-ochreous. Legs fuscous; posterior pair whitish-ochreous. Forewings moderate, not dilated, costa rather strongly arched, apex rounded, termen obliquely rounded; whitish-ochreous; markings blackish-fuscous; a broad, wedge-shaped, basal fascia, produced on costa to $\frac{2}{5}$; a triangular spot on costa beyond middle; an oblique streak from tornus towards but not reaching costal spot; a triangular, costal spot before apex giving rise to a subterminal series of dots, which reaches tornus; several terminal dots; cilia whitish-ochreous with a few fuscous scales, on costa before apex fuscous. Hindwings grey-whitish; cilia ochreous-whitish.

Two ♂ examples.

EULECHRIA STRAMENTARIA, n.sp.

Stramentarius, straw-coloured.

♀. 18 mm. Head whitish-ochreous. Palpi whitish-ochreous; external surface of second joint dark fuscous except at apex. Antennæ grey. Thorax whitish-ochreous. Abdomen ochreous-whitish, bases of segments ochreous-brown. Legs fuscous; posterior pair whitish-ochreous. Forewings moderate, not dilated, costa gently arched, apex rounded, termen obliquely rounded; whitish-ochreous; markings blackish-fuscous, a large spot on base of costa; a spot on costa at $\frac{1}{4}$ giving off a fine oblique line to near base of dorsum, a spot on midcosta; a minute discal dot at $\frac{1}{3}$, a second beneath it on fold, and a larger transverse mark at $\frac{2}{3}$; a spot on $\frac{3}{4}$ costa giving off a curved, subterminal line to tornus; this is preceded and followed by more or less fuscous suffusion; some indistinct terminal dots; cilia whitish-ochreous, with indications of a median fuscous line. Hindwings grey; cilia whitish-ochreous.

Two ♀ examples.

EULECHRIA EXIGUA, n.sp.

Exiguus, little.

♂. 10-11 mm. Head and thorax grey-whitish. Palpi grey-whitish; external surface of second joint fuscous. Antennæ dark fuscous; ciliations in ♂ 3. Abdomen ferruginous-ochreous, apices of segments and tuft grey-whitish. Legs fuscous, tarsi with whitish annulations; posterior pair, except tarsi, grey-whitish. Forewings narrow, costa gently arched, apex round-pointed, termen very obliquely rounded; grey-whitish; base of costa dark fuscous; some dark fuscous irroration toward dorsum and termen, and a dark fuscous discal dot at $\frac{3}{4}$; cilia grey-whitish, with a few fuscous scales. Hindwings narrow-ovate; pale grey; cilia pale grey.

Three ♂ examples.

BAREA PASTEODES

Compsotropha pasteodes Turn., Proc. Linn. Soc. N. S. Wales, 1914, p.559.

Nine ♂ examples, mostly in very good condition, in addition to the pair originally taken. This is a true *Barea* (*Phlæopola*), in spite of vein 7 of forewings running beneath apex. It comes near *B. nymphica* Turn.

Subfam. LYONETIANÆ.

BEDELLIA SOMNULENTELLA.

Bedellia somnulentella Zel., Isis, 1847, p.894; Meyr., Proc. Linn. Soc. N. S. Wales, 1880, p.170.

One example. Also from Q.: Duaringa, Brisbane, Coolangatta, Warwick.—N.S.W.: Murwillumbah, Glen Innes, Sydney, Bulli, Bathurst.—Vic.: Warragul.—Tasm.: Hobart.—S.A.: Pt. Lincoln. —W.A.: Geraldton. Also from New Zealand, Europe, and North America. This insignificant species is one of the most generally distributed.

Subfam. TINEINÆ.

NARYCIA NEMORIVAGA, n.sp.

Nemorivagus, wandering in the woods.

♀. 15 mm. Head white. Palpi very short: fuscous. Antennæ fuscous; basal joint white. Thorax dark fuscous. Abdomen grey; tuft whitish-ochreous. Legs fuscous; tarsi annulated with whitish-ochreous, posterior pair wholly whitish-ochreous. Forewings elongate-oval, not dilated, costa rather strongly arched, apex round-pointed, termen very obliquely rounded; 7 absent: white, on costa ochreous-tinged; markings dark fuscous; a narrow, basal fascia slightly prolonged on costa; a broad, slightly oblique fascia from $\frac{1}{3}$ costa to mid-dorsum, edges slightly irregular but approximately straight and parallel; a triangular, subapical fascia, very broad on costa where it is interrupted by a white dot before middle, narrowing to tornus; a triangular, apical blotch containing a subapical, white dot on costa; cilia fuscous, twice interrupted by ochreous-whitish on costa, on lower half of termen and tornus ochreous-whitish. Hindwings and cilia grey.

One ♀ example.

PETROLOGICAL NOTES.

No. ii. The Relations between some Western Australian Gneissic and Granitic Rocks.

By M. Aurousseau, B.Sc.

The following notes are the results of three visits to Roelands and one to Albany. As I may not be able to resume the work, it is given here as it stands. Detailed mapping was begun at Roelands, but was not carried far enough to be of value. Practically no laboratory-work was done, therefore all rock-names must be interpreted as field-names only.

The Geology of the Roelands District.

Roelands, 113½ miles from Fremantle, on the South-West Railway, stands at the foot of the Darling Range (fault-scarp), east of Bunbury. The surrounding country was examined by a number of traverses between the Collie and Brunswick Rivers, as far east as Shenton Elbow on the former, and Olive Hill Siding on the latter. The formations met with are, in order of increasing age—

Alluvials.
Laterite.
Conglomerate.
Basic dykes.
Pegmatites.
Gneiss.
Porphyritic granodiorite.

The Alluvials occur all along the foot of the range, and in the Brunswick River Valley, where they are stratified.

Laterite is sparingly distributed as a capping on the highest hills, about two miles east of the foot of the range.

An outcrop of *Conglomerate*, to be correlated tentatively with the Donnybrook Series, occurs as a low hill between the railway and the foot of the range, but separated from the range by alluvials, about a mile north of Roelands. The matrix is a fine-grained, reddish-brown grit, and contains well rounded pebbles and boulders of pegmatite, aplite, light quartzite, dark sandstone, and decomposed, basic, igneous rocks, from ½″ to 2′ in diameter.

The granodiorite, gneiss, basic dykes, and pegmatites form all the high land east of the railway, except where capped by laterite. They are intimately associated in the field.

The basic dykes intrude the acid rocks, forming a plexus, with only occasional approaches to parallelism. They show no distinct trend, and vary in width from mere veins to 50 feet and more. They are coarsely holocrystalline, variable in grainsize and basicity, and appear in most cases to be amphibolitic. They are often gneissic, sometimes passing from a granitoid texture in the middle, through a gneissic or schistose phase, to biotite-schist on the edges. They are generally associated with gneiss, rather than granodiorite.

The Granodiorite-Porphyry forms a number of sporadic outcrops, some of which are of large dimensions, and are fairly free from basic dykes. It is well developed just north of the Collie River, half-way between Shenton Elbow and the railway, also around Olive Hill Siding, and between Brunswick Junction and the Roelands quarry. It is a coarse, granitic rock, with very numerous felspar-phenocrysts, up to 2″ long, distributed entirely without arrangement in the most characteristic outcrops, where it weathers into small, rough tors. In the neighbourhood of the gneiss, it is rudely fluidal.

The Gneiss is most varied in character, and outcrops as irregularly as the granodiorite, but shows no definite boundary-relations to it. It is very well exposed along the Collie Tramway. There is not the slightest evidence that the granodiorite intruded it. All varieties, from fine, even-grained gneiss to coarse augen-gneiss occur, some of the latter bearing a suspicious resemblance to the fluidal modification of the granodiorite. The foliation follows no constant direction; on the other hand, it is best developed in the neighbourhood of basic dykes, and runs parallel to them. The more intense the foliation in the basic dykes, the more perfect are the neighbouring gneisses. In places, it is much contorted; it is then often associated with pegmatites, and may be intruded *lit par-lit* by amphibolite. The contortion is well shown in some cliffs on the north side of the Brunswick River Valley, near post 1997 on the Narrogin railway. A zone of contortion seems to run S.W. through this point, as it is met in several places south of the river too.

The Pegmatites are widely distributed, but are not abundant. In the hills south-east of Olive Hill Siding, they are associated with masses of a green, actinolitic mineral, and an earlier, talcose mineral, both as yet undetermined, the latter probably being a pseudomorph. These minerals also occur in the pegmatite-outcrops on the south side of the small valley beyond Flaherty Brook, S.E. of Roelands quarry.

The relations between the granodiorite, gneiss, and basic dykes, were most clearly shown in the Roelands quarry. Numerous dykes were exposed, some of which were foliated. In many places, in the main quarry, the granodiorite was seen to pass, in the direction of a basic dyke, by imperceptible gradations, into a fine-grained gneiss bordering the dyke, its foliations running parallel to the dyke, which was also slightly foliated, the edges being biotite-schist. Undoubtedly the gneiss is derived locally from the granodiorite, and its formation is connected with the basic dykes. At the south end of the quarry, a section was exposed showing three parallel dykes; between the first and second from the east, the granodiorite was unaltered, but between the second and third was a highly contorted gneiss, with a few felspar-phenocrysts.

The change from porphyritic granodiorite to fine-grained gneiss is very definitely shown by the felspar-phenocrysts, in the following arbitrary stages in the transition :—

1. Unaltered, porphyritic granodiorite; phenocrysts not oriented.
2. Phenocrysts fluidally oriented.
3. Phenocrysts fluidally oriented, and crushed peripherally.
4. Phenocrysts fluidally oriented, elongated and distorted.
5. Phenocrysts dragged out, and crushed into long streaks of granular felspar.

6. Fine-grained gneiss, without phenocrysts.

Perfect series of specimens can be collected in the quarry.

The above facts lead me to advance the following hypothesis. The gneisses of the Roelands District were produced from the porphyritic granodiorite by uneven shearing processes, which accompanied the injection of basic dykes, under intense pressure. Earth-movement was prolonged after the intrusion of the dykes.

The pegmatites appear to belong not to the granodiorite, but to some neighbouring intrusive, perhaps the Collie granite, an entirely different rock.

Physiography.—The Darling Fault-Scarp has a more dissected and mature aspect in the Roelands District than near Perth. This is also expressed by the scarcity of laterite, and its retirement from the edge of the range. This greater maturity is probably due to the heavier rainfall of the South-West.

There is a marked contrast between the valley of the Collie River west of Shenton Elbow, and that of the Brunswick. The latter is more mature, meandering, and well filled with alluvial; whereas, though the two are only three to five miles apart, the former, though the larger, is a straight, V-shaped trench, with more tributary gullies on the south than on the north. This suggests that the Collie follows a fault from Shenton Elbow to the west, where it takes a sudden turn from its former course.

The material from the Roelands quarry is being used for the breakwater at Bunbury, the quarry having been recently reopened. The quarry-face has now a very different appearance from what it had when I saw it last.

The Crystalline Rocks of Albany.

Previous observers have recorded only granites and basic dykes from the old crystalline complex of Albany. A number of different rocks occur there, however, and their relations are clearly shown in many fine exposures. The following types have been distinguished, and are arranged in order of increasing age—

Basic dykes (two series).
Pegmatites (two series).
Aplite.

Microgranite.
Porphyritic granodiorite.
Gneiss.

They comprise, in all, a fundamental gneiss, and igneous rocks belonging to at least two, perhaps to three periods of activity.

The gneiss and granodiorite are very much alike in appearance, especially when weathered, which is probably the cause of their not having been separated before. Their boundary, likewise, appears to be a very complicated and irregular one.

The Gneiss is variable, but generally coarse, and porphyritic with felspar. It forms part of the mass of Mt. Clarence, and Mt. Adelaide. At the south end of Middleton Beach, the folia strike at 272° prismatic, a trend which is maintained elsewhere. Between Mts. Clarence and Adelaide is a contorted zone, where it becomes garnetiferous, finer in grain, more irregular in composition, and contains dark schlieren. This zone is well exposed at the timber-yard between the deepwater- and town-jetties. Further south, near the entrance-beacon, a junction with granodiorite is exposed.

The Porphyritic Granodiorite forms the bulk of Mt. Melville, and part of Mt. Clarence, and occurs also as dykes in the gneiss. It is remarkably like the Roelands rock, but its large felspar-phenocrysts are generally fluidally arranged along different directions. It weathers into large, characteristic tors, which are a feature in the scenery of the district. Two very fresh dykes, exactly like the main rock, cut the gneiss on the coast, about one-quarter of a mile south of the south end of Middleton Beach. They are each a foot wide, and ultimately run together. They are cut and faulted by a small vein of microgranite.

The Microgranite occurs as dykes and veins in the granodiorite and gneiss. It is well exposed on the bare flanks of Mt. Melville, and one large dyke runs from the summit of Mt. Clarence down through the reservoir. It sometimes contains large felspar-xenocrysts. At a quarry on a bend of the Middleton Road, it is closely associated with a coarse, epidotic biotite-pegmatite, and is elsewhere bordered by pegmatite.

The Pegmatites occur in two series of veins and dykes, one set closely associated with microgranite, the other cutting it. The older can be seen occurring as irregular blebs, in a microgranite-dyke near the deepwater-jetty, where it also forms a border to the dyke at intervals. The younger occurs intersecting micro-granite in the railway-cutting south of the town-jetty. Both sets are exposed on the shore, north of the deepwater-jetty, where a N.W.-S.E. series cuts and faults a N.E.-S.W. set.

Aplite occurs only rarely, and its age is doubtful. It is older than the pegmatites, as the old one cuts it at the deepwater-jetty, but its relation to the microgranite has not been observed. It has intruded the gneiss, both transgressively and concordantly, on the coast, where the contorted zone appears, between Mts. Clarence and Adelaide.

Darwin recorded two series of *basic dykes* on the south side of the harbour. They cannot be distinguished on the north, as only a few dykes and veins occur. One dyke, near the deep-water-jetty, can be traced some distance seawards: it cuts gneiss, microgranite, and pegmatite, and is crammed with corroded xenoliths of acid rocks and xenocrysts of felspar. The smaller fragments are often associated with patches of sulphides. Some basic veins are to be seen in the railway-cutting, and on the shore, near the baths. They are marginally chilled, and cut microgranite and pegmatite. A slide of the junction of one of these veins with the gneiss, shows the cataclastic structure of the gneiss very well, while the basic rock is exactly like the so-called andesites of the goldfields.

The microgranite, aplite, and pegmatites seem to be related, but there is nothing to show whether they are directly connected with the granodiorite or not.

There are numerous examples of miniature faulting in the district.

For Roelands District, see No.116A of 40 chain Maps, Lands Survey Department, West Australia.

ORDINARY MONTHLY MEETING.

JULY 26th, 1916.

Mr. A. G. Hamilton, President, in the Chair.

Miss M. HINDER, B.Sc., Mosman; Miss E. M. HINDMARSH, B.Sc., Sydney; Miss E. C. PINKERTON, B.Sc., Ashfield; Miss M. ROSEBY, B.A., Neutral Bay; and Mr. C. E. TILLEY, B.Sc., Sydney, were elected Members of the Society.

The President announced—That the Council had decided to suspend the publication of the Abstract of Proceedings while the prevailing conditions of shortage and increased cost of paper continue. Also that Members were requested to curtail the notices of their exhibits, and to omit details not directly bearing on the scientific significance of the objects exhibited.

The Donations and Exchanges received since the previous Monthly Meeting (28th June, 1916), amounting to 5 Vols., 70 Parts or Nos., 7 Bulletins, 3 Reports, and 21 Pamphlets, received from 43 Societies, etc., and three private donors, were laid upon the table

NOTES AND EXHIBITS.

Mr. E. Cheel exhibited, on behalf of Mr. Hugh Dixson, fresh flowering-specimens of *Kennedya nigricans* Lindl., and *K. Stirlingii* Lindl., two West Australian species in cultivation at "Abergeldie," Summer Hill. Mr. Dixson reports that both species are in a healthy condition; but although *K. nigricans* is an old plant, it does not mature its seed; while *K. Stirlingii* seeds freely.

Mr. A. A. Hamilton showed a series of the fruits of *Tribulus terestris* Linn., ("Caltrops") [ZYGOPHYLLEÆ] exhibiting much variability in shape, and in the length of their spiny appendages; also an example of *Notelæa ovata* R.Br.,[N.O. JASMINEÆ] exhibiting polyphylly, apparently due rather to multiplication, than to division of one or more ordinary leaves.

Mr. A. G. Hamilton exhibited five specimens of "Vegetable Caterpillars," *Cordyceps Gunnii*, collected near Albury, by the District Forest Ranger. The caterpillars concerned probably belong to the *Hepialidæ*. They burrow in the soil, and line the tubes with web. One of the specimens is surrounded by the silken tube. The type of the species showed no stipes to the fructification; but it is more usual to find a stipes varying in thickness. The specimens shown included both forms.

STUDIES IN AUSTRALIAN NEUROPTERA.

No. iv. The Families *Ithonidæ*, *Hemerobiidæ*, *Sisyridæ*, *Berothidæ*, and the new Family *Trichomatidæ*; with a Discussion of their Characters and Relationships, and Descriptions of new and little-known Genera and Species.

By R. J. Tillyard, M.A., B.Sc., F.L.S., F.E.S., Linnean Macleay Fellow of the Society in Zoology.

(Plates xii.-xix., and ten Text-figs.)

Introduction.

In No.2 of this series of Studies,* I dealt with the families *Osmylidæ*, *Myrmeleontidæ*, and *Ascalaphidæ*. There remained over for study a large number of the smaller and more generalised Neuroptera, usually included more or less loosely in the family *Hemerobiidæ*. The working-out of this material, contained chiefly in my own collection, but augmented by the loan of specimens from the Queensland Museum, Brisbane, and from Mr. Froggatt's collection, has proved a difficult and protracted task. It would not, indeed, have been difficult to offer merely descriptions of new species, for the great majority of the species studied were new to science. The problem lay rather in attempting to form a conception of the true positions occupied by the smaller "Lacewings" within the Order Neuroptera. I was faced, at the start, with the fact that the family *Hemerobiidæ* had never been clearly defined from the very outset; that, as limb after limb had been chopped off from the old Hemerobiid tree (which originally embraced the whole of the Order Neuroptera, as we now accept it), the old hollow stump had become more and more the receptacle for any remnants which would not fit clearly into

* These Proceedings, 1916, xli., pp.41-70.

any of the numerous well-defined families cut off from it. I found, everywhere, that there seemed to exist no scientific conception of what the family *Hemerobiidæ* meant; no attempt has been made to study its venation thoroughly; and the authors, who used the family, either offered short, non-committal definitions, which utterly ignored the fundamental characters of wing-venation [see, for instance, Sharp(**13**), p.465], or merely used the name as a headline under which various genera might be placed, without troubling themselves why or wherefore. It was, therefore, of the utmost importance to carry out a thorough investigation of the venation of the genus *Hemerobius* and its true allies, and to discover a clear and comprehensive definition for the family *Hemerobiidæ*, which should not only embrace all the members of one natural group, but should also exclude the extraneous material that had, for so long a time, been allowed to drift in and out of the family, with no apparent reason, other than neglect of the fundamental principles of classification.

The results of a close study of all the forms available to me were originally collected together with a view to publication as an extended introduction to this paper. I found, however, that it would be necessary to refer back continually to the general discussion, when I came to deal with the separate families. In order, then, to save much repetition, I have decided to give the main arguments *under each separate family*, where they will now be found. Those who desire to trace the fate of the family *Hemerobiidæ*, its gradual narrowing down, and my own attempt to give it definite form and function, as a unit embracing only genera having true phyletic relationship with the type-genus *Hemerobius*, will find their information under this particular family, on pp.282-293. Similarly, the vagaries suffered by *Ithone* and *Sisyra* will be found under *Ithonidæ* (pp.274-279) and *Sisyridæ*(pp.312-313), together with analyses of the types of wing-venation found in these families. In dealing with *Spermophorella*, gen.nov., I had to choose between forming a new family for it, or including it within the Holarctic *Berothidæ*. I chose the latter, for the reasons given on pp.315-316. No apology is needed for the formation of the new family *Trichomatidæ* (pp.324-325), since the two new genera forming it differ most strikingly from all known Neuroptera.

The forms studied included also the beautiful genus *Psychopsis*, usually placed in the *Hemerobiidæ*, but already recognised by N. Banks and Handlirsch as entitled to at least subfamily rank. The discovery of the complete life-history of one species of this genus, and the opportunity of examining the habits of the living larvæ, pupæ, and imagines, has so strengthened the conviction (which I had already gained from a study of the venation), that this group has nothing whatever to do with the *Hemerobiidæ*, that I have cut it out of this paper, preferring to deal with it as a separate family, *Psychopsidæ*, in a monograph to follow later.

The only true allies of the *Hemerobiidæ*, as restricted by me, are the *Ithonidæ* and *Dilaridæ*, the latter not found in Australia. These three families might well be placed together as constituting the Sub-Order Hemerobioptera, constituting the only remains of a single phyletic line of descent, defined by the exceedingly ancient character of the possession of more than one radial sector in the forewing. This character, though it may have occurred more frequently in the past, in groups now extinct (as, for example, in the Protodonata), appears to be quite lost in other recent Insecta, a reduction to a single radial sector being the almost universal rule. Its persistence in the Hemerobioptera is correlated with the retention of an ancient wing-form and venational scheme. Narrowing or lengthening of the wing would require the elimination of the extra sectors; but the Hemerobioptera on the whole, though undergoing, through the course of ages, extreme reduction in size, have retained a very uniform and unspecialised venational pattern.

Distinguished from these by the possession of a single radial sector in the forewing, the whole of the rest of the Order Neuroptera stand out as an Osmyloid stock, and might fittingly form a Sub-Order Osmyloptera. These insects, though probably not in the main aquatic in their life-histories, have been continually throwing off aquatic or semi-aquatic remnants, while the great mass of forms progressed rapidly onwards along the more successful lines offered by the rapacious, terrestrial, carnivorous, larval habit. Thus we have, as semi-aquatic offshoots, the Liassic and Jurassic *Prohemerobiidæ*, the recent *Osmylidæ* (some semi-aquatic, some terrestrial), and the highly-reduced *Sisyridæ*, whose larvæ dwell in freshwater sponges. From the first of these, our Australian *Psychopsidæ* undoubtedly arose, by a unique specialisation of the wing-venation, and by the adoption of a larval habit closely resembling that of the Raphidians in the Northern Hemisphere. From the *Osmylidæ*, a small, terrestrial side-branch, the *Nymphidæ*, favoured by an exceptionally fortunate larval development, started out on the upward path which led to the great dominant groups of the *Myrmeleontidæ* and *Ascalaphidæ*. A small side-branch of the *Prohemerobiidæ*, the Jurassic *Mesochrysopidæ*, probably gave rise to the modern *Apochrysidæ* and *Chrysopidæ*. The highly-reduced remnant of the main stem, after throwing off the aquatic *Sisyridæ*, reached the extreme limits of reduction in the *Coniopterygidæ*. The positions of the *Nemopteridæ* and *Mantispidæ* are uncertain, but the former are probably allied to the *Nymphidæ*, the latter to the *Chrysopidæ*.

We see, then, that of the five families dealt with in this paper, only two are of the true Hemerobioid stock, while the other three possess Osmyloid affinities. The resemblance between *Hemerobiidæ* and *Sisyridæ* is purely due to convergent reduction, both these families being specialised in comparison with the other three, though generalised enough when contrasted with the more dominant groups, such as the *Chrysopidæ*. Of the three most ancient families, the *Ithonidæ* appear to possess traces of Sialoid affinities, while the *Berothidæ* and *Trichomatidæ* must not only stand very close to the base of the Neuropteroid stem, but may even lie not far off from the more specialised line which led to the *Micropterygidæ* in the Lepidoptera. Lepidopterists cannot, indeed, afford to ignore the growing importance of the Neuroptera in helping them to a true view of the phylogeny of their Order. In this connection, the scales on the wings of *Berothidæ*, the fringe of long hairs in this family and in the *Trichomatidæ*, the very obvious resemblance between the venation of the *Micropterygidæ* and the most highly reduced Neuroptera (*Coniop-*

terygidæ), and the persistence of a coupling apparatus for the wings, homologous with that of the Frenate Lepidoptera, in all but the most reduced forms of these archaic families, ought to be sufficient to attract their attention from the more humdrum duties of classifying and describing an immense mass of new forms.

The following is a list of the families, genera, and species dealt with in this paper :—

Family ITHONIDÆ, fam.nov.

Genus ITHONE Newman. (Type, *I. fusca* Newm.).

1. *Ithone fusca* Newman.
2. *Ithone fulva*, n.sp.

Family HEMEROBIIDÆ (a me restricta).

Genus DREPANEPTERYX Burm. (Type, *D. phalænoïdes* Linn.).

[*D. phalænoïdes* Linn.]

Genus DREPANACRA, n.g. (Type, *Drepanepteryx humilis* McLach).

3. *Drepanacra humilis* McLach.
4. *Drepanacra instabilis* McLach.
5. *Drepanacra binocula* Newman.
6. *Drepanacra hardyi*, n.sp.
7. *Drepanacra froggatti*, n.sp.

Genus DREPANOMINA, n.g. (Type, *D. gibbosa*, n.sp.).

8. *Drepanomina gibbosa*, n.sp.

Genus MEGALOMINA Banks. (Type, *M. acuminata* Banks).

9. *Megalomina acuminata* Banks.

Genus OXYBIELLA, n.g. (Type, *O. bridwelli*, n.sp.).

10. *Oxybiella bridwelli*, n sp.

Genus PSYCHOBIELLA Banks. (Type, *Ps. sordida* Banks).

11. *Psychobiella fusca*, n.sp.

Genus MICROMUS Rambur. (Type, *M. variegatus* Fabr.).

12. *Micromus tasmaniæ* Walker.

Genus NOTIOBIELLA Banks. (Type, *N. unita* Banks).

13. *Notiobiella viridis*, n.sp.
14. *Notiobiella multifurcata*, n.sp.

Genus Carobius Banks. (Type, *C. pulchellus* Banks).

15. *Carobius subfasciatus*, n.sp.

Family SISYRIDÆ.

Genus Sisyra Burm. (Type, *S. fuscata* Fabr.).

16. *Sisyra turneri*, n.sp.
17. *Sisyra rufistigma*, n.sp.

Family BEROTHIDÆ.

Genus Spermophorella, n.g. (Type, *Sp. disseminata*, n.sp.).

18. *Spermophorella disseminata*, n.sp. (also egg and larva).
19. *Spermophorella maculatissima*, n.sp.

Family TRICHOMATIDÆ, fam.nov.

Genus Trichoma, n.g. (Type, *T. gracilipennis*, n.sp.).

20. *Trichoma gracilipenne*, n.sp.

Genus Stenobiella, n.sp. (Type, *St. hirsutissima*, n.sp.).

21. *Stenobiella hirsutissima*, n.sp.
22. *Stenobiella gallardi*, n.sp.

A list of all publications referred to during the writing of this paper is placed at the end in the form of a Bibliography. References to this are printed in thick type.

I desire to thank Dr. A. J. Turner, F.E.S., of Sherwood, Brisbane, Mr. G. Hardy, F.E.S., of the Tasmanian Museum, Hobart, Mr. O. Lower, F.E.S., of Broken Hill, and Mr. J. C. Bridwell, of Honolulu, for rare specimens dealt with in this paper, and received from them either by gift or by exchange; also Dr. R. Hamlyn-Harris, Director of the Queensland Museum, Brisbane, and Mr. W. W. Froggatt, F.L.S., F.E.S., New South Wales Government Entomologist, for the loan of material for study.

Family ITHONIDÆ, fam.nov. (Plate xii.)

Rather large insects, expanse 45-50 mm., with stout body, broad, short, sessile prothorax, and small head closely united with it; *antennæ* of moderate length and stoutness, tapering, very finely pectinate, with numerous close-set cylindrical joints; *ocelli* absent. *Wings* smooth, membranous, semitransparent, the hairs on the veins very minute; surface of forewing not a plane, Sc being sunk in a deep furrow, and R raised up on a high ridge above it; M lying in a deep furrow, and Cu_1 raised on a high ridge, which is partly continued by M_2. The same ridges and furrows on the hindwing, but the ridge of Cu_1 straighter, and not continued by M_2. Sc and R not fused distally. Three radial sectors in forewing, two arising close to base, unbranched, a third arising a little distad from these, running parallel to and under R, and giving off numerous branches. In hindwing, only one radial sector, with numerous branches. M branching into two at a level about one-third of the wing-length in both wings Cu branching into two close up to base in both wings. Numerous irregularly placed cross-veins present. Costal area of forewing slightly enlarged, a recurrent veinlet present, the other crossveins seldom forked. A coupling apparatus well developed, but without a specialised frenulum on the jugal process. A well-developed false origin to Rs in the hindwing.

I propose this new family for the reception of the very isolated and peculiar, archaic, Australian genus *Ithone*, whose relationships have long been a puzzle to entomologists. Two of the most striking characteristics of this genus are (1) its resemblance, when alive, both in general appearance and behaviour, to a Hepialid moth, the mode of flight (especially when attracted to a light), the resting position, and the form of the head and body all contributing to heighten this similarity; and (2) its undeniable similarity to the *Sialidæ*, the family in which Walker placed it. As the life-history is quite unknown, we cannot even guess what the larva may be like; but, as will be seen below, I have collected evidence tending to show that it may be aquatic or semi-aquatic. The strong ridging of the wings along R and Cu is most certainly a Sialoid character; and it must be confessed that the term Planipennia is quite unsuited to the Order which contains this genus. But a study of the venation will convince us that *Ithone* belongs to the Neuroptera, s.str., and not to the Megaloptera (*Sialidæ*), since the arrangement of all the main veins and their branches is typically Neuropterous. I should like, however, to point out that, in my opinion, *Ithone* stands not very far from the point at which the Megaloptera may be supposed to have diverged from the main Neuropteroid stem, and that it is quite possible that the larva may be of a generalised type, and not possessing the sucking mandibles of the true Neuroptera. If this be so, we must perhaps consider the separation of the Order Megaloptera from the true Neuroptera to be unwarranted.

The character which seems to me to be of the greatest importance in this family is the peculiar generalised condition of the radius and its branches in the forewing. Naming the three radial sectors R_2, R_3, and R_4, respectively, from the most distal backwards towards the base, there can be little doubt that it is R_2, with its course laid parallel to and beneath R_1 (the main stem of the radius), and with its numerous subparallel branches, which is the true homologue of the single Rs, found in all Neuroptera except the *Hemerobiidæ*, *Dilaridæ*, and *Ithonidæ*. The two sectors, R_3 and R_4, arising closer to the base of R, are strongly suggestive of an archaic formation, which we know occurred in the forewing of the great Protodonate *Meganeura* (Upper Carboniferous), and which was once probably of frequent occurrence in archaic unreduced types with dense venation. Not a trace of these two sectors exists in recent Odonata, in which the specialisation of the wing-venation appears to have set in earlier, and to have been of a far more drastic character, than we find in the Neuroptera. In the Odonata, the wing is essentially *utilitarian*, the last word in the development of a magnificent flying type. In the Neuroptera, on the other hand, the wing is, if I may say so, purely *artistic*, a beautiful expression of the development of a symmetrical plan, which conserves almost all the archaic features of the insect-wing, and, as a result, is of little value for strong flight. How the two sectors, R_3 and R_4, have been eliminated in the newer forms, we are not in a position to determine. Either they have been simply suppressed during progressive simplification of the venation, or they have passed distad on to the base of R_2, where they would take on the character of branches of the radial sector. In either case, it is clear that Comstock and Needham's proposition(3), unsupported, as far as I can see, by any evidence, cannot be accepted. This proposition was to the effect that additional sectors of R had been added, one after another, from the distal end, and had thus progressed gradually basad. Now the whole study of Neuropterous venation emphasises the fact that the tendency of branches of R (and of M and Cu likewise) is to move progressively distad, as we pass from the older to the newer forms. Again, if Comstock and Needham were correct, the old original Rs, with its many branches, would have to be the most basally placed, whereas it is actually the most distally placed in all three families where more than one sector exists. Thirdly, Comstock and Needham's proposition would necessitate a recognition of the smallest simplified *Hemerobiidæ*, with only two sectors, as archaic types, from which, by progressive elaboration of the venation, the forms with many sectors (such as *Drepanepteryx*, *Megalomus*) have been built up; whereas it must be obvious, to the most superficial student of the Order, that the very opposite is the case. The only argument in favour of Comstock and Needham's proposition is the fact that fossil Neuroptera, so far as they are known, all have a single Rs in the forewing. But the only fossils known, other than those of Tertiary age, are a a small group of forms from the Upper Lias and Upper Jurassic (the *Prohemerobiidæ* of Handlirsch, together with one or two other forms) which are clearly allied to our *Osmylidæ* and *Psychopsidæ*, and show already, in the Lias, a degree of specialisation which places them very far from the beginning of the Neuropteroid stock. Nobody would claim, I suppose, that such an admittedly archaic group as the Neuroptera arose in the Lias, or even in the Trias. It must have been already in existence alongside the Carboniferous Protodonata, these latter being, in fact, a very vigorous side-branch of the main stem, specialising in the assumption of an aquatic larval life-history. Why, then, have we so small a record of fossil Neuroptera? The answer is obvious, viz., that they have all along been essentially a non-aquatic group, with a preference for dry climates. We cannot hope, then, to find their record written completely in freshwater beds, nor can we ever expect that the ancestry of any part of them is preserved for us in fossils, except that of the semi-aquatic *Osmylidæ* and their nearest allies. As for the *Hemerobiidæ*, essentially a forest-dwelling group, we should expect to find them in Baltic amber (where several species do occur), but to look for their ancestors in freshwater or estuarine deposits, such as those at Solenhofen, is unreasonable, since they were neither aquatic, semi-aquatic, nor strong-flying, as far as we are able to judge.

I conclude, therefore, that the *Ithonidæ* are an exceedingly archaic remnant of the old Neuropteroid stock, from which, later on, the *Dilaridæ* (with only two sectors) branched off, and whose main stem is represented to-day in the more highly reduced *Hemerobiidæ*. Apart from these three families, all the rest of the Neuroptera, with their single radial sector, must be considered as a more recent and highly specialised stock, of which the *Osmylidæ* and their near allies stand closest to the ancestral form, and from which the *Myrmeleontidæ*, *Ascalaphidæ*, *Chrysopidæ*, and *Mantispidæ* arose, as the most vigorous and dominant offshoots.

The nearest relatives of the *Ithonidæ* are undoubtedly the *Dilaridæ* (not found in Australia), which may be distinguished by their smaller size, slenderer build, the strongly pectinate antennæ of the male, the presence of a large ovipositor in the female; and, in the venation, the lack of strong ridging of R and Cu_1, the possession of only two radial sectors in the forewing, and the presence of fewer unspecialised crossveins.

Genus Ithone Newman. (Plate xii.).

Newman, Ent. Mag., v., 1838, p.181.

Characters as given above for the family, with the following additions:—No setæ or fine hairs on any of the crossveins except the costals. *Forelegs* placed close under the head, with the coxæ much enlarged and close together (Plate xii., fig.2). *Tibiæ* of all legs with a pair of short spurs. *Tarsi* five-jointed, the basal joint very long, a large bilobed *empodium* between the claws. *Anal appendages* of male strongly forcipate.

Genotype, *Ithone fusca* Newman.

The two known species of the genus may be separated as follows :—

Larger and darker species, expanse 50 mm. or more, colouration fuscous; antennæ about half as long as forewing; appendages of male enormous.. *I. fusca* Newman.

Smaller, less robust and paler species, expanse 45 mm., colouration dull fulvous; antennæ two-thirds as long as forewing; appendages of male of moderate size........................ *I. fulva*, n.sp.

1. Ithone fusca Newman. (Plate xii., figs.7-9).

Newman, *loc. cit.*, p.181.

This species appears to be well known, and represented in a number of collections, but I have not seen any good description or figure of it published. Newman's description of it is very short, but quite to the point:—"Fusca, setosa, subtus dilutior et paullo flavescens, alæ fuscescentes, venæ longitudinales setis tectæ, transversæ nisi supracostales nudæ." The general appearance is much like that of *I. fulva*, n.sp., as figured in Plate xii., fig.1, but the whole body is stouter, hairier, and darker, the antennæ shorter, thicker, and darker in colour, the wings broader and much darker. The appendages of the male are very remarkable, being in the form of an immense pair of forceps of very peculiar shape; the dorsal, profile, and posterior views are shown in Plate xii., figs.7, 8, and 9 respectively.

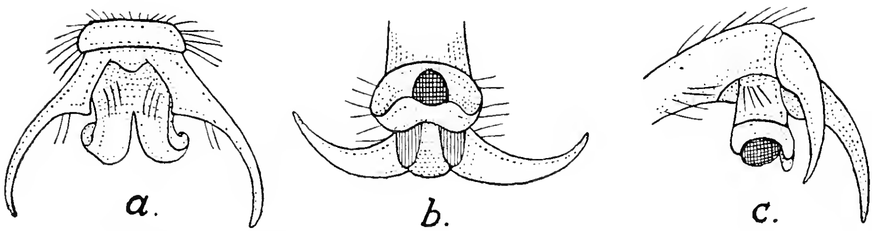
Hab.—Sydney District, N.S.W., where it appears to be at present very rare. I have a male and female taken at light in my house at Hornsby, but they are the only specimens that I have seen in the course of many years collecting. I also have some torn pieces of the wings of a specimen sent from Tasmania, but almost completely destroyed in the post, which probably belong to this species. It has also been recorded from Western Australia, but I do not know whether this is really the same species.

2. Ithone fulva, n.sp. (Plate xii., figs.1-6).

♂. *Total length* 17, *abdomen* 11·5, *forewing* 21, *hindwing* 18·5, *expanse* 45 mm.

Head: *eyes* button-like, shining black, wide apart; *antennæ* 14 mm., filiform, tapering, dull fulvous; *epicranium* brown, *clypeus* brownish, *face* and *mouth-parts* dull fulvous.

Thorax brown above, with short, blackish hairs, dull fulvous beneath; *prothorax* massive, wider than head. *Legs* dull fulvous, densely clothed with short, dark brown hairs; *tibial spines* straight, black, blunt, very short compared with first tarsal joint (Plate xii., fig.3), the latter nearly as long as the other four joints put together. Between the claws is a large *empodium* or *pulvillus* (Text-fig.1), formed of a single projecting piece, cylindrical basally, bilobed distally, but on the dorsal side only; below the lobes is seen a somewhat irregular black mass, which appears to be the dried, gummy exudation from the lumen of the organ. There can be little doubt that the pulvillus is essentially an adhesive disc, which, with the aid of a sticky secretion, enables this heavy-bodied insect to walk safely on slippery surfaces, and to rest for long periods on the outside of foliage.



Text-fig.1.—Tarsal claws and empodium of *Ithone fulva*, n.sp.,(×30): *a*, dorsal view; *b*, ventral view; *c*, nearly profile view.

Abdomen subcylindrical, tapering slightly towards apex; in profile, segments 3-7 somewhat swollen. Colour dull fulvous. *Appendages: superior* strong, forcipate, 2 mm. long, pale brownish, with short hairs; *inferior* 0·8 mm. wide, rounded, dark brown, hairy (Plate xii., figs.4-6).

Wings pale semi-transparent testaceous, with a tinge of mauve towards costal border. In Plate xii., fig.1, the radius and subcosta appear to be fused, but actually R stands on a high ridge, with Sc sunk far beneath it, so that the two come into line when viewed from above. (In *I. fusca*, R and Sc are separately visible, owing to the greater breadth of the wing).

The peculiar flattened head, sessile upon the large prothorax, the crossed mandibles, short maxillary and labial palpi, and the enlarged, contiguous procoxæ, are all shown in position, viewed from in front, in Plate xii., fig.2.

Type in Coll. Tillyard. (♂, Stradbroke Island, September 20th, 1915).

Hab.—Stradbroke Island, S. Queensland. Two males taken on September 20th, 1915; one beaten out of a cypress-tree, another found resting on reeds in a swamp.

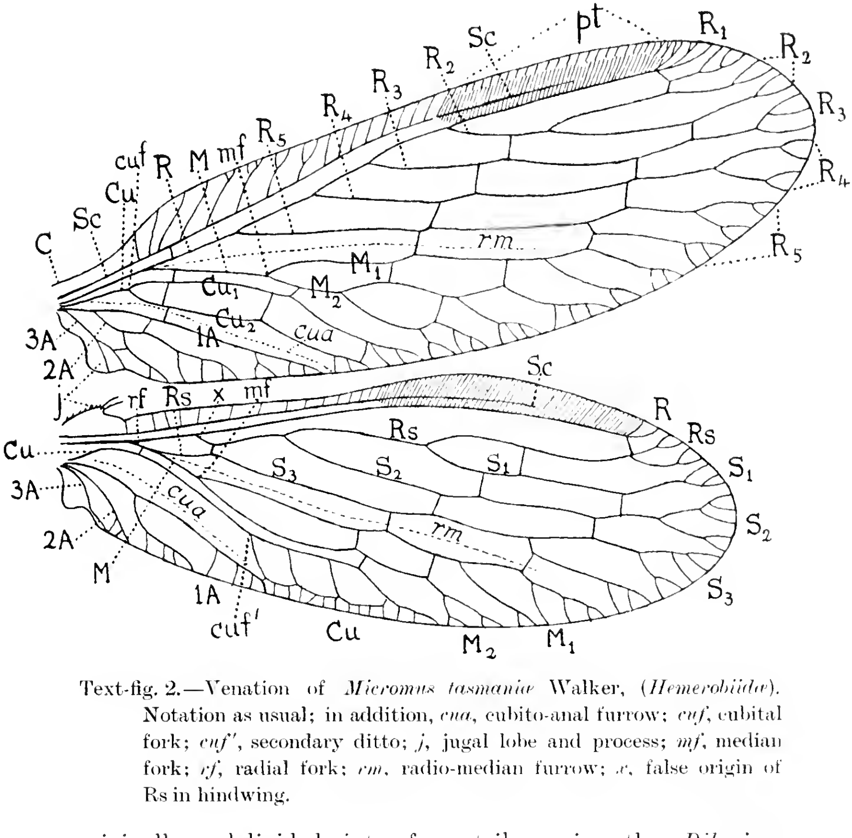
The following note on this species may help to throw some light on the question of whether *Ithone* is an aquatic genus or not. The town of Dunwich, on Stradbroke Island, is supplied with water from two large tanks, set high up on the side of a hill. Water is pumped from a perennial stream near the coast, about two miles distant, by means of a pipe-line, which discharges into tank A. Tank B is connected by a base-pipe, so that its level rises with that of A, but it receives no water direct from the pipe. When returning with Mr. H. Hacker, of the Queensland Museum, on September 21st, 1915, on our way to Dunwich to catch the steamer for Brisbane, we took the track up the hill to the Tanks. As the day was very hot, on arriving at the Tanks we stopped for a rest, and Mr. Hacker climbed the ladder placed between the tanks, in order to drink the cool water discharging into tank A. On looking into tank B, he noticed a large number of *Ithone* lying dead on the surface of the water, and called my attention to them. I ascended the ladder, but found that the depth of water in the tanks was so low (owing to the prolonged drought) that it was quite impossible to reach any of the *Ithone* with my net; also, they were all very much spoilt, and not worth securing as specimens. I noted, however, that they were of both sexes, and all appeared to be of a pale colour, as if newly emerged, while, in some cases, the wings were badly crumpled. In tank A, where the water was disturbed by the jet from the pipe, I did not notice any *Ithone* at all.

Now the question is, did all these *Ithone* fall into this tank and get drowned, while flying at night-time, either by pure accident, or perhaps because they are attracted by water? Or did their larvæ actually live in the still waters of tank B, and the imagines fail to escape on emerging, owing to the lack of reed-stems or other supports on which they could hang while their wings were drying?

As the pumps do not work at night, when these insects fly, I think that, if the former supposition were correct, both tanks should have contained numbers of this insect. But, of course, the strong jet of water in tank A may have drowned any insects that fell into it, and rendered them invisible. The abundance of *Ithone* in tank B (I counted over thirty), their evident immaturity, and the presence of both sexes, suggests the strong probability that the insect is aquatic in its larval stages.

Family HEMEROBIIDÆ (a me restricta).

Originally, the family *Hemerobiidæ* was formed to include all those insects which had a complete metamorphosis, a larva with suctorial mouth-parts, and an imago with densely-veined wings and mandibulate mouth-parts. That is to say, the insects included in this family comprised just exactly those which now form the well-defined and almost universally admitted Order Neuroptera Planipennia. Unfortunately, the old, unscientific and out-of-date treatment of the Order continues to be used in many general works on Insects, as, for example, Sharp's "Insects" in the Cambridge Natural History, 1901(**13**), and Froggatt's "Australian Insects," 1907(**5**). The initial step forward was the recognition of the fact that the old Order Neuroptera was a composite grouping. This fact was fully accepted by both Brauer (1885) and Packard (1886), both of whom restricted the Order Neuroptera to the two families *Hemerobiidæ* and *Sialidæ*. The term Neuroptera Planipennia was originally used to include three families, viz., the two just mentioned, and the *Panorpidæ*. With the elevation of this last family into a separate Order (Mecaptera or Panorpatæ), and the *Sialidæ* into a further Order Megaloptera, the Neuroptera Planipennia (or, simply, Neuroptera) was left with only those insects which went to form the old family *Hemerobiidæ*. The seven subfamilies (*Myrmeleontides*, *Ascalaphides*, *Nemopterides*, *Mantispides*, *Hemerobiides*, *Chrysopides*, and *Coniopterygides*), into which Hagen (1866) originally divided the family *Hemerobiidæ*, were then elevated to the rank of separate families. Six of these families are extremely well defined, and form natural groups well marked off from one another. The seventh, the old *Hemerobiides* of Hagen, was merely a common receptacle for all the archaic remnants of the Order. It was



Text-fig. 2.—Venation of *Micromus tasmaniae* Walker, (*Hemerobiidae*). Notation as usual; in addition, *cua*, cubito-anal furrow; *cuf*, cubital fork; *cuf'*, secondary ditto; *j*, jugal lobe and process; *mf*, median fork; *rf*, radial fork; *rm*, radio-median furrow; *x*, false origin of Rs in hindwing.

originally subdivided into four tribes, viz., the *Dilarina*, *Nymphina*, *Osmylina*, and *Hemerobiina*. The first three of these are now generally recognised as good families. Even with the removal of these, and the elevation of the fourth tribe, *Hemerobiina*, to the rank of a family, I am still unable to find any general agreement as to what constitutes a Hemerobiid!

Thus, N. Banks, in 1909, dealing with our Australian *Hemerobiidæ*(1), included both *Sisyra* and *Psychopsis* in that family. But the same author, in 1913(2), in a more general paper, includes, in the *Hemerobiidæ*, four separate subfamilies, viz., *Dilarinæ*, *Psychopsinæ*, *Osmylinæ*, and *Hemerobiinæ*, without offering any diagnosis of characters common to the four. It would, indeed, be difficult to indicate any. *Sisyra* is here put into *Osmylinæ*, to which it more properly belongs, but the same subfamily is made to include the whole of the *Nymphidæ*, *Myiodactylus*, *Polystæchotes*, and the exceedingly archaic and isolated *Ithone* ! On the other hand, Handlirsch, in 1908(6), recognised the *Sisyridæ*, *Polystæchotidæ*, *Dilaridæ*, *Nymphidæ*, and *Osmylidæ* as separate families, retaining, in the *Hemerobiidæ*, only three subfamilies, viz., *Berothinæ*, *Psychopsinæ*, and *Hemerobiinæ*.

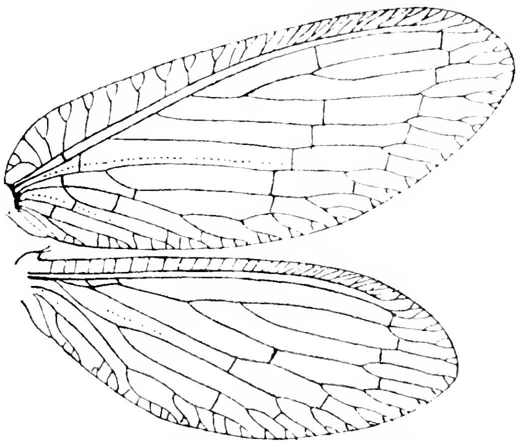
There can be little doubt that Handlirsch has most nearly achieved the task of cleansing the Augean stable, though he is certainly wrong in including *Berotha* with the *Hemerobiidæ*, since it is more closely allied to the *Osmylidæ*, as Banks supposed. I have already given my reasons for separating out the *Psychopsinæ* as a very distinct, archaic family. What, then, are the characters by which the family *Hemerobiidæ*, when reduced to its correct limits, may be known ? Nowhere have I been able to find any satisfactory diagnosis—chiefly because, as we have already seen, the family has always been so cumbered with extraneous elements that a diagnosis was impossible.

I think that the family *Hemerobiidæ* may be very clearly defined by the combination of the following characters (Text-figs.2-4):—

(1). *The presence of more than one radial sector in the forewing.* This character appears to me to be of the utmost importance, since it separates out the *Hemerobiidæ* at once from *all the rest of the Order*, except the *Ithonidæ* and *Dilaridæ*.

(2). *The absence of unspecialised cross-veins.* In the *Hemerobiidæ*, the few cross-veins left are all put to some important use, either by forming gradate series (cf. *Chrysopidæ*) or, in single cases, as special supports or junctions for longitudinal veins. Unspecialised cross-veins are present in the *Ithonidæ* and *Dilaridæ*

(3). *The presence of at least one false or secondary origin for the radial sector in the hindwing* (Text-fig.2). At least one false origin (*x*) is present in all *Hemerobiidæ* known to me, as well as in all *Chrysopidæ*. Owing to the true origin of Rs being placed too close to the base of the wing to afford the necessary support to the vein, the cross-vein placed next distad from it, between R and Rs, becomes strengthened and oblique, while the portion of Rs lying basad to it becomes weakened and often bent, and, in many cases, fuses basally with M. The result can be seen

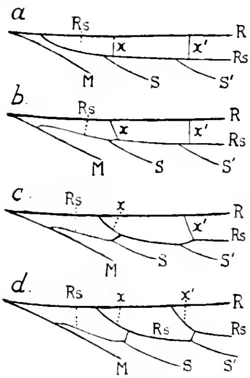


Text-fig.3.—Venation of *Hemerobius humuli* Linn.

very clearly in Text-fig.4. The false origin *x* (originally a simple cross-vein) appears to be the real origin of Rs, while the small portion of Rs, lying just basad to *x*, takes on the form of a cross-vein. In *Drepanepteryx* (Plate xiii.), a second cross-vein follows suit, and we have *two* false origins, *x* and *x′*. In *Megalomina* (Text-fig.8), we see an intermediate condition, the second cross-vein being only partly specialised, though the first has become greatly lengthened. In *Hemerobius* (Text-fig.3), two false origins are present, but are very short, owing to the close approximation of Rs to R basally.

A single false origin is always present in *Chrysopidæ*, *Ithonidæ*, and *Sisyridæ*.

(4). *The presence, in all except very reduced forms, of a coupling apparatus at the base of the wings.* The coupling apparatus (Text-fig.2, *j*; also Plates xiii.-xiv., *jl*, *jp*, *fr*) consists of two parts:—



* Text-fig.4.

(*a*) On the forewing, a convex, projecting, oval lobe, the *jugal lobe (jl)*, occupying the extreme base of the posterior margin.

(*b*) On the hindwing, a concave, projecting, and somewhat angular process, the *jugal process (jp)*. The upturned edge of this process is fringed with fine setæ, while its apex, or angle, carries one or more very strong and stiff bristles of a larger size, constituting a true *frenulum (fr)* directed outwards.

During flight, the two wings on one side are coupled together by the projecting jugal process with its frenulum of bristles, which passes beneath the base of the forewing, so as to project upwards into the concavity of the jugal lobe.

These structures have frequently been remarked upon in *Drepanepteryx*, where they are, indeed, very conspicuous, and have been well figured by Sharp (**13**; p.468). McLachlan also described them as present in *Megalomus*, though less conspicuous. It seems extraordinary, therefore, that nobody should have noticed their presence in other genera of this family. I have examined the Palæarctic genera *Boriomyia*, *Hemerobius*, *Micromus*, and *Sympherobius*, and I find the coupling apparatus quite

* Diagrams to show phylogenetic development of false origins of Rs in hindwing: *a*, archaic stage, crossveins unspecialised (e.g., *Spermophorella*, Pl. xvii.); *b*, intermediate stage, first crossvein becoming oblique, Rs hitched on to M; *c*, false origin completed at *x*, second crossvein becoming oblique (e.g., *Megalomina*, Text-fig.8); *d*, two false origins completed at *x* and *x'* (e.g., *Drepanepteryx*, Pl. xiii.).

conspicuous in all of them. It is also present in all Australian genera; though, in extremely small and reduced forms like *Carobius* and *Notiobiella* (Plate xvi.), the jugal process is either absent or only represented by a frenulum.

That the apparatus is of very archaic origin is shown, not only by its being most highly developed in the oldest and most densely-veined forms of *Hemerobiidæ*, but also because it is present and well formed in *Ithone*, which stands very close to the ancestral stem of those insects.

(5). *The absence of any distal fusion between Sc and R.* This is the character relied upon by N. Banks. Unfortunately, in some of the most reduced genera (e.g., *Carobius*), Sc and R are so close as to be practically fused throughout their length. Also, in the *Chrysopidæ*, there is no fusion between Sc and R distally. However, from a phylogenetic point of view, the character is important, since it shows us a point in which the *Osmylidæ* and *Psychopsidæ* have undoubtedly progressed beyond the *Hemerobiidæ*. In the *Chrysopidæ*, Sc runs into the pterostigma well above R, and ends weakly there. This appears to be most certainly a specialisation from an original Hemerobiid-like condition of Sc and R. Lastly, in *Ithone*, there is the same condition of Sc as in the *Hemerobiidæ*, but Sc is deeply sunk under the high ridge of R.

(6) *The archaic, unspecialised form of Rs.* This character is shared with most other families of Neuroptera, but serves to enable us to distinguish the *Hemerobiidæ* from the *Chrysopidæ*, in which Rs is zig-zagged.

(7). *The retention of the archaic branchings of the veins as they approach the wing-border.* In the *Hemerobiidæ*, these branchings are present, and usually numerous, for all veins from the pterostigma outwards to the apex, and round along the posterior border to the base. In the costal space of the hindwing, from base to pterostigma, the cross-veins are regular and unbranched. In the forewing, however, these same cross-veins are elongated and usually branched. Only in those genera, in which the costal space of the forewing is not enlarged, do we find any considerable number of these veins unbranched.

Phylogenetically (if we may take the venation of the Mesozoic fossils as a true guide), there can be little doubt that the most archaic condition is that in which the costal space is not unduly enlarged, and the costal cross-veins either slightly, or not at all, branched, while the veins approaching all the rest of the wing-border are freely branched. Thus the costal space of the *hind-wing* retains the archaic form, while the great enlargement of the same space in the forewing, seen in such genera as *Drepanepteryx*, together with the formation of the *recurrent costal veinlet* (Plate xiii., Cr) must be regarded as specialisations correlated with increase in wing-breadth.

(8). *The fusion of M with R basally in the forewing, and the fusion of M in the hindwing with the weakly formed, original, basal portion of Rs.* These are distinct specialisations in the venation, which, though found in the *Chrysopidæ* and *Dilaridæ* also, offer a definite distinction from the *Ithonidæ* and *Osmylidæ*, where M is fused with R in both wings.

(9). *The unspecialised form of the antennæ.* These are formed of very numerous, small joints, the basal joint being usually slightly enlarged. The antennæ may be described as slender, moniliform, and very finely pectinate. In length, they vary from a little less than half the wing-length (*Drepanepteryx*), to about the full length of the wing (*Oxybiella*). They most closely resemble the antennæ of *Osmylidæ* (probably the most archaic form of these organs), but these latter have the separate joints longer and thinner by comparison. The antennæ also serve to distinguish the *Hemerobiidæ* from the *Psychopsidæ*, in which these organs are exceedingly short; from the *Chrysopidæ*, in which they are exceedingly long; and from the *Nymphidæ*, in which they are distinctly thickened.

(10). *Position of rest:* the wings completely hiding the body, and placed almost vertically to the resting-plane, with the costal margins downwards, the posterior margins meeting in a high ridge above the body; the head bent downwards, and often partly hidden by the projecting costæ of the forewings.

This resting-position is very like that of the *Osmylidæ*, and *Coniopterygidæ*, in both of which, however, the head shows much more freely in front of the wings, while the approximation of the two pairs of wings towards the mid-vertical plane is not so great. The *Psychopsidæ* rest quite differently, with the wings forming a very flat roof over the body, the angle between each forewing and the resting-plane being very small. The resting position of *Ithone* resembles that of a Hepialid moth.

Having thus indicated the principal characters of this (as it seems to me) exceedingly clearly defined family, we may summarise them in the following short definition. *Small, short-bodied insects with short prothorax. Antennæ of moderate length, moniliform, finely pectinate. Ocelli absent. Wings held almost vertically in repose, with costal margins downwards, completely hiding the body. Generalised form of Rs (not zig-zagged), and numerous branchings of the veins at the margins of the wings. Sc and R not fused distally. M fused basally with R in forewing, with weak base of Rs in hindwing At least two radial sectors in forewing; only one in hindwing, but this one strengthened by the development of at least one false origin, formed from a cross-vein placed distad from the true origin. Absence of all unspecialised cross-veins; the few that are present forming either gradate series or special braces between the main veins. A coupling apparatus. in the form of jugal lobe and process, nearly always present at base of wings.*

The *Hemerobiidæ*, then, are distinguished from the other families with which they are likely to be confused, as follows (the characters are numbered as above):—

From all except the *Ithonidæ* and *Dilaridæ*, by (1): from the *Ithonidæ* and *Dilaridæ* by (2). In particular

From the *Psychopsidæ* by (1), (3), (4), (5), (9), and (10).

From the *Osmylidæ* by (1), (2), (3), (4), (5), (8), and (9), as well as by the peculiar, elongated and upcurved mandibles of the Osmylid larvæ.

From the *Chrysopidæ* by (1), (4), (6), (7), (9), and (10).

From the *Sisyridæ* by (1), (5), and the important differences in larval form and life-history.

From the *Berothidæ* by (1), (3), (4), and (5), and the absence of any scales on the wings of the female.

The genera *Rapisma* and *Oliarces*, included in the *Hemerobiidæ* by N. Banks(2), must be removed from that family as defined above, on account of the presence of only one radial sector, and numerous, unspecialised cross-veins. I think that a new family will be required for these two genera. They are not found in Australia.

I have not attempted to divide the *Hemerobiidæ* into subfamilies, because it seems to me that a single phyletic line of descent is clearly indicated, with all the intermediate stages still present, from the comparatively large, densely-veined, and most generalised form (*Drepanepteryx*) right down to the smallest forms (*Sympherobius*, *Notiobiella*, etc.) in which the venation is comparatively simple, and in which all the signs of a high specialisation by reduction are evident. Thus, if we attempt to separate *Drepanepteryx* and its allies off on a very important venational character (as I had hoped to do), viz., the presence of the original Cu_2 in the hindwing, we shall make an unnatural grouping: for a new genus (*Drepanomina*) has just come to light, which is most certainly a close ally of *Drepanepteryx*, but lacks this important vein. Nor does the falcate form of wing justify us in elevating this same group into a subfamily, since, in other respects, *Drepanomina*, *Megalomus*, and *Megalomina* are very closely allied. Again, while we can pass in a descending scale (by reduction) from *Drepanepteryx to Drepanacra*, thence to *Drepanomina*, and thence directly to the pointed-winged forms *Megalomina* and *Oxybiella*, the connection with the smaller, round-winged forms is supplied by *Micromus*, which is clearly a specialisation from *Megalomina* (loss of recurrent costal vein by narrowing of costa), and in a somewhat different direction by *Psychobiella* (fusion of the two basal radial sectors of forewing into one). Thus we arrive, at last, at a form with only three radial sectors in the forewing. The final reduction to two radial sectors is actually accomplished, in the Palæarctic region, within the range of the type-genus *Hemerobius* itself; while, in Australia, the line of reduction passes on from *Psychobiella* to *Notiobiella*, with *Carobius* as a side-branch.

In the actual practice of determining genera of *Hemerobiidæ* from tables or keys based upon venation, it seems to me that much confusion would be avoided (especially for those whose knowledge of the group is not extensive) if two points were carefully borne in mind. Firstly, it is necessary to be able to pick up the median vein at a glance. But, owing to the basal fusion of this vein with R or Rs, how can we recognise it with certainty, except by recourse to the pupal tracheation? This can always be done by looking for the *radio-median furrow* (Text-fig.2, *rm*), a deep groove which separates the last (most basal) branch of R in the forewing, or Rs in the hindwing, from M. This furrow runs just anteriorly to M, and, in certain lights, it shows up as a white, shining line, even more conspicuous than the veins themselves. The median vein also is always two-branched in *Hemerobiidæ*, the fork being called the *median fork* (Text-fig.2, *mf*). In the Plates, *rm* is represented as a dotted line. A similar, very distinct furrow separates Cu from A, and is designated the *cubito-anal furrow* (Text-fig.2, *cua*). Occasionally, as in *Drepanepteryx* (Plate xii., fig.1), a third furrow, the *medio-cubital*, separates M from Cu, but usually this is absent.

Secondly, it must be remembered that the cubitus of the hindwing in *Hemerobiidæ* is a highly specialised vein. In most genera, it forms a high ridge, and is much stronger and thicker than any vein near it. Now the sharp forking of this ridge, which can often be seen at a level distad from that of *mf*, is *not* the *primary fork* (*cuf*) dividing Cu into Cu_1 and Cu_2, but the *secondary fork* (*cuf'*) dividing Cu_1 into Cu_{1a} and Cu_{1b}.* This can be seen at once by referring to *Drepanepteryx* or *Drepanacra* (Plate xiii.), where *cuf* may be seen very close to the base of the wing, with Cu_2 as a weak vein running parallel and close up to Cu_1. How Cu_2 has been lost, can be clearly seen in *Drepanomina* (Plate xiv., fig.18), where the cubito-anal furrow is double,

* The resemblance of this secondary fork to the cubital fork in *Myrmeleontidæ* has led me to re-examine the structure of the cubitus in this latter family. As a result, I have discovered, in the *Dendroleontinæ* and *Acanthaclisis*, the remnant of the true Cu_2 near the base of the forewing. It follows that the branch hitherto called Cu_2 is in reality Cu_{1b} for the forewing, and probably for the hindwing also.

the anterior portion representing the just-vanished vein, the posterior the true furrow.

If these points be kept in mind, there should be no difficulty in determining all the Australian genera from the key here offered. As most of the Australian forms are exceedingly rare in collections, I have figured every known genus, in the hope that our Lepidopterists and Coleopterists, even if they cannot be expected to master the intricate venation of the wings, may recognise their captures from the figures, and save them for the advancement of the study of this interesting family, of which Australia may yet be proved to possess a large number of representatives.

Key to the Australian Genera of the Family *Hemerobiidæ*.*

	Forewing distinctly falcate at tip, the margin of the wing being distinctly excavated posteriorly to the apex (*Drepanepteryx*-group)	1.
	Forewing either rounded or pointed at apex, but not falcate. (*Hemerobius*-group)	2.
1.	Costal area of forewing broad at base, narrowing gradually and regularly towards pterostigma. Cu_2 present in hindwing	3.
	Costal area of forewing narrow at base, then swelling out into a kind of hump, and finally becoming very narrow again towards pterostigma. Cu_2 absent in hindwing, its position occupied by a furrow..... *Drepanomina*, n.g.(Type *D. gibbosa*, n.sp.).	
2.	Forewing distinctly pointed at apex	4.
	Forewing rounded at apex	5.
3.	Forewing with numerous (ten or more) radial sectors, and with M_1 and M_2 both branched again close to *mf*. Hindwing with Cu_2 not united to Cum, distally. Three complete gradate series in forewing, two in hindwing............ ....*Drepanepteryx* Burm.,(Palearctic).(Type *D. phalænoïdes* L.).	
	Forewing with fewer (four to six) radial sectors, and with no secondary branchings of M_1 and M_2. Hindwing with Cu_2 and Cum, united distally. Only two complete gradate series in forewing; hindwing with outer gradate series complete, inner series represented by a few cross-veins............ ....*Drepanacra*, n.g.(Type *D. humilis* McLach.).	

* The Palaearctic genus *Drepanepteryx* is included, in order to show the differences between it and the Australian species, which have hitherto been included in it.

4. Forewing broadly lanceolate, with three gradate series.........*Megalomina*.(Type *M. acuminata* Banks).
Forewing narrowly lanceolate, with only two gradate series, of which the outer is irregular and incomplete.................*Oxybiella*, n.g.(Type *O. bridwelli*, n.sp.).

5. Three to six radial sectors in forewing.............................. 6.
Only two radial sectors in forewing................................ 7.

6. Forewing with only three radial sectors, one arising near base, and two close together near middle of wing; recurrent costal veinlet present...*Psychobiella* Banks.(Type *Ps. sordida* Banks).
Forewing with from four to six radial sectors; recurrent costal veinlet absent.........*Micromus* Ramb. (Type *M. variegatus* Fabr.).

7. No distal gradate series in either wing.............................*Notiobiella* Banks.(Type *N. unita* Banks).
A long, distal gradate series present in forewing, a short one in hindwing............*Carobius* Banks. (Type *C. pulchellus* Banks).

Genus DREPANEPTERYX Burm. (Plate xiii., fig.1).

I propose to restrict this genus to the Palæarctic species with the characters given above in the table. Genotype, *D. phalænoïdes* L.

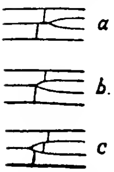
Genus DREPANACRA, n.g. (Plates xiii.-xiv., figs.12-17).

This genus is proposed for the reception of all but one of the Australian and New Zealand species, hitherto placed in *Drepanepteryx*. Characters as given above in the table. Genotype, *D. humilis* McLach.

Three species of this genus have so far been described, viz., *D. binocula* Newman (1838), from "New Holland," *D. instabilis* McLachlan(1863), from New Zealand, and *D. humilis* McLachlan (1863), from Australia and New Zealand. McLachlan gave excellent descriptions and figures of both his species. Newman's description of *D. binocula* is very brief, and gives no details of the shape or venation of the wings. The date of Newman's specimen makes it fairly certain that it came from New South South Wales, and probably from near Sydney. I have seen a large number of specimens of the genus from different parts of Australia, chiefly from the neighbourhood of Sydney, and I have never seen any form that possessed the conspicuous, round spot, encircled by a pale ring, near the posterior angle of each forewing, which can be seen in Newman's type. All the species are, however, so exceedingly variable in ground-colour and markings, that it seems almost certain that Newman's type was an extraordinary variation, which may not turn up again for a very long time. As *D. humilis* McLach., is, at the same time, the commonest and the least variable species, it seems wise to fix this species as the type of the new genus *Drepanacra.*

In this genus, variability is not confined to the colouration, but extends also, within certain limits, to the venation of the wings, while the limits of size for any given species are also considerable. The task of working out the material which has passed through my hands has been a very laborious one; though, indeed, it would prove delightful enough to the confirmed "splitter," who could describe new species to his heart's content, on the extraordinary variations of colour-scheme. A peculiar difficulty is met with in this and many other Hemerobiid genera, viz., that, after death, the body, inconspicuous enough even in life, shrivels up so completely that it is quite useless for specific diagnosis. As for the colour of the antennæ, this varies with age, being palest in freshly emerged specimens. We must have recourse, then, almost entirely to the wings for our specific characters. Even here, we must proceed with great caution, and define our species so as to take account of the extremes of venational variation.

Two characters that are of the greatest importance generally in the *Hemerobiidæ*, and that have been used for defining species in *Drepanacra* by McLachlan, are found to be variable when any large number of specimens is examined. These are (1) the number of cross-veins in the gradate series, (2) the number of radial sectors in the forewing. In order to explain the reason for the variability in these characters, reference should be made to Text-figs.5 and 6. As regards the outer gradate

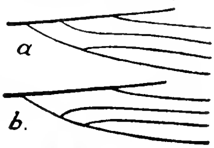


* Text-fig.5.

* Diagrams to show inconstancy of number of crossveins in the outer gradate series of *Drepanepteryx*: *a*, usual condition; *b*, approach of a fork to gradate series; *c*, interpolation of an extra crossvein in the gradate series.

series (Text-fig.5), we see that a distal forking of one of the sectors may become interposed between two of the gradate veins, and thus allow of the occasional introduction of an extra cross-vein. I propose, therefore, to lay down two rules for numbering these cross-veins:—(*a*) only to count cross-veins from the most anterior branch of Cu_1 upwards; (2) to give, as the *normal* number, the number counted in specimens in which no extra cross-vein is interposed in the manner shown in Text-fig.5, *c*.

Secondly, as regards the number of radial sectors in the forewing. In all specimens of *Drepanacra* which I have examined, the most distal branch of R, viz., R_2, gives off one or more *posterior* branches, while the most basal branch gives off one or more *anterior* branches. The branching of the former is nearly constant, there being only *two* posterior branches (small forkings distad from the outer gradate series are not taken into account). But, for the most basal branch, we find two conditions almost equally prevalent. Either this branch gives off only a single, anterior branch, and is followed distally along R by a *fixed number* of simple sectors; or else it gives off *two* anterior branches, and is followed by *one less than this fixed number* of simple sectors. The explanation of this is, that what is really the second sector from the base frequently becomes detached from R, and fuses on to the most basal sector, giving it an extra branch anteriorly. This is shown in Text-fig.6. A single specimen sometimes has the condition *a* on one side, and the condition *b* on the other. To deal with this variability, I propose the following plan. An imaginary line, drawn approximately parallel to and just inside the outer gradate series, will cut all the radial sectors and their main branches. If we denote a single sector by the figure 1, a sector with one branch by 2, and so on, and reckon from the distal (anterior) end of our imaginary line



* Text-fig.6.

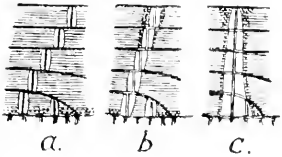
* Variation in condition of branches of radius in forewing of *Drepanepteryx*: *a*, archaic condition; *b*, the second branch from the base becomes hitched on to the most basal branch.

downwards to M_1, we obtain what I shall call the *radial formula*, which may be equated to the total number of branches passed. Thus for *D. humilis*, as figured in Plate xiii., fig.2, we have

Radial formula, 3 + 1 + 1 + 1 + 2 = 8 (the count stopping short at the vein lying above the radio-median furrow, shown as a dotted line). An equally common, radial formula for this species is 3 + 1 + 1 + 3 = 8, representing the case shown in Text-fig.6, *b*.

One of the most remarkable structures to be seen in the wing of *Drepanepteryx phalænoïdes* is the peculiar transparent patch, at about the middle of the posterior border of the forewing, resembling a split or tear in the wing. Such a structure I propose to call a *fenestella* (Lat. = a little opening). It occurs in a slightly less conspicuous form in some species of *Drepanacra*. Its effect is to give the insect, when at rest, the appearance of a dead leaf, with a small tear in it. It is clearly a development correlated with the falcate type of wing, for the effect of a dead leaf is obtained primarily by this latter formation, and there is no record of a fenestella occurring in any but a falcate wing. This is a nice little problem in protective resemblance, which has long puzzled entomologists.

If we examine a fenestella (Plate xiii., figs.11, 13), we shall see that the apparent interruption of the veins is a very simple deception brought about by the absence of pigment. The veins are all present, and are all easily seen under a moderate power of the lens, the actual condition being such as I have shown in my drawings, and not as figured by Sharp (**13**; p.468). The "split" effect is obtained (1) by the complete absence of pigment on the wing-membrane within the fenestella itself, and (2) by a certain amount of increase of the pigment surrounding it. To understand how the fenestella arose, we must first of all realise that it is formed around a small series of cross-veins which have been brought into line; they are, in fact, a posterior extension of the outer gradate series, originally, no doubt, arranged in step-form, but later on combined to form a single line running transversely in from the wing-border. Now we have many cases of the enclosure of gradate cross-veins in small pigmentless areas, in an otherwise pigmented wing. For instance, in *Psychopsis illidgei*, the whole of the outer gradate series runs through a deeply pigmented brown mark on the wing; but each separate cross-vein is enclosed in a tiny clear area of the kind shown in Text-fig.7, *a*. If we admit that the fusion of our cross-veins, in the case of *Drepanepteryx*, took place originally as a specialisation for mechanical advantage, and that, at the same time, these cross-veins happened to be enclosed in small, clear areas as they are in *Psychopsis illidgei*, we get at once a weak fenestella of the form seen in *D. humilis*. A slight extension of this gives us the well-formed fenestella of *D. phalaenoïdes*. Thus it would seem that the formation of this peculiar structure may well be due to the accumulation of small, advantageous variations to the benefit of the species, and that it is really an excellent illustration of the action of "natural selection" in the strict, Darwinian sense.



* Text-fig.7.

In *Drepanacra*, the forewing is considerably less falcate than it is in *Drepanepteryx*. It is interesting, therefore, to find in this genus the development of still another structure of the same nature as the fenestella, viz., a set of one or more, white (unpigmented) *lunules* along the falcate border of the wing. One of these lunules is shown in Plate xiii., fig.14, enlarged, while the set of three, usually present in *D. humilis*, is shown in fig.12 of the same Plate. These structures not only serve to increase the *apparent falcation* of the wing, but, when well developed, they suggest a series of small "bites" or "tears" out of the edge of the dead leaf, which the wing so closely represents in repose, and thus contribute, presumably, to the immunity from attack enjoyed by these archaic insects.

As regards the *frenulum* of *Drepanacra* (Plate xiv., fig.19), it is of a more specialised form than that figured by Sharp(**13**; p.168) for *Drepanepteryx*. I find, in the males of *D. humilis*, that the

* Diagrams to show the evolution of a fenestella: *a*, gradate crossveins in small, clear areas; *b*, alignment of same; *c*, fenestella completed.

frenulum consists of a single, strong bristle, usually blackish; while, in the females, there are two, somewhat shorter and paler bristles, one longer than the other. In *D. instabilis*, it is probable that the same condition holds, but I have seen only three females of this species. Thus it would seem that the form of the frenulum is of no help in specific diagnosis, but that it enables us to distinguish the sexes, when, as is usually the case, the abdomen is too shrivelled for that purpose. The average expanse of the females is about 1 mm. greater than that of the males, for any given species.

The following key will separate the five known species:—

Forewing with a conspicuous, nearly round, dark spot, encircled by a pale ring, situated near the posterior angle. Expanse 15 mm. .... *D. binocula* (Newman).
Forewing with no such spot .... 1.

1. Small species, expanse 15-16 mm., without any definite fenestella, radial formula $3+1+1+2=7$, rarely $4+1+1+2=8$. .... 2.
Larger species, expanse 16-22 mm., fenestella present; radial formula totalling 8 or 9. .... 3.

2. Tip of forewing barely falcate; deep mottled grey-brown colouration on forewings .... *D. hardyi*, n.sp.
Tip of forewing distinctly falcate; forewings pale, with irregular, brownish markings .... *D. froggatti*, n.sp.

3. Ground-colour of forewing uniform ochreous or medium brown, without numerous irregular markings, and with little or no sign of numerous, oblique fasciæ extending inwards from costa. Forewing slightly falcate, with moderately rounded tip. Usually three lunules. Radial formula nearly always totalling 8. Hindwing with 5-6 branches of Rs. Expanse 16-18 mm. .... *D. humilis* (McLach.).
Forewing much more irregularly marked, with numerous, distinct, oblique fasciæ extending inwards from costa; very distinctly falcate, with pointed tip. Radial formula totalling 8 or 9. Hindwing with 6-7 branches of Rs. Expanse 19-22 mm. .... *D. instabilis* (McLach.).

3. DREPANACRA HUMILIS McLachlan. (Plate xiii., figs. 12-14).

McLachlan, Journ. Ent., Nov. 1863, pp. 111-116.

The venation figured in Plate xiii., fig. 12, is that of a female, expanse 18 mm. The following seem to be the most important characters. *Radial formula* usually either 3 + 1 + 1 + 1 + 2 = 8 (as in figure) or 3 + 1 + 1 + 3 = 8 (as in specimen figured by Esben-Petersen, These Proceedings, 1914, xxxix., Pl. lxxiv., fig. 8); very rarely 2 + 1 + 1 + 1 + 1 + 2 = 8. *Hindwing* with 5-6 branches of Rs, usually 5, the two false origins of Rs well-formed but short; very little cloudiness on hindwing, usually only along costa and proximal part of posterior margin to Cu_{1b}, and a cloud on Cu_{1b} itself. *Fenestella* usually fairly distinct, sometimes not very clear. *Lunules* distinct, three in number, very rarely four. *Number of gradate cross-veins* above Cu_1, in forewing, 9-10 in inner, 11-13 in outer series; in hindwing, 4 in inner, 10-11 in outer.

As regards Australian specimens, it may be given as a general rule that the most northern forms are the smallest and palest, the most southern forms the largest and darkest. McLachlan's type, from Moreton Bay, is smaller than any specimen I have examined. The specimen from Melbourne, examined by Mr. Petersen, and determined as conspecific with McLachlan's type, has an expanse of quite 18 mm.; while the expanse of the type-specimen is given as "7 lines," *i.e.*, just over 14 mm., which is considerably smaller than any specimen of *Drepanacra* known to me. I think, however, that the printed measurement is an error, since the body-length is given as "3 lines," and the very carefully drawn figure shows the expanse to be quite thrice the body-length.

The following varieties, or forms, may be distinguished.

a.—The type-form; ground-colour of forewings greyish-ochreous, subhyaline, with a few, scattered, black dots; hindwing with ochreous pterostigma.

This form is typical of S. Queensland and New South Wales; Victorian specimens are, on the whole, slightly darker and more distinctly marked, usually with a distinct row of black spots along the inner gradate series. One Victorian specimen in Mr. Froggatt's collection has the forewings a rich brown, the hindwing shaded with brown.

Localities.—Brisbane district, S. Queensland; Sydney district, N.S.W., common (including two specimens bred from larvæ found in rolled-up leaves of *Eucalyptus* saplings, feeding upon the common Sugar-lerp, *Psylla eucalypti*, at Hornsby); National Park, N.S W., fairly common; Melbourne, Victoria; Mt. Wellington, Tasmania.

b.—Var. *tasmanica*; ground-colour of forewings rich russet-brown; hindwing with reddish pterostigma. The usual form taken in Tasmania; Hobart; Maria Island.

c.—Var. *longitudinalis*; a dark, longitudinal streak runs from base to apex of forewing.

National Park, one specimen, November 20th, 1915; Maria Island, Tasmania, one specimen, December 31st, 1915, taken by Mr. G. H. Hardy. This latter has the ground-colour of var. *b.* The National Park specimen has a radial formula,

$$2+1+1+1+1+2=8.$$

4. DREPANACRA INSTABILIS McLachlan. (Plate xiv., fig.15).

McLachlan, Journ. Ent., Nov. 1863, pp.111-6.

The venation figured is that of a female, expanse 21 mm.

Radial formula $3+1+1+1+3=9$, or $4+1+1+3=9$, or $3+1+1+4=9$. Very rarely, $3+1+1+1+2=8$. *Hindwing* with 6-7 branches of Rs, usually 6; the two false origins of Rs are longer than in *D. humilis*; cloudiness usually much more marked than in *D. humilis*. *Fenestella* usually quite distinct, and placed more perpendicularly to the wing-margin than in *D. humilis*. *Lunules* very distinct, usually four, rarely three or five. *Number of gradate cross-veins* above Cu_1, in forewing, 10-11 in inner, 12-14 in outer series; in hindwing, 4-5 in inner, 10-12 in outer.

Differs from *D. humilis* in its larger size, stouter thorax, more falcate wing-tips, slightly denser venation, and generally much more varied colouration.

McLachlan's type was described from New Zealand; his figure shows a beautifully variegated form. The three specimens which

I have seen, and which I refer to this species, are of very different appearance from one another, as follows:—

a.—A beautifully variegated specimen from Brisbane, not unlike the type in markings.

b.—Var. *pallida.* An almost colourless, transparent specimen from Hobart, Tasmania, taken by Mr. C. Cole, December 16th, 1915, and forwarded by Mr. G. H. Hardy. The lunules and fenestella are deeply bordered with blackish. There is also a black patch near the base of the hindmargin of the forewing, and some dark specks along Sc + R. Radial formula is 3 + 1 + 1 + 3 = 8 on one side, 3 + 1 + 1 + 1 + 2 = 8 on the other.

c.—Var. *rubrinervis.* A richly marked specimen from Maria Island, Tasmania, taken by Mr. G. H. Hardy, April 3rd, 1915. Ground-colour of forewing rich brown, with a patch of russet on costa; many of the veins crimson; numerous darker irrorations all over the wing, and several oblique fasciæ extending into the wing from the costa; hindwing clouded all round the margin and along Cu_{1b}.

5. DREPANACRA BINOCULA Newman.

Ent. Mag., v., 1838, p.400. See also McLachlan, *loc. cit.*

The expanse is given as "·6 unc" = about 15 mm. As I have already stated above, I think that this type will prove to be an exceptional variety of one of our commoner species, in which case the name now in use must sink as a synonym of *binocula* Newm. I know of no specimens of *Drepanacra* with a conspicuous eye-spot on the wings. The type is in the British Museum, so that it may be possible to get a detailed description of the form and venation of the wings later on.

6. DREPANACRA HARDYI, n.sp. (Plate xiv., fig.16).

A single specimen taken by Mr. C. Cole at Hobart, Tasmania, on December 18th, 1915, and forwarded by Mr. G. H. Hardy, is so distinct from all other specimens seen by me, that I have no hesitation in naming it as new to science. Expanse 15·5 mm.

Radial formula 3 + 1 + 1 + 2 = 7 on left side, 4 + 1 + 1 + 2 = 8 on right side. *Forewing* broad, scarcely falcate, deep grey, spotted and marked all over with darker grey-brown, hindwing much clouded. Cross-veins of the outer gradate series in both wings strongly marked with black. *Hindwing* with six branches to Rs. *Fenestella* absent. *Lunules* of forewing coalesced into a single, long lunule. *Number of gradate cross-veins* above Cu_1, in forewing, 9 in inner, 11 in outer series; in hindwing, 3 in inner, 10 in outer series.

Type in Coll. Tillyard. Unique.

Easily distinguished by its small size, broad and scarcely falcate forewings, dark grey-brown colouration, absence of fenestella, and fusion of lunules.

7. Drepanacra froggatti, n.sp. (Plate xiv., fig.17).

A small specimen, expanse 15·5 mm., in Mr. Froggatt's collection. Resembles *D. hardyi* in size and venation, and in the absence of fenestella; differs from it in possessing a much more falcate forewing, and a totally different colouration, this latter being variegated as in the type-form of *D. instabilis* McLach., but duller. Ground-colour of forewing pale greyish-ochreous, semi-hyaline; an irregular, dull brownish cloud behind the lunules, which are separate, four in number, but not very distinct; a slight brown cloud around the median fork, and five or six, faint, oblique, brown fasciæ running into the wing from the costa. About five of the cross-veins of the outer gradate series, situated behind the lunule, marked with black. Hindwing marked with greyish-brown on pterostigma, along base of hind-margin, along whole of outer gradate series, and on Cu_{1b}.

Type in Coll. Froggatt. Unique. Not labelled, but Mr. Froggatt tells me that it was taken in Victoria. It resembles a very dwarfed *D. instabilis*.

Genus Drepanomina, n.g. (Plate xiv., fig.18).

Characters as given above in the table.

A very distinct genus, easily recognised by the costal hump on the forewings, the extreme falcation of both fore- and hind-wings, and the absence of Cu_2 in the hindwing.

Genotype, *D. gibbosa*, n.sp.

Apart from the peculiar shape of the wings, the venation shows this genus to be closely allied to *Megalomina* Banks, with which it agrees in the number and form of the gradate veins, there being three in the forewing and two in the hindwing, though the middle series of the forewing and the inner of the hindwing are more complete than in *Megalomina*.

8. DREPANOMINA GIBBOSA, n.sp. (Plate xiv., fig.18).

Total length 7 mm., *forewing* 10 mm., *expanse* 21·5 mm.

Head brown, heavily marked with shining black on epicranium and face: eyes dark brown; *antennæ* pale brown at base, the rest ochreous, annulated with dark brown. Thorax: *prothorax* blackish, with a rich orange-brown median patch on notum; rest of thorax blackish, with a paler brown border posteriorly on metathorax. Abdomen (shrunken) brownish; markings indistinct. Wings: *forewings* with all veins alternately speckled with dull whitish and dark brown, the general effect being a medium brown colour all over the wing; posterior margin from apex nearly to base marked with dark brown in regular patches, isolating paler areas suggestive of the lunules of *Drepanacra*; a darker brown cloud runs obliquely across the wing not far from the falcate border, and is widest on the posterior margin, and tapering almost to a point towards the costa, not far from the apex; a number of short, dark, oblique streaks on R, and just proximally to the brown cloud. *Hindwings* with venation around the margins, and in distal half of wing, dull brown; in basal half of wing, whitish: pterostigma pale straw-colour. No fenestella.

Radial formula 2 + 1 + 1 + 1 + 1 = 6. *Hindwing* with five branches to Rs; only one false origin, but that very strongly developed, Rs being strongly looped concavely to R, and strongly bent at origin of its most basal branch.

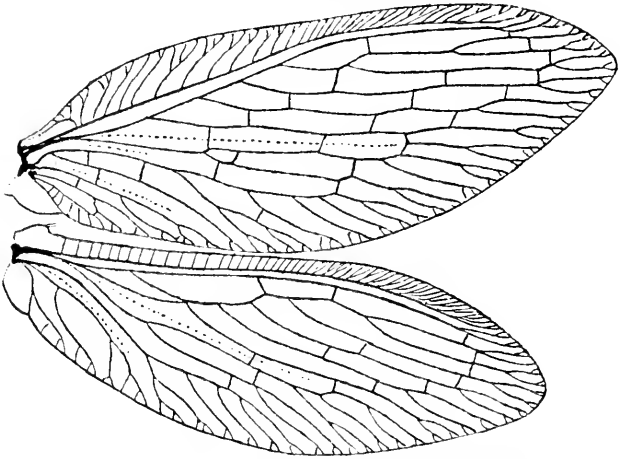
Type in Coll. Froggatt. Unique. Not labelled: but Mr. Froggatt informs me that it was taken in Victoria.

Genus MEGALOMINA Banks. (Text-fig.8).

Banks, Proc. Ent. Soc. Washington, xi., 1909, p.78.

Wings rather broad, lanceolate. *Forewing* with four radial sectors, all simple except the most distal one, which has two posterior branches; three series of gradate cross-veins; costal space narrow at extreme base, and then broadening considerably; recurrent costal veinlet present, but not conspicuously branched. *Hindwing* with no true Cu_2; Cu_1 strongly formed, sharply branched at *cuf'*: Rs with one false origin, very oblique and elongated, and a second cross-vein slightly oblique; between the two, Rs is curved concavely to R, and gives off several branches; five branches to Rs altogether; two gradate series.

Genotype, *M. acuminata* Banks.



Text-fig.8.—Wings of *Megalomina acuminata* Banks.

9. MEGALOMINA ACUMINATA Banks. (Text-fig.8).

Banks(**1**: p.78). Esben Petersen(**11**: p.642, and Pl. lxxiv., fig.9).

This species appears to be very rare. Banks' type came from Bundaberg, Q. A second specimen is in Mr. Froggatt's collection (loc. Queensland), and is the one figured by Petersen. The specimen, whose venation is figured in Text-fig.8, was taken by me at One-Tree Hill, Brisbane, on September 23rd, 1915, by sweeping the lower branches of a Hoop-Pine (*Araucaria Cunninghamii*) with a large net.

This is the only species of the genus.

Genus OXYBIELLA, n.g. (Plate xv., fig.20).

Antennæ nearly as long as forewing. *Wings* narrow lanceolate, very sharply pointed. *Forewing* with four radial sectors, all simple except the most distal; inner gradate series present, and arranged close under, and nearly parallel to R; outer series not regularly formed; no middle series; costal space very narrow at base, then somewhat broadened; recurrent costal veinlet present, but very weakly formed. *Hindwing* with no true Cu_2; Cu_{1b} rather weak and curved; a single rather long and oblique false origin to Rs; Rs with four branches; jugal process very prominent. Hind *tibiæ* broadened, blade-like.

G e n o t y p e, *O. bridwelli*, n.sp.

This genus is most closely allied to *Megalomina*, from which it differs by the narrower and more pointed wings, and the absence of the middle gradate series in the forewing.

10. OXYBIELLA BRIDWELLI, n.sp. (Plate xv., fig.20).

Total length 4·8, *antennæ* 5·5, *forewing* 8, *expanse* 17·5 mm.

H e a d pale brownish; *eyes* black; *antennæ* long and slender, basal joint swollen, pale yellowish-brown, rest brownish with darker annulations. T h o r a x : *prothorax* large, divided into three by two fine transverse furrows, brownish. *Pterothorax* broad, brownish. *Legs:* femora brown, tibiæ testaceous, just touched with rose-pink, tarsi testaceous with black claws. A b d o m e n dark brown, apex rounded; no visible appendages. W i n g s : *forewing* semi-transparent brown, with a clear whitish streak running longitudinally through distal three-fifths of wing to tip, a less distinct and more irregular white streak below it in region between M_1 and Cu_1; also a subtriangular whitish area between Cu_2 and 1A. All these white areas bordered irregularly with black blotches; a number of smaller black spots along R. Venation of forewing brownish, except branches of R and M, which are rose-coloured. *Hindwing* hyaline, shaded with brown lightly on costa, pterostigma, and hindmargin.

Type in Coll. Tillyard. Unique.

This very striking insect was taken by Mr. J. C. Bridwell, of Honolulu, on September 12th, 1915, while collecting with me at Kedron Brook, Brisbane. It was beaten out of a small wattle-tree whose foliage was completely covered, and almost destroyed, by a small species of Psyllid.

Genus PSYCHOBIELLA Banks. (Plate xv., fig.21).

Banks (**1**; p.79).

Antennæ quite two-thirds as long as forewings. *Wings* well rounded at tips. *Forewing* with three radial sectors, two arising close together near middle of R, and the third close to the base, just distad from M; this last gives off an anterior branch, strongly arched upwards; the middle sector is simple, the most distal sector many-branched. Costal space of forewing broad near base, the recurrent veinlet present, with a number of forked branches. Two gradate series in both wings, the outer very long and running nearly parallel with the wing-margin, the inner with much fewer cross-veins. *Hindwing* with two well-developed false origins to Rs; Cu_2 absent, Cu_{1b} fairly well formed, but not diverging strongly from Cu_{1a} at *cuf''*.

Genotype, *Ps. sordida* Banks.

The genus is a very distinct one, but may be considered as a rather specialised derivative from *Megalomina*, in which the number of radial sectors in the forewing is reduced from four to three, by the shifting of the origin of the second sector from the base on to the stem of the most basal one. This gives, as a fixed generic condition, the arrangement which occurs as a frequent *variation* in *Drepanacra*, as shown in Text-fig.6, *b*.

There are two closely allied species, which may be distinguished as follows:—

Forewings brown, with reddish stigma; hindwings with three branches to Rs; middle tibiæ fusiform ....*Ps. sordida* Banks.

Forewings fuscous, stigma dull brown; hindwings with five branches to Rs; all the tibiæ slightly fusiform, those of hind-legs elongated and somewhat flattened......................*Ps. fusca*, n.sp.

11. Psychobiella fusca, n.sp. (Plate xv., fig.21).

Total length 4·7, *forewing* 8·5, *expanse* 18 mm.

Head: *eyes* dull black; *antennæ* brown with darker annulations, basal joint semitransparent orange-brown, enlarged; *epicranium* hairy, brown; *face* yellowish-brown. Thorax and Abdomen dark brown. *Legs:* forelegs dark brown; the rest pale testaceous. Wings: *forewings* deep semitransparent fuscous, tinged with blackish along basal half of hind-border; pterostigma dull brown, with a fine yellow line passing through it just below costal margin. *Hindwing* hyaline, with brownish stigma.

Type in Coll. Tillyard. A unique specimen, captured by me at One-Tree Hill, Brisbane, on September 23rd, 1915, while sweeping the branches of the same pine-tree from which I obtained *Megalomina acuminata.*

Genus Micromus Rambur. (Text-fig.2).

Rambur, Hist. Nat. Névroptères, 1842.

Wings rounded at tips. *Forewing* with four or more radial sectors, regularly and evenly spaced off from one another, all simple except the most distal. Two series of gradate cross-veins in both wings. *Hindwing* with only one false origin to Rs; Cu_2 absent, Cu_1 close to M, Cu_{1b} weakly formed. *Pterostigma* strongly formed, especially in hindwing.

Genotype, *M. variegatus* Fabr.

The two Australian species of this widely distributed genus may be separated as follows:—

Smaller species, with only five radial sectors in forewing...... ....*M. tasmaniæ* (Walker).
Larger species, with broader wings and six radial sectors..... ....*M. vinaceus* Gerst.

12. Micromus tasmaniæ*(Walker). (Text-fig.2).

Walker, "Characters of undescribed Neuroptera in the Collection of W. W. Saunders, Esq.", Trans. Ent. Soc., v., 1859. = *M. australis* Froggatt, Agricultural Gazette of N. S. Wales,

* In 1852, Walker(**14**) described *Hemerobius australis* from New Holland

1904 (nec *M. australis* Hagen, 1858). = *M. froggatti* Banks (**1**: p.77, 1909).

In spite of the brevity and futility of Walker's description, which ignores almost every point of real importance, there can be no doubt that he described this common species, for three reasons. Firstly, it is the only Hemerobiid known from Tasmania (where it is quite common), except species of the genus *Drepanacra*. Secondly, the measurements given by Walker ("length 2-2½ lines, wings 5-6 lines") agree with the size of Tasmanian specimens of this insect. Thirdly, Walker's remark "veins rather few, with brown points," indicates the speckled character of the venation, one of the most noticeable characteristics of the species. Hence the more familiar names given by Banks and Froggatt must sink as synonyms of Walker's name *tasmaniæ*.

This species is abundant, not only in Tasmania, but also in all, except the driest, parts of Australia. It varies greatly in size, as well as in the amount of speckling on the veins of the forewing, some specimens being very pale, others much darker and more variegated. A black mark covering *mf* and Cu_1 just below it, and black on the cross-veins of the outer gradate series above the lowest radial sector, appear to be constantly present in the forewing. The expanse of wing varies from 11 to 22mm., females being larger than males, and southern specimens generally larger than northern ones. More specimens of this insect exist in collections than of all the other Australian *Hemerobiidæ* put together. It is one of our most beneficent insects, the larvæ destroying annually immense quantities of aphides in orchards and gardens.

M. vinaceus Gerst., is a rarer species, confined to the N. Queensland coast-line.

(p.289); his description agrees with this species fairly well for size and colouration, but his statement "radii sector primus unifurcatus, do. secundus unifurcatus, do. tertius trifurcatus" does not agree with the venation, unless his type was an anomalous specimen.

Genus NOTIOBIELLA Banks. (Plate xvi., figs.22, 23).

Banks (**1**; p.80).

Small insects, with well rounded wing-tips, forewing much longer and wider than hindwing. *Forewing* with only two radial sectors, both branched, and connected by a cross-vein running from the fork of the basal one to near the base of the distal one. *Hindwing* with false origin of Rs strongly formed, very oblique; Cu_2 absent. Outer gradate series completely absent in both wings; the inner series represented by three or four cross-veins in forewing, only one in hindwing (connecting M_1 to basal branch of Rs). Costal space of forewing more or less widened, with the recurrent veinlet present.

Genotype, *N. unita* Banks.

This genus is a highly specialised reduction from a type resembling *Psychobiella*, by the elimination of the long, outer gradate series, and the loss of one of the two radial sectors arising from near the middle of R in the forewing.

N. Banks has described five species, *N. extrema*, *N. stigmatica*, *N. unita*, *N. obliqua*, and *N. pretiosa*, the last from Fiji, the others from Middle Queensland. None of these species is known to me. Two species from S. Queensland appear to be very distinct from any described by Banks.

13. NOTIOBIELLA VIRIDIS, n.sp. (Plate xvi., fig.22).

Total length 3, *forewing* 6·5, *hindwing* 3·8, *expanse* 13·5 mm.

Head yellow; *eyes* black; *antennæ* yellowish shading to brown distally. Thorax and Abdomen bright yellow. *Legs* testaceous. Wings hyaline, with pale green venation. *Forewing* with costal space only of moderate width, but all the cross-veins densely branched along costa; distal radial sector branched only once. All the veins approaching the distal border of the wing divide into two *once only*, and each branch divides into minute forkings at the margin. Some of the veins near the base are much thickened, particularly M in forewing; Cu_1 in forewing arches up after leaving *cuf*.

Type in Queensland Museum Coll., Brisbane; taken at Brisbane on June 26th, 1911, by Mr. H. Hacker. Unique.

This very distinct and peculiar species might well form the type of a new genus, since it differs from all other species of *Notiobiella* by its green venation, very reduced hindwings, and by the peculiar thickening of the veins near the base of the wing. I prefer, however, to leave it in *Notiobiella* until we know more about that genus.

14. NOTIOBIELLA MULTIFURCATA, n.sp. (Plate xvi., fig.23).

Total length 4, *antennæ* 2·7, *forewing* 6·7 by 2·9 wide, *hindwing* 4·8 by 2·1 wide, *expanse* 14 mm.

Head, thorax, and abdomen dark brown, the last with pale creamy annuli or crescents on the segments (much shrunken). *Legs* testaceous, middle and hind tibiæ strongly fusiform. Wings with subhyaline, rather nacreous membrane, the reflections on the forewing in the fresh specimen being pink basally, greenish near the middle, and purplish towards the tip. *Venation* dull brownish in forewing, paler in hindwing; cross-veins and forks dark brown, except the vein connecting the two radial sectors, which is black. The veins approaching the distal border of the wing fork strongly at *two levels*, so that the branches which fork minutely along the margin are very numerous and close together. In the forewing, M is very close to the basal radial sector, and is connected with it by a short cross-vein from *mf*; the veins are not thickened near the base, and Cu_1 is not arched upwards.

Type in Coll. Tillyard. Unique. Taken by Dr. A. J. Turner, at Coolangatta (Tweed Heads), S. Queensland, on April 17th, 1915.

This species is closely related to *N. unita* Banks, from which it differs in the dark colouration, the broader and more closely veined costal space, and probably also in the peculiar and abundant distal forking of the veins (not mentioned by Banks in describing *N. unita*). From *N. obliqua* Banks, it differs in possessing narrower and more elongate forewings, the less broadened and less densely-veined costal space, the much darker general colouration, and larger size (expanse of *N. obliqua*, 12 mm.).

Genus CAROBIUS Banks. (Plate xvi., figs.24, 25).

Banks (**1**; p.78).

Small insects with well-rounded wing-tips. *Forewing* with only two radial sectors; the distal one arising from R near the middle of the wing-length, and giving off two posterior branches; the basal one arising from R at about one-third distance from the base of the wing, simple, but connected with M_1 (and also with R anteriorly, in the specimens examined by me) by short, strong cross-veins. *Hindwing* with a single false origin to Rs; Cu_2 absent, Cu_{1b} weakly formed. An outer gradate series present in both wings, complete in forewing, but with only four or five cross-veins in hindwing. No inner gradate series, but two cross-veins connect Cu_1 with M in forewing, and one lies between Cu_1 and Cu_2. In forewing, Sc and R run exceedingly close together, so as to appear almost fused; the costal space is fairly broad, and the recurrent veinlet is present.

Genotype, *C. pulchellus* Banks.

Three species are known, which may be separated as follows:

	Forewings narrow, over two and a half times as long as broad	*C. angustus* Banks.
	Forewings broader, less than two and a half times as long as broad............	1.
1.	Expanse about 13 mm. Forewings with three weakly indicated brownish waved fasciæ............	*C. subfasciatus*, n.sp.
	Expanse 11-12 mm. Forewings very prettily marked with irregular dark brown streaks and patches........	*C. pulchellus* Banks.

15. CAROBIUS SUBFASCIATUS, n.sp. (Plate xvi., fig.24).

Forewing 6 mm. *Head*, *thorax*, and *abdomen* brownish (much shrunken).

Wings: *forewing* subhyaline, lightly suffused with brown; three indistinct, wavy, transverse fasciæ near middle of wing, the most distal one being the broadest. Venation very pale, touched with brown on the costal cross-veins; cross-veins of the gradate series mostly dark brown; a short black streak on R between the origin of the basal sector and the connecting cross-vein. *Hindwing* hyaline, a touch of pale brown on stigma.

Type in Coll. Tillyard, received by exchange from Queensland Agricultural Department; label "F. P. Dodd, Toowong, Brisbane," no date.

This species can be separated from *C. angustus*, not only by its broader wings, but also by the position of the brown shading of the forewings, which, in the latter species, is darkest on the hindmargin and at the apex; also the black streak on R is not present in *C. angustus*. *C. pulchellus* is a very distinct and clearly-marked species, which could not be mistaken, although there seems to be a considerable amount of variation in the shape and extent of the markings. I figure, in Plate xvi., fig.25, a specimen in my Collection from Brisbane, which evidently belongs to this species.

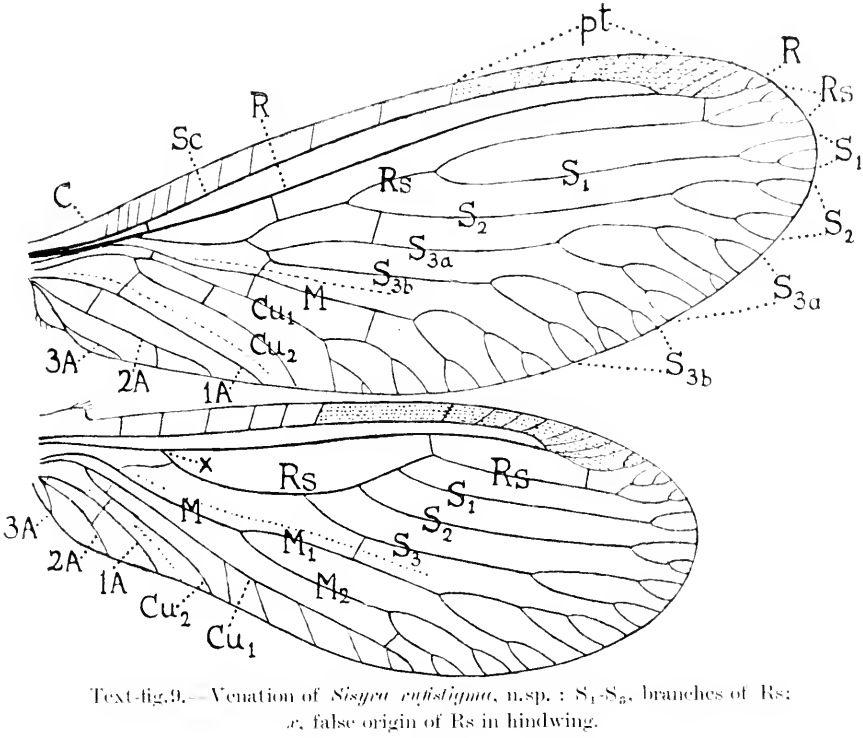
Family SISYRIDÆ. (Plate xvi., figs.26, 27; Text-fig.9).

Small insects with a general resemblance to *Hemerobiidæ*. *Sc and R distinctly fused distally. Only one radial sector in forewings.* M unbranched in forewings, branched in hindwings. Original archaic Cu_2 present in both wings, *cuf* being close to base of wings. Hindwing with a single false origin to Rs, the basal remnant of Rs attached to M. A weak coupling-apparatus may be present. Costal space of forewings not strongly broadened, and not carrying either a recurrent veinlet or forked cross-veins. No unspecialised cross-veins.

Larva with peculiar specialised hair-like mouth-parts; lives on freshwater sponges.

As is generally recognised at present, the *Sisyridæ* owe their resemblance to *Hemerobiidæ* not to any close phyletic relationship, but rather to convergence by reduction. They must be regarded as a highly reduced offshoot from the ancient semi-aquatic *Osmylidæ*. The marks of *Osmylid* ancestry are the fusion of Sc and R distally, and the single radial sector in the forewing; while the peculiar larval mouth-parts could only conceivably be derived from the elongated sucking mouth-parts of the *Osmylidæ*, and by no stretch of imagination from the form of mouth-parts found in the *Hemerobiidæ*.

Under the name *Branchiostoma spongillæ* Westwood, the larva of *Sisyra* was, for long, a puzzle to entomologists, and indeed to



Text-fig. 9.—Venation of *Sisyra rufistigma*, n.sp.: S_1-S_3, branches of Rs: *x*, false origin of Rs in hindwing.

zoologists in general. Needham(**9**) has reared the larva of species of both the American genera, *Sisyra* and *Climacia*, but we do not yet know whether they feed on the tissues of the sponge, or whether they use the latter only as a shelter, from which to attack other small animals. The same author has suggested for the imagines of this family the appropriate name "Spongilla-flies."

Genus SISYRA Burm. (Text-fig.9).

Burm., Handb. Entom., ii., Part 2, p.975.

To the characters of the family we must add, for this genus, the absence of gradate series of cross-veins, and the form of the prothorax, which is not elongated. These two characters separate it from *Climacia*, which has not been found outside America.

Genotype, *S. fuscata* Fabr.

Four species of *Sisyra* occur in Australia, and may be distinguished as follows:—

	Antennae with basal joint elongated, nearly twice as long as usual	*S. punctata* Banks.
	Antennae with basal joint of normal length	1.
1.	Antennae black throughout: forewings variegated with pale and dark patches	*S. turneri*, n.sp.
	Antennae not black on distal half, forewings almost uniformly brown	2.
2.	Pterostigma dark brown	*S. brunnea* Banks.
	Pterostigma reddish	*S. rufistigma*, n.sp.

16. SISYRA TURNERI, n.sp. (Plate xvi., fig.27).

Antennae 2·5; *forewing* 5·5; *expanse* 11·5 mm.

Head: *eyes* and *antennae* jet black, epicranium shining brown, rest of head black. Thorax and Abdomen black. *Legs* dull yellowish. *Anal appendages* in the form of a pair of strong forceps. Wings: *forewing* pale brown, mottled with darker patches. Pterostigma 2 mm., dark brown. An oblique triangular dark patch across middle of wing, tapering posteriorly; a second less oblique triangular dark patch below stigma, tapering anteriorly; smaller patches near base and apex; the intervening spaces pale; posterior border mostly shaded. *Hindwing* hyaline, with long, dark pterostigma.

Type in Coll. Tillyard. Four specimens taken by Dr. A. J. Turner, F.E.S., at Armidale, N.S.W., altitude 3,300 feet.

17. SISYRA RUFISTIGMA, n.sp. (Plate xvi., fig.26).

Antennae, ♂ 2, ♀ 2·5; *forewing*, ♂ 4·5, ♀ 5·5; *expanse*, ♂ 9·5, ♀ 11 mm.

Head rich brown; *eyes* dark brown; *antennæ* with basal joint rich brown, rest dark brown. Thorax blackish; *legs* testaceous. Abdomen blackish, with no clearly visible appendages in ♂; end of abdomen in ♀ with two closely appressed processes, with flattened, upturned ends. Wings: *forewing* uniformly brown all over, with large, reddish pterostigma. Most of the cross-veins strongly darkened. All the veins shaded with darker brown, except near base and apex. *Hindwing* hyaline, with long, reddish-brown pterostigma.

Types, ♂♀, in Coll. Tillyard. A long series taken in November, 1915, along the river-side at National Park, N.S.W., by sweeping wattle-trees and bushes overhanging the water.

This species appears to be closely allied to *S. brunnea* Banks, from Queensland, but is clearly distinguished from it by the much darker body-colouration and the reddish pterostigma. *S. punctata* Banks, also from Queensland, is distinguished by its broader hindwings, and by the elongated basal joint of the antennae.

Family BEROTHIDÆ. (Plates xvii.-xviii., figs.28-33).

Rather small, somewhat slenderly built insects; antennæ short or moderate in length; wings variable in shape. No unspecialised cross-veins. Sc and R fused distally. A single Rs present in forewing, with four to eight, subparallel, and regularly arranged branches. No false origin to Rs in hindwing. M forked in both wings. Cu forked in forewing, but no true Cu_2 present in hindwing, where Cu_{1b}, however, comes off from Cu_1 not far from posterior border of wing, and runs close to, and parallel with it. Wings hairy, especially along the posterior border, which carries a fringe of long hairs. Peculiar scales, of a seed-like form, developed from modified hairs, present on some part of the wing (either on the posterior fringe, or on some of the main veins). Females with long, caudate appendages.

I propose to include in this family the two closely allied Holarctic genera, *Berotha* and *Isoscelipteron*, together with the very remarkable, new Australian genus *Spermophorella*, described below. These may be distinguished as follows:—

	Wings evenly rounded at tips; in the female, small, seed-like scales present on the main veins of the hindwing, over at least the middle portions of M_1, M_2, and some of the branches of Rs. ....*Spermophorella*, n.g.(Type, *S. disseminata*, n.sp).	
	Forewings subtriangular, with the outer margin excavated; no seed-like scales on the main veins of the hindwing in the female, but flattened, seed-like scales may be present among the hairs of the posterior fringe........................	1.
1.	Only four to five branches of Rs..........................	*Berotha* Walker.
	Eight branches of Rs................................	*Isoscelipteron* A. Costa.

I doubt whether *Berotha* and *Isosceliptron* are really generically distinct. The relationship of *Spermophorella* with these two genera may well be open to question. They represent two, isolated end-twigs of a very old stock, now nearly extinct, rather than two, closely-related offshoots of a single stem. However, I think that the agreement in venational scheme, the hairiness of the wings, and, above all, the very remarkable development of *scales* from some of the hairs of the wings, justifies us in placing them together, in spite of some very obvious differences in form of body and shape of wing. The excavate form of wing crops up continually at different places within the Neuroptera, as also in the Lepidoptera, and should not be made a bar to the recognition of closer affinities.

With regard to the development of scales, McLachlan was the first to discover them, in *Isoscelipteron*(**8**). He noticed that the hairs of the fringe, on the posterior margin of the wings, appeared to be very coarse and thick. On examining them with a lens, he discovered that they were, in reality, somewhat flattened scales, "like the seeds of certain Umbelliferous plants," but probably not striated. McLachlan further remarks that all the specimens which he examined were males, on account of their long, caudate appendages!

Now, in *Spermophorella*, it is the *females* which possess long, caudate appendages, and they have apparently some use in connection with the process of ovipositing. I had myself taken the females to be males at first, owing to these appendages, and was only convinced of my error when I kept the insects in glassbottomed pill-boxes, and noticed that those which laid eggs all possessed caudate appendages. The eggs are stalked as in *Chrysopidæ*, and the stalk is formed much in the same manner. The appendages appear to be of value in helping the insect to draw out the stalk to its full length, as they act as a kind of lever to the end of the abdomen. When not in use, they are folded under it, with their tips directed forwards.

Bearing in mind, then, the foregoing facts, it seems fairly certain that McLachlan was examining *females*, and not males, of *Isoscelipteron*, and that the development of the scales on the wings is confined to the females.

The scales on the hindwings of the females of *Spermophorella* are interspersed with hairs of the usual form. They are small, black, club-shaped, arising from a short stalk, and scarcely flattened at all. Their insertions in the chitin of the vein do not differ, as far as I could see, from the ordinary form of insertion of a hair. (Plate xviii., fig.30).

Genus SPERMOPHORELLA,* n.g. (Plate xvii., figs.28, 29).

Characters as given in the table above, with the following additions. No ocelli, antennæ of moderate length (a little less or greater than half the length of the forewing). Coupling apparatus of wings absent, except for a rudiment of a jugal process. Costal area of forewings exceedingly narrow at base, then widening rapidly, then narrowing towards pterostigma. Costal cross-veins branched; no recurrent, basal, costal veinlet. Pterostigma well developed in all four wings. Between Sc and R, only one cross-vein, continued downwards on to Cu_1. Rs connected to R by three cross-veins in the forewing (one under the pterostigma, just beyond the fusion of Sc with R), and by two only in the hindwing. Four or five branches of Rs in both wings. M fused basally with R, and with a cross-vein between it and R close to its origin. A single gradate series of cross-veins in the forewing, running parallel to R obliquely through the middle of the wing;

* Greek σπέρμα, seed; φορά, a bearing or producing; -ella, diminutive = "the little seed-bearer."

in the hindwing, only the lower half of the series is present, consisting of four cross-veins. Tibiæ without spurs.

Females larger and more darkly coloured than males, the latter without any scales on the hindwing.

Genotype, *Sp. disseminata*, n.sp.

The two known species may be easily distinguished as follows:

Body-colouration pale fawn, marked with brown; antennæ less than half as long as forewing; costal cross-veins only once forked; forewing clouded irregularly with pale fawn, and one darker brown blotch; scales on hindwing of female covering nearly the whole of the wing............................*Sp. disseminata*, n.sp.

Body-colouration blackish and dark grey; antennæ longer than half the length of the forewing; costal cross-veins much branched; forewing marked all over with dark, irregular streaks and blotches; scales on hindwing of female confined to a small area along the middle portions of M_1, M_2, and three branches of Rs...*Sp. maculatissima*, n.sp.

18. SPERMOPHORELLA DISSEMINATA, n.sp. (Plate xvii., fig.28).

Total length, ♂ 5·5, ♀ 6·5; *abdomen*, ♂ 3, ♀ 3·5; *forewing*, ♂ 9, ♀ 11·5; *expanse*, ♂ 19, ♀ 24 mm.

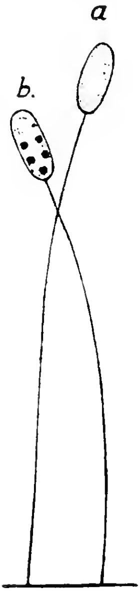
Head: *eyes* grey, head and antennæ pale fawn, a touch of brown on epicranium. Thorax brownish, with paler markings on notum; *legs* pale fawn or creamy, moderately long, slender. Abdomen fawn-coloured, with an interrupted brown dorsal band. Appendages of ♀ 1·2 mm., creamy, slender, cylindrical, hairy; there are also two, pointed, triangular processes, 0·3 mm. long, closer to the base of segment 9, and nearly hidden by the long appendages.(Plate xviii., fig.31). Wings with pale, almost white, venation, which, in forewing, is speckled all over with brownish dots. Several of the costal forks darkened, also cross-veins at each end of the pterostigma. Running obliquely upward, from a point about one-third of the way along the posterior border, is a brown mark, which reaches up to M_2; many irregular fawn-coloured blotches and streaks also occupy the middle of the wing, especially below the pterostigma. All these markings vary much in intensity, and are more conspicuous in the females than in the males. Hindwings without markings, except a touch of brown at each end of pterostigma; in ♀, M_1 and the three branches of Rs above it are clouded with black for a short distance below the pterostigma; scales very numerous, black, causing the hindwing to appear smoky.

Types, ♂♀, in Coll. Tillyard (Kenthurst, N.S.W., January 23rd, 1916).

Hab.—Rocky sandstone-cliffs and gullies north and north-west of Sydney, Murphy's Creek, Kenthurst, three males and three females; Long Island, Hawkesbury River. December-February.

This very peculiar insect was discovered by Mr. Luke Gallard, of Epping, in 1914, at Kenthurst. My specimens were taken while on a visit to the original locality with Mr. Gallard. The insect rests with the wings in the usual Osmylid position, on the fretted faces of caves and hollows in the sandstone-cliffs and escarpments. It makes no attempt to escape, its colouration rendering it absolutely invisible, unless one has previously marked the spot where one of them alights. In company with it, but less common, was the remarkable ghost-like Myrmeleontid, *Xantholeon helmsi*, whose colouration is very similar. Mr. Gallard's method of disturbing these insects was very ingenious, and I found it most effective. Using a thick, leafy branch about a yard long, cut from some tree or bush, he rustled it vigorously into every hole and corner of the cave. All the lacewings, which were touched, would flutter out from their hiding-places, and settle a yard or two further on, when they were easily pill-boxed.

Several patches of the stalked eggs were found, there being from thirty to fifty eggs in a patch, which closely resembled the fructification of a small patch of moss. The eggs are very similar to those of *Chrysopa*, but slightly rounder; both egg and stalk are cream-coloured. My three females, confined in pill-boxes, set to work almost at once to lay eggs, from twenty to fifty apiece. The egg is an elongate spheroid, length 0·75 mm., and breadth through middle 0·35 mm. (Text-fig. 10, *a*). It is supported on an excessively fine stalk, varying in length from 3 to 5 mm., and so delicate that it does not always support the egg firmly, but may bend with the weight of it. This stalk is hollow throughout, except at the extreme base and tip. It is stoutest at its base, where the diameter of the cross-section is 0·013 mm., that of the lumen being 0·005 mm. It then tapers rather rapidly until, at about one-fifth of the total length from the base, it is only 0·007 mm. wide, with a lumen of about 0·003 mm. It then continues to taper more gradually, reaching a width of only 0·005 mm., with a lumen of only 0·002 mm., close up to the egg.



Text-fig. 10.*

During the embryonic period, the egg becomes curiously speckled, until it appears an absurd-looking object. This peculiar marking is due to the early development of a pair of dark patches of pigment on alternate segments of the embryo. As the latter is very elongated, it becomes curved round the egg, so that a double band of five pairs of dark spots is clearly visible (as shown in Text-fig.10, *b*). These spots appear on the fourth day, and are followed, on the fifth, by a pair of smaller spots, marking the position of the mesothorax. The unpigmented prothorax and head lie curved around the anterior pole of the egg, which, therefore, appears unspotted. On the eighth day, smaller mid-dorsal spots appear on all the segments.

The young larva (Plate xviii., fig.32) emerges on the tenth day after the egg is laid. It is a long, slender creature, some 2·5 mm. in length, and exceedingly active. It descends the egg-stalk at once, and moves off at a rapid pace, with the looping gait of a Geometer caterpillar, using its small legs and anal clasper for walking. Unfortunately, I could find no food suitable for these peculiar larvæ: so, after fixing and mounting a number of them, I let the rest go free on the rocks at the bottom of my garden. The only food which suggests itself to me as at

* Stalked eggs of *Spermophorella disseminata*, n.sp., (× 12·5) : *a*, freshly laid; *b*, five days old. Profile-view, showing the five pigment-spots on one side of embryo only. The sixth, smaller spot indicates the position of the mesothorax.

all likely is the caterpillars of the small Pyralid moths which inhabit the caves and rocks so abundantly. These caterpillars are not known for certain, but it is supposed that they are nocturnal, and feed upon the patches of lichen on the rocks. As will be seen from the figure in Plate xviii., fig.32, the larva of *Spermophorella* might easily pass unnoticed amongst such caterpillars. It is probable that its great activity and protective colouration enable it to discover the colonies, or hiding-places, of the Pyralid larvae, and to dwell with them without causing them any alarm. They could then be attacked and eaten at leisure. The mouth-parts of the larvae are very peculiar, adapted for sucking, but the mandibles are neither elongated, as in *Osmylidae*, nor curved, as in *Chrysopidae* and *Hemerobiidae*.

The young larva, when hatched, has the head, prothorax, and legs cream-coloured, except for the black eye-spots, and a touch of pale brown on the head and neck. The metathorax and the even segments of the abdomen, from the second to the eighth, are deeply shaded with brown, each carrying two, very large, lateral blotches, and a smaller, central, dorsal patch. The mesothorax and the odd segments of the abdomen, from the first to the seventh, are cream-coloured, with a small, central, dorsal patch of brown. The ninth abdominal segment, carrying the anal clasper, is pure cream-coloured.

The figure in Plate xviii., fig.32, shows the larva after being fixed and mounted. In actual life, however, when at rest, it is considerably more elongated, and, when travelling quickly along, it extends itself to a great length.

The mouth-parts (Plate xviii., fig.33) are rather peculiar. The *mandibles* (*md*) are broad at the base, about as long as the head, and tapering to a point, the inner margin being strongly curved. They are strongly grooved beneath, the maxillae fitting into the grooves. The *maxillae* (mx_1) resemble the mandibles, but are less strongly chitinised, narrower at the base, and grooved on the upper surface. The combined maxilla and mandible form a sucking-tube whose lumen is very nearly straight, except at the base. There are no maxillary palpi. The *labial palpi* (*lp*) are placed close together, three-jointed, and slightly longer than the mandibles. The basal joint is short and moderately narrow, the second longer, broader, and somewhat fusiform, the third long, very narrow and seta-like The *labrum (lr)* is merely a weak, slightly bifid projection between, and slightly above, the mandibles.

The head itself is curiously elongate, the black eye-spots being placed laterally close up to the anterior border. The *antennæ (ant)* are situated just in front of the eye-spots, above the mandibles, and closely resemble the labial palpi. They are, however, longer, and four-jointed. The basal joint is short and fairly thick; the second joint is somewhat broader and slightly fusiform as regards its distal two-thirds, but the basal third is narrower, and the outer border is slightly dentate or ridged at one-third from the base; this ridging probably representing the beginning of the formation of a number of small segments from this joint. The third joint is long and very slender, the fourth merely a sharply-pointed, seta-like termination. The *neck* or *microthorax (mc)* is very conspicuous, elongated and rather narrow.

Larval Types in Coll. Tillyard. Three, mounted on one slide; hatched on February 2nd, 1916, from eggs laid by the type ♀, on January 23rd, 1916.

19. SPERMOPHORELLA MACULATISSIMA, n.sp. (Plate xviii., fig.29).

Total length, ♂ 5·3, ♀ 7; *abdomen*, ♂ 3, ♀ 3·8; *forewing*, ♂ 9·5 ♀ 11·5; *expanse*, ♂ 19·5, ♀ 23·5 mm.

Head hairy, dark grey; *eyes* blackish; *antennæ* brownish, more than half as long as forewing. Thorax dark greyish-black, prothorax hairy, metathorax paler on posterior border of notum. *Legs* slender, hairy, testaceous, spotted with blackish on femora, tibiæ, and apices of tarsal joints. Abdomen blackish, with a pair of grey-brown spots placed latero-dorsally on each segment near its apex *Appendages* of ♀ closely resembling those of *Sp. disseminata* ♀ in size and shape. Colour testaceous. Wings: *forewing* with venation speckled alternately with straw-colour and black, the black spots and markings being very frequent; many of the small, branching veins around the wing-border strongly outlined and thickened with black. The whole of the forewing is heavily marked with irregular greyish-black streaks, spots, and blotches, tending to form oblique fasciæ across the wing. *Pterostigma* well-formed in both wings, spotted with black along costa. Tip of forewing more evenly rounded than that of *Sp disseminata*, and costal area of same wing more abruptly dilated near the base; costal cross-veins more irregularly placed, and much branched. *Hind-wing* not speckled, venation testaceous along Sc, R, and Rs, dark grey to black on the rest of the wing: in ♀, M_1, M_2, and the three branches of Rs above them, are provided with scales over a moderate-sized area in the middle of the wing.

(*Note.*—In figuring the two species of *Spermophorella*, I have omitted the short, bristly hairs which are present on all the veins, in order to show up the venation more clearly.)

Types: ♂♀, in Coll. Tillyard (Brisbane: September 23rd, 1915).

Hab.—One-Tree Hill, Brisbane: two males and two females, taken on a hot afternoon, disturbed while resting on the face of a cutting about half-way along the road to the summit. September.

The four specimens captured were put separately into pill-boxes alive. The same evening, both females laid a number of stalked eggs, from twenty to thirty apiece. These were very similar to those described for *Sp. disseminata*, but the eggs had a slight greyish tinge. They hatched on the tenth day after being laid. During the embryonic period, the eggs darkened to a semiopaque grey, through which a double band of black markings made itself visible on the developing larva. The young larva, when hatched, resembled that of *Sp. disseminata* in size, shape, and actions: but it was of quite a different colour, the ground-colour being pale grey, with large black spots on alternate segments. It would seem, then, that this larva inhabits the darker rocks which are so common around Brisbane, and probably preys upon Lepidopterous caterpillars, which feed on the lichens of the rocks. I was unable to obtain suitable food for my larvæ, and they all died.

Family TRICHOMATIDÆ,* fam.nov.

(Plate xviii., fig.34; Plate xix., fig.35.)

Small or moderate-sized insects, with the whole body, and the veins and margins of the wings, densely clothed with thick hairs. Head moderately wide, the basal joint of the antennæ much enlarged, sometimes hypertrophied. Wings variable in shape. Costal area of forewing narrow: recurrent veinlet at base either absent or rudimentary. In forewing, Sc and R run close together, but remain quite separate throughout their length: cross-veins between them either absent, or one only. In the hindwing, Sc and R also remain quite separate, but are somewhat further apart. A single radial sector present in both wings, with 3-5 branches. M fused basally with R, and forked in both wings. Cu forked in forewing, simple in hindwing (original Cu_2 absent). No unspecialised cross-veins present, there being only a single (distal) gradate series in forewing, two or three cross-veins connecting Rs with R, and a few others placed in suitable positions for supporting the main veins: in hindwing, very few cross-veins, and no gradate series. Along posterior border of wing, there are numerous, short branches from the main veins: this border also carries a dense fringe of very long hairs, which may even exceed in length the width of the wing itself. A small coupling apparatus, with frenulum, present at bases of wings. No false origin to Rs in hindwing.

I propose this family for the reception of two extraordinary insects recently captured at light, one by Mr. O. Lower, at Broken Hill, N.S.W., the other by Dr. A. J. Turner, at Brisbane. Though very different in appearance, these insects are united by a large number of common characters. They also differ from all Neuroptera, except the *Chrysopinæ*, in combining the absence of fusion of Sc and R with the presence of only one Rs in the forewing. Their differences from *Chrysopidæ* are so great and obvious as scarcely to need commenting upon, since they possess none of the striking specialisations of that family. They differ from all other Neuroptera in the immense development of

* Greek τρίχωμα = a shock of hair.

hairs upon the body and wings; indeed, I know of few Trichopterous insects even that have such a hairy appearance.

Two genera are represented, which may be separated as follows,—

Wings of moderate breadth, slightly falcate, the margin below the apex being slightly excavated. Antennæ with basal joint not unduly enlarged ....
............Genus *Trichoma*, n.g. (Type, *T. gracilipenne*, n.sp.).

Wings elongate, excessively narrow, fore and hind margins parallel, apex almost in line with hind margin. Antennæ with greatly hypertrophied basal joint.......................................
...........Genus *Stenobiella*, n.g. (Type, *St. hirsutissima*, n.sp.).

Genus TRICHOMA, n.g. (Plate xix., fig.34).

Characters as given above in the generic key, with the following additions. Size moderate (about 1 inch expanse), antennæ nearly as long as forewing; three branches to Rs in forewing, four in hindwing. In hindwing, Cu_1 runs parallel to posterior margin from just above the ending of 1A to the point where M_2 branches, and then curves down to meet the wing-border just before the tornus; from this part of Cu_1, oblique, much-branched veinlets descend to the border; Cu_1 is also connected with 1A, from just above the end of the latter, by a vein running back to 1A parallel with the border. Costal cross-veins in forewing all branched before pterostigma; the most basal one is tending to become a true, recurrent veinlet.

G e n o t y p e, *T. gracilipenne*, n.sp.

20. TRICHOMA GRACILIPENNE, n sp. (Plate xix., fig.34).

Total length, 10; *abdomen*, 6; *forewing*, 12; *expanse*, 25 mm.

H e a d dark brown, *eyes* very dark; *antennæ* with basal joint dark, hairy, the rest a medium brown, barely pectinate. T h o r a x: *prothorax* dark brown, hairy, divided into two by a transverse, median groove. *Pterothorax* dark brown, about as wide as head, moderately hairy, rather shiny, with pale brown markings along the sutures and posterior border. *Legs* of medium length, hairy, brown; tibiæ without spurs; tarsi 5-jointed, the basal joint nearly as long as the other four together. A b d o m e n dark brown, hairy; appears narrow when viewed dorsally, broad in profile (probably cylindrical and of moderate breadth in life); two, short, subconical, anal appendages present. (Sex indeterminate). Wings subhyaline, clouded with pale brown. Veins and hairs mostly brown, but a very delicate effect of silvery-grey patches is produced in forewing by the areas on either side of the gradate series, and a few smaller patches along M and the margins, possessing a whitish venation with whitish hairs upon it; this effect is heightened by patches of dark brown along the gradate series, on the pterostigma, and irregularly round the wing-margins. The hairs of the fringe are chiefly pale brownish or brownish-grey, but there are a number of conspicuous patches of dark brown hairs, especially along the posterior margin, in both wings. *Cross-veins in forewing:* five in the gradate series from M_2 up to R; three between R and Rs (inclusive of the uppermost one of the gradate series); one below Rs just proximad from the gradate series; one from base of Rs to M; one between M_1 and M_2, and a second just below it; also an oblique one supporting the wide forking of M_2; one between Cu_1 and Cu_2, and one between 1A and 2A not far from base. *Cross-veins in hindwing:* one between Sc and R above middle of wing; one only, distad from this, between R and Rs, and two exactly below this, one above and one below M_1; an oblique one supporting the forking of M_2; one connecting *mf* to Rs; and one from base of M to Cu.

Type in Coll. Tillyard. Unique. Taken at light by Mr. O. Lower, at Broken Hill, N.S.W. Undated.

Genus STENOBIELLA, n.g. (Plate xix., fig.35).

Characters as given in the generic key, with the following additions. Size rather small (expanse about three-quarters of an inch): antennæ about two-thirds the length of the forewing: three branches to Rs in both wings. In hindwing, Cu_1 comes very close to posterior margin at the level of the ending of 1A, and thence onward, for about one-third of the wing-length, runs parallel to, and just above, the wing-margin, giving off a number of exceedingly short, unbranched veinlets to it: Cu_1 is connected with 1A by a cross-vein. Costal cross-veins in forewing branched only to about half the wing-length from the base. Owing to the narrowness of the wing, all the main veins tend to assume a nearly parallel course: the hindwing has only six specialised cross-veins, three near the base, and three just beyond the middle. Fringe of posterior margin very long: in hindwing, near the base, its hairs are longer than the wing is wide.

Genotype, *St. hirsutissima*, n.sp.

21. Stenobiella hirsutissima, n.sp. (Plate xix., fig.35).

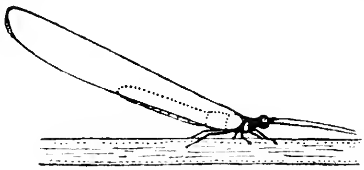
Total length, 5; *abdomen*, 2·5; *forewing*, 9; *expanse*, 18·5 mm.

Head blackish, hairy, touched with brown on epicranium; some of the hairs pale greyish; *eyes* dark grey; *antennæ* black, the basal joint 0·8 mm. long, swollen, very hairy. Thorax hairy, blackish, touched with dark brown; some pale grey hairs on prothorax. *Legs* short, dull brownish-grey; tibiæ without spurs; tarsi with five short joints. Abdomen very short, slender, hairy, blackish, touched with pale grey apically on each segment. *Appendages* very minute, conical. (Sex indeterminate). Wings subhyaline, clouded with dull greyish-brown; forewing with slightly darker patches, irregularly placed around the margins and along the gradate series; three indistinct patches along Rs, and two lying upon Cu; apex slightly darkened. *Pterostigma* slightly darkened in both wings; fringes uniformly dark grey. *Cross-veins in forewing:* five in the gradate series from M_2 up to R; another from R to Rs a little proximad to the top vein of the gradate series; one between R and M near base, another between M and Cu_1 just distad from *cuf*, and one below it from Cu_2 to 1A; two more placed more distally between M_2 and Cu_1, and one joining Cu_1 to the upper branch of Cu_2. *Cross-veins in hindwing:* three at about the same level, distad from middle of wing, one from R to Rs, one from M_1 upwards to the lowest branch of Rs, and one from M_2 to Cu_1; three more near the base, one from Rs to M, one, nearer still, from M to Cu, and one, more distally placed, from Cu_1 to 1A. Numerous, small veinlets descend upon the posterior margin in both wings.

Type in Coll. Tillyard. Unique. Taken at light by Dr. A. J. Turner, at his house at Sherwood, near Brisbane, November 10th, 1915.

This extraordinary insect is clearly a highly specialised offshoot from the more normal form represented in *Trichoma*. The very narrow and elongated wings, with long fringes, mark it off from all other Neuroptera.

Postscript, added May 1st, 1916.—Since the completion of this paper, I have received from Mr. Luke Gallard, of Epping, N.S.W., a living specimen of a fine new species of *Stenobiella*, which he captured while beating bushes and low trees at Kenthurst, N.S.W. This remarkable insect, when alive, rests with its wings forming a steep roof over its back, and projecting far beyond the end of its body. When resting on a twig, the antennæ are directed straight forwards, while the body and wings are held rigidly at an angle of about 30° to the plane of rest. As the wings are a dull brownish colour with irregular grey markings and numerous hairs, the effect produced is that of a broken-off stump of a small side-twig. The principal factor in the success of this disguise is, of course, the length of the wings. A pencil sketch, which I made of the insect at rest, is reproduced in Text-fig.11. I append a short description of this new species, which I have dedicated to its discoverer.



Text-fig. 11.*

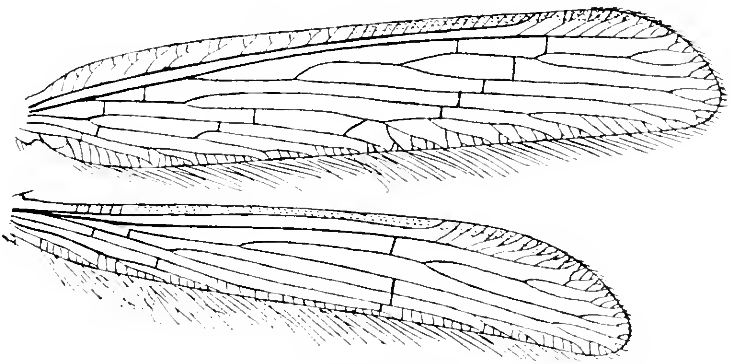
STENOBIELLA GALLARDI, n.sp. (Text-figs.11-12).

Total length, 5·5; *abdomen*, 2·8; *forewing*, 9·3; *hindwing*, 8·4 mm. [Measurements of the dried specimen; the living insect was considerably larger]. Sex indeterminate.

Head dark brown, touched with grey; *eyes* dull blackish; *antennæ* 5 mm. long, dark brown, basal joint 0·8 mm., very hairy, not quite so much enlarged as in *St. hirsutissima*. **Thorax** and legs dark brown. **Abdomen** brownish black. **Wings**

* *Stenobiella gallardi*, n.sp., at rest on a twig, to show natural position of holding wings and abdomen (drawn in outline only); (× 3⅗).

dull semitransparent brown, hairy, the forewing irrorated with grey in irregular patches, and with a few, indistinct, dark brown spots; a pale spot on the costa just beyond pterostigma, and an oblique, faint, dark band along the gradate series. *Shape* much as in *St. hirsutissima*, but forewing slightly wider in comparison with length, hindwing narrower at base and more broadened towards tip. *Fringe* of uniformly dark brown hairs, not so long as in *St. hirsutissima*. *Venation* (Text-fig.12) broadly as in *St. hirsutissima*, but differing in the following points. In both



Text-fig.12.—Venation of *Stenobiella gallardi*, n.sp.; (× 9).

wings, Sc is shorter; and hence there are more branch-veins running up to C from distal end of R. In forewing, the cross-vein from near the distal end of Cu_1 up to M_2 is *strongly oblique* (normal in *St. hirsutissima*); in hindwing, there is an extra cross-vein placed distally between M_1 and M_2, exactly in line with the one above it.

Hab.—Kenthurst, N.S.W. Taken by Mr. Gallard on April 23rd, 1916.

Type in Coll. Tillyard. Unique.

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EXPLANATION OF PLATES XII.-XIX.

Plate xii.

Fig. 1.—*Ithone fulva*, n.sp.; (×4).

Fig. 2.—*Ithone fulva*, n.sp.; head, prothorax, and forelegs, viewed from in front; (×6); (*ant*, antennæ; *cl*, clypeus; cx_1, coxa of foreleg; *e*, eye; *ep*, epicranium; *g*, gena; *lp*, labial palp; *lr*, labrum; *md*, mandible; *mxp*, maxillary palp; *pr*, prothorax).

Fig. 3.—*Ithone fulva*, n.sp.; tibial spines; (×13); *sp*, spines; *ti*, tibia; *ts*, basal joint of tarsus.

Fig. 4.—*Ithone fulva*, n.sp.; appendages of male, dorsal view; (×8); *i*, inferior; *s*, superior.

Fig. 5.—*Ithone fulva*, n.sp.; appendages of male, profile view; (×8); *i*, inferior; *s*, superior.

Fig. 6.—*Ithone fulva*, n.sp.; appendages of male, posterior view; (×8); *i*, inferior; *s*, superior.

Fig. 7.—*Ithone fusca* Newman; appendages of male, dorsal view; (×8); *i*, inferior; *s*, superior.

Fig. 8.—*Ithone fusca* Newman; appendages of male, profile view; (×8); *i*, inferior; *s*, superior.

Fig. 9.—*Ithone fusca* Newman; appendages of male, posterior view; (×8); *i*, inferior; *s*, superior.

Plate xiii.

Fig. 10.—*Drepanepteryx phalænoïdes* (Linn.). Venation; (×8).

Fig. 11.—*Drepanepteryx phalænoïdes* (Linn.). Fenestella; (×20).

Fig. 12.—*Drepanacera humilis* (McLach.). Venation; (×8).

Fig. 13.—*Drepanacera humilis* (McLach.). Fenestella; (×20).

Fig. 14.—*Drepanacera humilis* (McLach.). Third or most posterior lunule; (×20).

Venational notation as usual. In addition, *cuf*, cubital fork; *cuf'*, secondary cubital fork; *fn*, fenestella; *jl*, jugal lobe; *jp*, jugal process with frenulum; *ln*, lunule; S_1-S_8, branches of Rs in hindwing; *x*, first false origin of Rs in hindwing; *x'*, second ditto.

Plate xiv.

Fig. 15.—*Drepanacera instabilis* (McLach.). Venation; (×8).

Fig. 16.—*Drepanacera hardyi*, n.g. et sp. Venation; (×8).

Fig. 17.—*Drepanacera froggatti*, n.g. et sp. Venation of apical third of forewing; (×8).

Fig. 18.—*Drepanomina gibbosa*, n.g. et sp. Venation; (×6).

Fig. 19.—*Drepanacera humilis* (McLach.), ♂. Coupling apparatus of the wings; *fr*, frenulum; *jl*, jugal lobe; *jp*, jugal process; (×32).

Plate xv.

Fig. 20.—*Oxybiella brid welli*, n.g. et sp.; (×10).

Fig. 21.—*Psychobiella fusca*, n.sp.; (×10).

Plate xvi.

Fig.22.—Wings of *Notiobiella viridis*, n.sp.; (×9).

Fig.23.—Wings of *Notiobiella multifurcata*, n.sp.; (×9).

Fig.24.—Wings of *Carobius subfasciatus*, n.sp.; (×9).

Fig.25.—Wings of *Carobius pulchellus* Banks; (×9).

Fig.26.—Wings of *Sisyra rufistigma*, n.sp.; (×9).

Fig.27.—Wings of *Sisyra turneri*, n.sp.; (×9).

Plate xvii.

Fig.28.—*Spermophorella disseminata*, ♀, n.g. et sp.; (×7).

Fig.29.—*Spermophorella maculatissima*, ♀, n.g. et sp.; (×7).

Plate xviii.

Fig.30.—*Spermophorella disseminata*, ♀, n.g. et sp. Small portion of a vein from hindwing, showing hairs and seed-like scales; (×90).

Fig.31.—*S. disseminata*, ♀, n.g. et sp. Appendages, profile view; (×14).

Fig.32.—*S. disseminata*. Newly-hatched larva; (×32).

Fig.33.—*S. disseminata*. Head of ditto; (×90): *ant*, antenna; *lp*, labial palpi; *lr*, labrum; *mc*, microthorax or neck; *md*, mandible; mx_1, maxilla.

Fig.34.—*Trichoma gracilipenne*, n.fam., gen. et sp.; (×7).

Plate xix.

Fig.35.—*Stenobiella hirsutissima*, n.fam., gen. et sp.; (×15).

STUDIES IN AUSTRALIAN MICROLEPIDOPTERA.

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

OECOPHORINÆ.

Mr. E. Meyrick, F.R.S., has asked me to describe some species of this group, which I have sent to him under MS names at various times during the last twenty years; and he has very kindly assisted me by sending me a tabulation of the Australian genera according to his most recent revision, not yet published. I find that I have such a large number of undescribed species, that, in the present paper, I can deal only with those belonging to Mr. Meyrick's groups *Oecophorides* and *Eulechriades*, leaving the *Philobotides* and *Depressariades* for a future occasion. Unless otherwise stated, the types of new species are in my Collection.

Macrobathra rubicundella.

Gelechia rubicundella Wlk., Cat. Brit. Mus., xxix., p.649.

Macrobathra rosea Turn., Trans. Roy. Soc. S. Aust., 1896, p.33.

Q.: Brisbane, in November and February.

Macrobathra puncticulata.

Macrobathra puncticulata Turn., Trans. Roy. Soc. S. Aust., 1896, p.32.

Q.: Brisbane, in October. The type is still unique.

Macrobathra chrysospila.

Macrobathra chrysospila Meyr., Proc. Linn. Soc. N. S. Wales, 1885, p.822; *M. chrysobaphes* Turn., Trans. Roy Soc. S. Aust., 1896, p.32.

N.Q.: Townsville, in September.—Q.: Brisbane, in September, January, and March.

Macrobathra honoratella.

Oecophora honoratella Wlk., Cat. Brit. Mus., xxx., p.1030.

Macrobathra chlorosoma Meyr., Proc. Linn. Soc. N. S. Wales, 1885, p.810.

Q.: Duaringa, Caloundra, and Brisbane: in August, September, December, February-April.

MACROBATHRA BIGERELLA.

Gelechia bigerella Wlk., Cat. Brit. Mus., xxix., p.644.

Macrobathra crymalea Meyr., Proc. Linn. Soc. N. S. Wales, 1885, p.816.

Q.: Brisbane, Toowoomba.—S.A.: Port Lincoln.

MACROBATHRA MYRIOPHTHALMA.

Macrobathra myriophthalma Meyr., Proc. Linn. Soc. N. S. Wales, 1885, p.822.

Q.: Brisbane, Toowoomba.—N.S.W.: Sydney.—Vic.: Melbourne.

The larva feeds on various species of *Acacia*. Mr. Meyrick records it from *A. pubescens*. I have found it on *A. decurrens* and *A. complanata*.

MACROBATHRA XUTHOCOMA.

Macrobathra xuthocoma Meyr., Proc. Linn. Soc. N. S. Wales, 1885, p.813.

Q.: Brisbane.—N.S.W.: Sydney.—Vic.: Melbourne. I have found the larva on *Acacia penninervis*.

MACROBATHRA CALLISPILA, n.sp.

καλλισπιλος, prettily spotted.

♀. 17 mm. Head ochreous-grey, back of crown blackish; face whitish-ochreous. Palpi ochreous-whitish; a slight fuscous suffusion towards apex of second joint, terminal joint fuscous. Antennæ blackish annulated with white. Thorax blackish: patagia, except at base, whitish-ochreous. Abdomen ochreous-brown, terminal half irrorated with dark fuscous. Legs blackish, with whitish-ochreous annulations, which are specially broad on the posterior pair. Forewings blackish, with one fascia and three spots whitish-ochreous; fascia evenly broad, from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; a small spot on midcosta; a large, triangular, subapical, costal spot; a large, triangular spot on tornus; cilia blackish, on tornal spot whitish-ochreous. Hindwings dark fuscous; cilia fuscous, bases ochreous-brown, on costa before apex and on tornus wholly ochreous-brown.

N.A.: Port Darwin; two specimens, received from Mr. G. F. Hill.

MACROBATHRA EXÆTA, n.sp.

ἔξαιτος, choice.

♀. 16 mm. Head blackish; face white. Palpi whitish; terminal joint dark fuscous on external surface. Antennæ blackish with ochreous-whitish annulations. Thorax ochreous-whitish with a posterior blackish spot. Abdomen pale ochreous. Legs fuscous, with ochreous-whitish annulations; outer surface of anterior tibiæ whitish; posterior pair ochreous-whitish, femora, base of tibiæ, and a broad subapical band on tibiæ fuscous. Forewings blackish, with one fascia and four spots ochreous-whitish; fascia evenly broad from $\frac{1}{5}$ costa to $\frac{1}{4}$ dorsum; a small spot on midcosta; a large, rounded spot on dorsum before tornus, connected on dorsum with a small, tornal spot; a large, more whitish, triangular spot on $\frac{4}{5}$ costa, its lower angle tending to be connected with tornal spot; cilia dark fuscous, apices whitish between apex and midtermen, on tornus and dorsum wholly ochreous-whitish. Hindwings dark fuscous; cilia fuscous, on dorsum ochreous-whitish.

N.Q.: Kuranda, near Cairns; in November; one specimen, received from Mr. F. P. Dodd.

MACROBATHRA RHYTHMODES, n.sp.

ῥυθμώδης, symmetrical.

♀. 13 mm. Head dark fuscous; face fuscous. Palpi fuscous, inner aspect of second joint whitish towards base. Antennæ dark fuscous annulated with whitish. Thorax yellow; tegulæ and bases of patagia dark fuscous. Abdomen fuscous, beneath ochreous-whitish. Legs fuscous, posterior pair ochreous-whitish. Forewings dark fuscous; central area broadly yellow, bounded by lines from $\frac{1}{5}$ costa to $\frac{1}{4}$ dorsum, and from $\frac{3}{4}$ costa to $\frac{3}{4}$ dorsum; cilia fuscous. Hindwings fuscous, cilia fuscous.

N.Q.: Kuranda, near Cairns; in October; one specimen.

MACROBATHRA ALLOCRANA, n.sp.

ἀλλοκρανος, with dissimilar head.

♂. 11 mm. Head and thorax pale yellow; face ochreous-whitish. Palpi ochreous-whitish. Antennæ fuscous, with whitish annulations, towards apex whitish; ciliations in ♂ 1. Abdomen fuscous, beneath ochreous-whitish. Legs ochreous-whitish; anterior and middle pairs somewhat infuscated. Forewings pale yellow; a fuscous basal spot bounded by a line from $\frac{1}{3}$ costa to $\frac{1}{5}$ dorsum; a large, fuscous, apical blotch bounded by an inwardly curved line from costa near apex to dorsum before tornus; cilia fuscous. Hindwings and cilia grey.

Similar to the preceding, but with head and thorax wholly yellow.

N.Q.: Innisfail; in November; one specimen.

BORKHAUSENIA SPHÆROIDES.

Oecophora sphæroïdes Turn., Trans. Roy. Soc. S Aust., 1896, p.31.

Q.: Brisbane.

BORKHAUSENIA HEMILEUCA.

Oecophora hemileuca Turn., Trans. Roy. Soc. S. Aust., 1896, p.31.

Q.: Brisbane I have not been able to re-examine this species, as I possess no example.

BORKHAUSENIA NEPHELELLA.

Crossophora nephelella Turn., *op. cit.*, 1898, p.312.

Q.: Brisbane and Coolangatta; in August and September.

BORKHAUSENIA THOLOPA, n.sp.

θολωπος, muddy.

♂♀. 14-16 mm. Head, thorax, and palpi fuscous. Antennæ fuscous; ciliations of ♂ 3. Abdomen fuscous; in ♂, apices of segments and tuft ochreous-whitish. Legs fuscous; posterior pair ochreous-whitish. Forewings very elongate-oval, costa rather strongly arched, apex rounded, termen very obliquely rounded; ochreous-whitish densely and evenly irrorated with fuscous; cilia fuscous. Hindwings very elongate-ovate; ochreous-whitish, towards apex greyish-tinged, in ♀ wholly grey: cilia ochreous-whitish, at apex greyish-tinged, in ♀ wholly grey.

Q.: Mount Tambourine; in October; three specimens.

BORKHAUSENIA PAUROPHYLLA, n.sp.

παυροφυλλος, small-winged.

♂♀. 10-12 mm. Head whitish-ochreous. Palpi whitish-ochreous: second joint with subapical ring and basal half of external surface fuscous; terminal joint with base and apex fuscous. Antennæ white, annulated with fuscous; ciliations in ♂ $\frac{2}{3}$. Thorax fuscous, posterior and anterior margins whitish-ochreous. Abdomen fuscous, tuft whitish-ochreous. Legs fuscous annulated with ochreous-whitish; posterior pair mostly ochreous-whitish. Forewings rather narrowly elongate, not dilated; whitish-ochreous with fuscous irroration and markings; an ochreous-yellow line along basal half of fold: an ill-defined, basal patch produced along costa: a median discal dot at $\frac{1}{3}$, preceded by a second on fold, a third in middle at $\frac{2}{3}$; an ill-defined squarish blotch on midcosta and another on tornus; a series of dots on apical fourth of costa and on termen; cilia whitish-ochreous with fuscous irroration, on apex and tornus wholly fuscous. Hindwings ovate-lanceolate; grey; cilia pale grey.

Q.: Burpengary, near Brisbane, in April; Stradbroke Island, in February; Coolangatta, in September: five specimens.

BORKHAUSENIA TETRAPHÆA, n.sp.

τετραφαιος, four times dusky.

♂. 11 mm. Head and palpi ochreous. Antennæ fuscous: ciliations in ♂ 1. Thorax and abdomen dark fuscous. Legs fuscous; anterior pair dark fuscous. Forewings moderate, not dilated; pale ochreous-yellowish; markings dark fuscous; a narrow, basal fascia somewhat produced along costa; a broad spot on dorsum from $\frac{1}{4}$ to $\frac{3}{4}$, with rounded outline, extending nearly to middle of disc: an oblique fascia, slightly outwardly curved from costa beyond middle to tornus; a large, apical spot; cilia fuscous, at apex whitish-ochreous. Hindwings and cilia dark grey.

N.S.W.: Mt. Kosciusko (5000 to 6000 ft.); in January; four specimens.

BORKHAUSENIA MACROPTERA, n.sp.

μακροπτερος, long-winged.

♂. 20-21 mm. Head whitish-ochreous; face grey. Palpi fuscous; terminal joint whitish. Antennæ fuscous; ciliations in ♂ $\frac{2}{3}$. Thorax and abdomen fuscous. Legs fuscous, tarsi obscurely annulated with whitish. Forewings elongate, not dilated, costa slightly arched, apex rounded, termen nearly straight, very strongly oblique; grey densely irrorated with whitish; a fuscous, discal spot at $\frac{1}{4}$, a second beneath it on fold, a third below middle, and a fourth transversely elongate at $\frac{2}{3}$; cilia grey, bases mixed with whitish. Hindwings and cilia grey.

N.S.W.: Mt. Kosciusko (4500 to 5000 feet): in January; two specimens.

BORKHAUSENIA GYPSOPLEURA, n.sp.

γυψοπλευρος, with chalky costa.

♂♀. 20-23 mm. Head grey-whitish. Palpi grey; terminal joint whitish, except anterior edge. Antennæ grey-whitish; ciliations in ♂ $\frac{2}{3}$. Thorax and abdomen grey-whitish. Legs grey; posterior pair whitish. Forewings narrow-elongate; costa gently arched, apex round-pointed, termen very obliquely rounded; grey rather densely irrorated with whitish; a broad, whitish, costal streak from base to $\frac{3}{4}$, gradually narrowing posteriorly; a grey, subcostal streak from base to costa before apex; costal edge towards base grey; a grey dot in disc before middle, a second before it on fold, and a third in disc beyond middle; cilia whitish mixed with grey. Hindwings and cilia grey-whitish.

W.A.: Cunderdin, in November and December; three specimens received from Mr. R. Illidge.

Gen. PALIMMECES, n.g.

παλιμμηκης, elongate.

Palpi long; second joint exceeding base of antennæ, with a tuft of loose, spreading hairs towards apex beneath; terminal joint slender. Antennæ with strong, basal pecten; ciliations in

♂ moderate (1). Forewings elongate, not dilated: vein 7 to costa. Hindwings elongate-ovate.

Readily distinguished by the tufted palpi.

PALIMMECES ITHYSTICHA, n.sp.

ἰθυστιχος, straight-lined.

♂♀. 20-23 mm. Head pale fuscous, side-tufts white. Palpi white, tuft and base of second joint pale fuscous. Antennæ fuscous: ciliations in ♂ 1. Thorax white, tegulæ and patagia pale fuscous. Abdomen fuscous, apices of segments and tuft whitish. Legs fuscous; external surface of anterior pair white; posterior pair ochreous-whitish. Forewings elongate, not dilated: pale fuscous; a white, median streak from base to apex: more or less white irroration on termen, better marked in ♀; cilia pale fuscous. Hindwings ovate-lanceolate: grey; cilia ochreous-whitish.

N.S.W.: Glen Innes; in March; five specimens.

Gen. COPRIODES, n.g.

κοπριωδης, resembling excrement.

Palpi moderate; second joint somewhat dilated with loose scales anteriorly towards apex: terminal joint moderately stout. Antennæ of ♂ with moderately long ciliations. Thorax smooth. Anterior tibiæ and tarsi strongly dilated with scales. Forewings with a tuft of scales on costa at or before middle; vein 7 to costa.

Type, *Piloprepes aristocratica* Meyr. In this species, the antennal pecten is strongly developed: in *C. lophoptera*, it is absent; but the two species are certainly nearly related. Perhaps *C. anassa* Meyr., also belongs to this genus.

COPRIODES ARISTOCRATICA.

Piloprepes aristocratica Meyr., Proc. Linn. Soc. N. S. Wales, 1888, p.1598.

Q.: Brisbane, Mt. Tambourine, Coolangatta.—N.S.W.: Sydney. —Vic.: Fernshaw.

COPRIODES LOPHOPTERA.

Piloprepes lophoptera Low., Trans. Roy. Soc. S. Aust., 1894, p.96.

Q.: Nambour, Brisbane, Mt. Tambourine, Coolangatta.

Gen. AGLAODES.

Aglaodes Turn., Trans. Roy. Soc. S. Aust., 1898, p.205.

This genus is distinguished by the very long, second joint of the palpi, and the short, terminal joint, not more than $\frac{1}{3}$ of the second.

AGLAODES CHIONOMA.

Aglaodes chionoma Turn., Trans. Roy. Soc. S. Aust., 1898, p.205.

I have seen no second example of this species.

PILOPREPES GELIDELLA.

Cryptolechia gelidella Wlk., Cat. Brit. Mus., xxix., p.766. *Piloprepes Lucasii* Turn., Trans. Roy. Soc. S. Aust., 1896, p.19.

Antennal ciliations in ♂ $2\frac{1}{2}$.

N.A.: Darwin, in June (G. F. Hill).—Q: Brisbane, in January.

PILOPREPES GLAUCASPIS.

Piloprepes glaucaspis Turn., Trans. Roy. Soc. S. Aust., 1896, p 19.

Antennal ciliations in ♂ 4. The type is still unique.

Q.: Brisbane.

Gen. BAREA.

Barea Wlk., Cat. Brit. Mus. *Phlæopola* Meyr., Proc. Linn. Soc. N. S. Wales, 1883, p.347.

BAREA CONSIGNATELLA.

Barea consignatella Wlk., Cat. Brit. Mus. *Phlæopola pyrgonota* Meyr., Proc. Linn. Soc. N. S. Wales, 1888, p.1594; *P. melanospila* Turn., Trans. Roy. Soc. S. Aust., 1896, p.17.

Q.: Brisbane.—N.S.W.: Sydney.—Vic.: Melbourne, Gisborne.

BAREA EUCAPNODES.

Phlæopola eucapnodes Turn., Trans. Roy. Soc. S. Aust., 1896, p.16; *P. euprepes* Turn., *loc. cit*, p.17: *P. trizyga* Meyr., Exot. Microlep., i., p.169(1914).

This species varies in the presence or absence of general fuscous irroration.

N.Q.: Herberton, from December to February; Kuranda, near Cairns, in November.—Q.: Gayndah, Gympie, Dulong near Nambour, Brisbane, Stradbroke Island, and Southport; from December to April.

Barea subviridella.

Phlœopola subviridella Turn., Trans. Roy. Soc. S. Aust., 1896, p.15.

Q.: Brisbane, Mt. Tambourine.

Barea basigramma.

Phlœopola basigramma Turn., Trans. Roy. Soc. S. Aust., 1896, p.16.

Q.: Nambour and Brisbane, in November and December.

Barea leucocephala.

Phlœopola leucocephala Turn., Trans. Roy. Soc. S. Aust., 1896, p.18.

N.Q.: Stannary Hills.—Q.: Brisbane; in October, December, and January.

Barea chloreis.

Phlœopola chloreïs Turn., Proc. Linn. Soc. N. S. Wales, 1914, p.561.

N.S.W.: Ebor.

Barea panarcha.

Phlœopola panarcha Turn., Proc. Linn. Soc. N. S. Wales, 1915, p.193.

N.S.W.: Ebor.

Barea arbitra.

Eulechria arbitra Meyr., Exot. Microlep., i., p.167 (1914).

Vic.: Lorne, Gisborne.

Barea pyrora.

Eulechria pyrora Meyr., Exot. Microlep., i., p.166 (1914).

♂. 18-23 mm. Head fuscous; face dull whitish-ochreous. Palpi whitish-ochreous with some fuscous scales; terminal joint and a subapical ring on second joint fuscous. Antennæ fuscous;

in ♂ slightly serrulate, ciliations 1. Thorax fuscous, tips of patagia and crest whitish-ochreous. Abdomen fuscous. Legs fuscous annulated with whitish-ochreous; posterior pair mostly whitish-ochreous. Forewings moderate, slightly dilated posteriorly, costa gently arched, apex rounded, termen obliquely rounded; blackish-fuscous with patchy, whitish-ochreous irroration; a short. blackish streak on fold; a short, blackish, median streak from $\frac{1}{3}$ to $\frac{2}{3}$ interrupted by two whitish-ochreous dots; cilia fuscous. Hindwings ochreous-yellow; a dark fuscous, terminal band, thickened at apex and tornus, rather narrow between: cilia dark fuscous.

Easily recognised by the colour of the hindwings. I have redescribed this species, as Meyrick's type seems to have been in poor condition. Mr. Lyell has lent me his co-type, and it is identical with my examples, but with the thorax badly rubbed. In worn examples, there appear dark streaks on veins towards termen.

N.S.W.: Ebor (4000 feet), in January and February; eleven specimens, taken flying close around the farmhouse at daybreak: Gosford.

Barea bryochroa, n.sp.

♂. 15mm. Head whitish; face fuscous. Palpi fuscous; second joint white at apex, and with a longitudinal, white stripe on basal $\frac{3}{4}$ of internal surface; terminal joint white, with a dark fuscous, median band. Antennæ greyish, annulated with dark fuscous. Thorax greenish-fuscous, with a square, whitish, anterior spot Abdomen dull ochreous. Legs whitish; anterior pair fuscous, with whitish annulations. Forewings moderate, not dilated, costa moderately arched, apex rounded, hindmargin obliquely rounded; whitish irrorated with greenish-fuscous scales, which form markings; a narrow, basal fascia prolonged along costa to $\frac{1}{3}$: a rather large spot on costa beyond middle, broadening and becoming suffused in disc to form an obscure fascia; a discal dot at $\frac{1}{3}$, and a second before $\frac{2}{3}$ are connected with this fascia; a suffused spot on costa before apex: cilia greyish. Hindwings and cilia pale grey.

From the other two species with greenish forewings, *B. subviridella* Turn., and *B. hylodroma*, it may be readily distinguished by the basal fascia prolonged along costa.

Q.: Mt. Tambourine (1800 ft.); two specimens, in November.

Barea hylodroma, n.sp.

♂. 18-22 mm. Head ochreous-whitish. Palpi ochreous-whitish; terminal joint with a broad, fuscous band below middle. Antennæ ochreous-whitish annulated with fuscous. Thorax ochreous-whitish; base of patagia greenish-fuscous. Abdomen dull ochreous; apices of segments whitish. Legs ochreous-whitish; anterior and middle tibiæ, and tarsi fuscous with whitish annulations. Forewings somewhat dilated posteriorly, costa slightly arched, apex rounded, hindmargin slightly oblique, rounded beneath; ochreous-whitish, markings suffused greenish-fuscous; a broad line from base of costa along fold to $\frac{1}{3}$; a small suffusion on costa at $\frac{1}{4}$, tending to be connected with a large spot in disc above fold; a large spot on costa beyond middle, connected with a large spot in disc above and before anal angle; a small spot on costa before apex, from which an obscure series of dots proceeds to anal angle; a line along hindmargin; cilia whitish irrorated with fuscous. Hindwings and cilia greyish.

Distinguished from the other two greenish species by the basal line. It appears also to be allied to *B. eucapnodes* Turn.

Q.: Mt. Tambourine (1800 feet); two specimens, in November and December.

Barea nymphica, n.sp.

νυμφικος, bridal.

♂. 12-16 mm. Head whitish. Palpi whitish mixed with pale fuscous. Antennæ whitish annulated with fuscous; ciliations in ♂ 1. Thorax whitish, bases of patagia and a median transverse bar fuscous. Abdomen pale ochreous-fuscous, apices of segments and tuft ochreous-whitish. Legs whitish with some fuscous irroration. Forewings not dilated; whitish; markings fuscous; short, costal and subcostal streaks from base; a dot on base of dorsum, and two on costa at $\frac{1}{3}$ and $\frac{2}{3}$; a discal dot before middle, a second preceding it on fold, and a third in disc at $\frac{2}{3}$: more or less fuscous suffusion towards apex, termen, and tornus: cilia whitish mixed with fuscous. Hindwings whitish, towards apex and termen grey; cilia whitish.

N.Q.: Kuranda near Cairns, in June, October, and November. —Q.: Brisbane, in October; Mt. Tambourine, in September, October, and November. Thirteen specimens.

Barea anerasta, n.sp.

ἀνέραστος, unlovely.

♂♀. 17-20 mm. Head whitish-brown. Palpi with apical joint rather stout; fuscous. Antennæ fuscous: ciliations in ♂ 1. Thorax fuscous mixed with whitish-brown. Legs ochreous-whitish; anterior and middle tibiæ, and tarsi annulated with fuscous. Forewings not dilated; brown-whitish with dark fuscous markings tolerably well-defined, and some dark fuscous irroration towards base; a dot on base of costa, and another on base of dorsum, the former more or less produced along fold; a discal dot before middle; a second preceding it on fold and forming the apex of a triangular spot on mid-dorsum; a third dot at $\frac{2}{3}$ forming the apex of a triangular spot on $\frac{2}{3}$ costa; a subapical costal spot connected by an outwardly curved line of dots with tornus; cilia brown-whitish. Hindwings ochreous-whitish; towards apex pale fuscous; cilia ochreous-whitish, towards apex fuscous-tinged.

Q.: Brisbane; in August and September.—N.S.W.: Kiama. Six specimens.

Barea eusciasta, n.sp.

εὐσκίαστος, well-shaded.

♂♀. 16-18 mm. Head fuscous; lower edge of face ochreous-whitish. Palpi fuscous: apex of terminal and second joints, inner surface and a subapical band of second joint, ochreous-whitish. Palpi fuscous: ciliations in ♂ $\frac{1}{2}$. Thorax fuscous, apices of patagia and crest ochreous-whitish. Abdomen pale grey. Legs fuscous: annulations of tibiæ and tarsi, and hairs on posterior tibiæ ochreous-whitish. Forewings not dilated, costa moderately arched, apex rounded, termen obliquely rounded: ochreous-whitish irrorated and shaded with fuscous; a broad, basal, fuscous suffusion; a rather broad, suffused, fuscous fascia from $\frac{2}{3}$ costa to tornus; a second fascia from costa before apex narrowing rapidly in disc, and joining first fascia at tornus; from this, several short streaks run parallel to veins to termen; cilia fuscous mixed with ochreous-whitish. Hindwings pale grey; cilia grey-whitish.

Q.: Brisbane: in September and October: three specimens.

BAREA PSOLOGRAMMA, n.sp

ψολογραμμος, soot-marked.

♂♀. 21-34 mm. Head whitish. Palpi whitish, with a few fuscous scales; apical joint dark fuscous with a few whitish scales. Antennæ with segments triangularly dilated in apical half; whitish, with fuscous annulations; ciliations of ♂ $1\frac{1}{2}$. Thorax fuscous, apices of patagia and crest whitish Abdomen ochreous-fuscous, apices of segments and tuft whitish. Legs dark fuscous, with whitish annulations; posterior pair whitish, with very long, dense hairs on tibiæ. Forewings not dilated: whitish, with patchy brownish suffusion and fuscous irroration: a dark fuscous discal dot at $\frac{1}{3}$, a second preceding it on fold, a third in middle of disc, a fourth obliquely before and beneath third; a larger spot between second dot and dorsum; an ill-defined, fuscous spot on $\frac{1}{3}$ costa; another on $\frac{2}{3}$ costa produced to mid-disc beyond third dot and darker at apex; a subapical, fuscous spot with a brownish suffusion between it and termen; cilia whitish, with a broad, interrupted, fuscous line. Hindwings whitish tinged with grey towards apex; cilia grey-whitish.

Tas.: Hobart, in January; ten specimens, received from Mr. A. M. Lea.

BAREA ATMOPHORA, n.sp.

ἀτμοφορος, smoky.

♂. 20-25 mm. Head fuscous; face ochreous-whitish. Palpi fuscous; second joint with apex and a broad, ill-defined ring beyond middle, ochreous-whitish. Antennæ fuscous; in ♂

slightly serrate, ciliations $\frac{1}{3}$. Thorax fuscous, apices of patagia and crest ochreous-whitish. Abdomen ochreous-grey-whitish. Legs fuscous; posterior pair ochreous-whitish; fore and middle tibiæ and tarsi annulated with ochreous-whitish. Forewings slightly dilated, costa gently arched, more strongly towards base, apex rounded, termen obliquely rounded; ochreous-whitish, with general fuscous irroration; markings fuscous and dark fuscous; an oblique fascia from base of costa, gradually broadening and extending on dorsum from $\frac{1}{4}$ to middle, its posterior edge showing a rounded projection above and below middle, of which the latter includes the plical dot; a discal dot at $\frac{1}{3}$, another at $\frac{2}{3}$, and another beneath middle of disc; three costal spots, first at $\frac{1}{4}$, second at middle connected with second discal dot, third before apex connected with a circular blotch above tornus; an interrupted, terminal line; cilia ochreous-whitish mixed with dark fuscous, apical half grey, apices whitish. Hindwings pale grey; cilia whitish, with some basal, grey scales.

Best distinguished by the basal fascia of forewings.

Vic.: Gisborne, in February.—Tas.: Hobart, in December and January. Seven specimens.

Gen. Lophopepla.

Lophopepla Turn., Trans. R. Soc. S. Aust., 1896, p.10.

Perhaps allied to *Trachypepla*, with which it agrees in the tufted forewings, but vein 7 runs to termen.

Lophopepla igniferella.

Hypercallia igniferella Wlk., Brit. Mus. Cat., xxix., p.670.
Lophopepla igniferella Turn., Trans. R. Soc. S. Aust., 1896, p.10.

Antennal ciliations of ♂ 1.

N.A.: Darwin.—N.Q.: Thursday Island, Townsville.—Q.: Brisbane, Toowoomba.

Lophopepla triselena.

Eomystis triselena Low., Trans. R. Soc. S. Aust., 1902, p.240.

Antennal ciliations of ♂ $1\frac{1}{2}$.

N.Q.: Townsville.

Lophopepla asteropa.

Eomystis asteropa Low., Proc. Linn. Soc. N. S. Wales, 1900, p.410.

Antennal ciliations of ♂ 1½.

N.Q.: Townsville.

Trachypepla poliochroa.

Linosticha poliochroa Turn., Trans. R. Soc. S. Aust., 1898, p.208.

Q.: Mt. Tambourine.

Trachypepla atrispersa, n.sp.

Atrispersus, speckled with black.

♂♀. 12-14 mm. Head and thorax white. Palpi white; base of second joint, and a spot before apex on external surface, dark fuscous; terminal joint with a median, dark fuscous spot on external surface. Antennæ whitish. Abdomen whitish-ochreous. Legs whitish; anterior pair fuscous anteriorly. Forewings narrow, costa moderately arched, apex rounded, hindmargin very obliquely rounded; white, sparsely irrorated with pale fuscous and black scales; a black dot in disc at ⅔; cilia white mixed with pale fuscous. Hindwings and cilia whitish-grey.

Q.: Brisbane; in August and September; three specimens.

Trachypepla hæmalea, n.sp.

αἱμαλεος, blood-red.

♂♀. 18-22 mm. Head and thorax reddish irrorated with dark fuscous. Palpi whitish, more or less reddish-tinged with dark fuscous irroration; terminal joint mostly dark fuscous. Antennæ fuscous; ciliations in ♂ 1½. Abdomen ochreous-fuscous, apices of segments and tuft whitish. Legs fuscous; tarsi obscurely annulated with ochreous-whitish; posterior pair ochreous-whitish. Forewings not dilated; pale reddish, with more or less general dark fuscous irroration; an irregular, dark fuscous streak from base of costa along fold, and thence through middle of disc to apex, sometimes interrupted; usually two or three, dark fuscous dots in disc above median streak; cilia pale reddish, apices ochreous-whitish, with some fuscous irroration. Hindwings pale grey; cilia whitish, with a pale grey, sub-basal line.

Q.: Eidsvold; Brisbane, in August; seven specimens.

Gen. ATRIBASTA, n.g.

ἀτρίβαστος, unusual.

Head with dense, anterior and side-tufts. Palpi with second joint exceeding base of antennæ, shortly roughened with loose scales towards apex anteriorly; terminal joint short, less than half second, slender. Antennæ with strong, basal pecten; in ♂, moderately ciliated. Thorax with a small, posterior crest. Forewings with 7 and 8 coincident and running to apex, 2 and 3 connate. Hindwings with 2 and 3 connate, or short-stalked.

ATRIBASTA FULVIFUSA, n.sp.

Fulvifusus, suffused with brown.

♂. 23 mm. Head ochreous-whitish. Palpi ochreous-whitish; outer surface of second joint brownish. Antennæ whitish; ciliations in ♂ 1½. Thorax whitish, patagia and a few scattered scales fuscous brown. Abdomen ochreous-whitish, on bases of segments mixed with brown. Legs fuscous-brown; [posterior pair broken]. Forewings moderately broad, posteriorly dilated, costa rather strongly arched, apex rounded, termen obliquely rounded; whitish, generally suffused, except on central area, with pale fuscous-brown; discal dots dark fuscous, a dot in disc at ⅓, a second beneath it on fold, a third streak-like beyond and midway between these, a fourth above middle, a fifth before ⅔, a sixth below fifth prolonged crescentically towards third; some fuscous dots on termen; cilia whitish, with faint brownish suffusion. Hindwings and cilia grey-whitish.

Of ordinary *facies*, but curious in structure.

Q: Warwick, in April; one specimen.

ŒNOCHROA OCHROSOMA.

Œnochroa ochrosoma Turn., Trans. R. Soc. S. Aust., 1896, p.13.

Q: Brisbane.

ŒNOCHROA GNOPHODES.

Œnochroa gnophodes Turn., *op. cit.*, 1896, p.14.

♂♀. 14-19 mm. Q.: Brisbane, in August and April; three specimens.

PLACOCOSMA PHAEINA.

Placocosma phaëina Turn., *op. cit.*, 1896, p.14.

Antennal ciliations in ♂ 1½.

Q.: Brisbane.

Gen. PHYLLOPHANES.

Phyllophanes Turn., *op. cit.*, 1896, p.21.

I am in some doubt as to the correct location of this genus.

PHYLLOPHANES DYSEURETA.

Phyllophanes dyseureta Turn., *op. cit.*, 1896, p.21

Q.: Brisbane. The type (♀) still remains unique.

ELÆONOMA LATHRÆA, n.sp.

λαθραιος, hidden, secret.

♂. 20-26mm. Head and thorax fuscous-brown. Palpi ochreous-whitish irrorated with dark fuscous, especially on external surface. Antennæ ochreous-whitish; ciliations in ♂ $\frac{2}{3}$. Abdomen whitish-ochreous with some fuscous irroration towards base. Legs whitish-ochreous irrorated with fuscous. Forewings somewhat dilated posteriorly; pale brownish, with some fuscous irroration; markings fuscous; a dot in disc at $\frac{1}{3}$, a second beneath it on fold, and a third before $\frac{2}{3}$; a broad, inwardly oblique line from $\frac{4}{5}$ costa, suddenly angled outwards and narrow, then angled again parallel to termen and sometimes dentate to dorsum before tornus; an interrupted, terminal line not reaching tornus; cilia pale brownish, with some fuscous irroration. Hindwings broadly ovate; ochreous-whitish greyish-tinged; cilia ochreous-whitish.

Q.: Brisbane, in June, July, and August; seven specimens.

ELÆONOMA ACROPHÆA, n.sp.

ἀκροφαιος, with dusky apex.

♂♀. 14-16 mm. Head whitish-ochreous. Palpi fuscous, internal surface whitish. Antennæ fuscous; ciliations in ♂ $\frac{2}{3}$. Thorax ochreous-whitish, bases of patagia fuscous. Abdomen fuscous, apices of segments and tuft whitish. Legs fuscous, tarsi annulated with ochreous-whitish; posterior pair ochreous-whitish. Forewings not dilated; whitish; markings dark fuscous; more or less fuscous suffusion beneath costa; a discal dot at $\frac{1}{3}$, a second beneath and slightly beyond it on fold, a third before $\frac{2}{3}$, a fourth above middle, and a fifth beneath and beyond third; a more or less marked, fuscous, apical blotch; a terminal series of dark fuscous dots; termen ochreous-tinged; cilia grey. Hindwings elongate-ovate; pale grey; cilia pale grey, bases ochreous-tinged.

Q.: Nambour (including Eumundi and Montville) in August, October, and November: Bunya Mountains, in December: five specimens.

Gen. EPITHYMEMA,

Epithymema Turn., Proc. Linn. Soc. N. S. Wales, 1914, p.562.

EPITHYMEMA DISPARILE.

Epithymema disparile Turn., *op. cit.*, 1914, p.562.

N.S.W.: Ebor.

EULECHRIA PACIFERA.

Eulechria pacifera Meyr., Exot. Microlep., i., p.165 (1914).

I have one ♂ example from Port Darwin, received from Mr. G. F. Hill. Antennal ciliations in ♂ 1.

EULECHRIA STIGMATOPHORA.

Eulechria stigmatophora Turn., Trans. R. Soc. S. Aust., 1896, p.11.

Antennal ciliations of ♂ 2½.

N.Q.: Herberton.—Q.: Nambour, Caloundra, Brisbane, Stradbroke Island, Mt. Tambourine, Coolangatta, Killarney.—N.S.W.: Ebor.

EULECHRIA BARYPTERA.

Eulechria baryptera Turn., *op. cit.*, 1896, p.11.

Antennal ciliations of ♂ 1.

Q.: Nambour, Caloundra, Brisbane.

EULECHRIA EUCHLORA.

Eulechria euchlora Turn., *op. cit.*, 1896, p.12.

Q.: Brisbane. The type is still unique.

EULECHRIA CURVILINEA.

Eulechria curvilinea Turn., *op. cit.*, 1896, p.12.

Antennal ciliations of ♂ 1.

Q.: Brisbane, Southport.

EULECHRIA TETRAPLOA.

Eulechria tetraploa Turn., *op. cit.*, 1896, p.13.

Antennal ciliations of ♂ 2.

Q.: Brisbane. The type is still unique.

EULECHRIA XIPHERES.

Philobota xipheres Turn., *op. cit.*, 1896, p.23.

Antennal ciliations of ♂ 1.

Q.: Brisbane, in December; Mt. Tambourine, in November.

EULECHRIA SILVICOLA.

Eulechria silvicola Turn., *op. cit.*, 1898, p.206.

Antennal ciliations in ♂ 1.

Q.: Mt. Tambourine, in November and February; Coolangatta, in November and May.

EULECHRIA CONCOLOR.

Eulechria concolor Turn., *op. cit.*, 1898, p.206.

Antennal ciliations of ♂ $\frac{3}{4}$.

Q.: Warwick, Stanthorpe, in February and March.—N.S.W.: Bathurst. The last locality is based on a specimen in Mr. Meyrick's collection, which was confused with *Philobota monolitha*. The Bathurst locality for the latter species should be deleted.

EULECHRIA CANDIDA.

Eulechria candida Turn., *op. cit.*, 1898, p.206.

Antennal ciliations of ♂ $\frac{3}{4}$.

Q.: Brisbane, Stanthorpe.—N.S.W.: Tabulam, Tenterfield, Glen Innes, Ben Lomond, Armidale.

EULECHRIA CHRYSERES.

Eulechria chryseres Turn., *op. cit.*, 1898, p.207.

Antennal ciliations of ♂ 1.

Q.: Brisbane. The type is still unique.

EULECHRIA DIAPHANES.

Eulechria diaphanes Turn., *op. cit.*, 1898, p.207.

♂♀. 14-20 mm. Antennal ciliations of ♂ $1\frac{1}{2}$.

Q.: Eumundi near Nambour, Mount Tambourine, and Killarney, in November.

EULECHRIA BATHROPHÆA.

Eulechria bathrophaea Turn., Proc. Linn. Soc. N. S Wales, 1914, p.562.

N.S.W.: Ebor.

Eulechria modica, n.sp.

Modicus, ordinary, unpretending.

♂♀. 12-14 mm. Head white. Palpi fuscous; apex of second joint, and terminal joint, except apex, whitish. Antennæ grey; ciliations in ♂ ½. Thorax white, base of patagia fuscous. Abdomen grey-whitish or grey, tuft ochreous-whitish. Legs fuscous; posterior pair ochreous-whitish. Forewings narrow, not dilated; white, with scanty, fuscous irroration; markings fuscous; a spot on base of costa; a discal dot at ⅓, a second beneath it on fold, a third before and above middle, a fourth at ⅔ indistinctly double, and suffusedly connected with tornus; a broadly suffused line from ⅚ costa, at first inwardly oblique, then bent outwards, then inwards and parallel to, and near termen to tornus; some fuscous irroration along termen; cilia whitish, with fuscous irroration. Hindwings pale grey; cilia whitish, at apex greyish.

Q.: Warwick and Killarney, in October; five specimens.

Eulechria decolor, n.sp.

Decolor, discoloured.

♂♀. 23-24 mm. Head and thorax whitish-grey. Palpi fuscous anteriorly, whitish-grey posteriorly. Antennæ whitish-grey; ciliations in ♂ ½. Abdomen ochreous-fuscous; apices of segments and tuft whitish-grey. Legs fuscous; posterior pair whitish. Forewings elongate, costa moderately arched, apex rounded, hindmargin very obliquely rounded; pale fuscous-grey, densely irrorated with whitish scales; first two discal dots obsolete (in my specimens); an obscure, fuscous dot above middle, and three or four similar dots in disc beyond middle, coalescing to form a semilunar mark, all these sometimes obsolete; cilia whitish. Hindwings pale grey; cilia whitish-grey.

Type in Coll. Lyell.

Vic.: Gisborne, in February; three specimens, received from Mr. G. Lyell.

Eulechria psarophanes, n.sp.

ψαροφανης, greyish.

♂♀. 23-24 mm. Head and palpi grey-whitish. Antennæ whitish; ciliations in ♂ ½. Thorax whitish; a central spot and bases of patagia grey. Abdomen pale ochreous-brown, apices of segments and tuft ochreous-whitish. Legs grey-whitish. Forewings moderate, not dilated, costa moderately arched, apex round-pointed, termen obliquely rounded; grey-whitish; sometimes a terminal series of grey dots: cilia grey-whitish. Hindwings grey: cilia grey-whitish.

Like *E. decolor*, but without discal markings. It may prove to be a local race of that species.

Q.: Stanthorpe, in February.—N.S.W.: Glen Innes, in January. Three specimens.

EULECHRIA APHANOSPILA, n.sp.

ἀφανοσπιλος, without spots.

♂. 20-22 mm. Head and thorax ochreous-grey-whitish. Palpi ochreous-grey-whitish: outer surface of second joint fuscous. Antennæ ochreous-grey-whitish; ciliations of ♂ $\frac{2}{3}$. Abdomen ochreous-grey; apices of terminal segments and tuft pale ochreous. Legs fuscous, posterior pair pale ochreous. Forewings moderately elongate, not dilated: ochreous-grey-whitish without markings; cilia pale grey. Hindwings grey: cilia whitish-ochreous, towards apex greyish-tinged.

Allied to *E. concolor*, but without the brownish colouration of both fore and hind-wings.

N.S.W.: Glen Innes, in March; eight specimens.

EULECHRIA SYNCHROA, n.sp.

συγχροος, of one colour.

♂. 17 mm. Head pale ochreous; face fuscous. Palpi fuscous, apex of second joint whitish. Antennæ grey; ciliations in ♂ $\frac{1}{2}$. Thorax dark brown; tegulæ pale ochreous. Abdomen brownish, apices of segments and tuft pale ochreous. Legs fuscous: posterior tibiæ and tarsi pale ochreous. Forewings not dilated, costa strongly arched, apex rounded, termen very obliquely rounded; brown; cilia fuscous, bases whitish. Hindwings grey; cilia grey, bases whitish-ochreous.

Not unlike *E. concolor*, but at once distinguished by the pale ochreous head.

N.S.W.: Glen Innes, in December; one specimen.

EULECHRIA NIPHOGRAMMA, n.sp.

νιφογραμμος, snow-marked.

♂. 18 mm. Head brownish-fuscous, side-tufts mixed with white, face whitish. Palpi whitish, external surface of second joint brownish-tinged, anterior edge of terminal joint fuscous. Antennæ grey, towards base whitish; ciliations of ♂ 1. Thorax brown. Abdomen ochreous-whitish; bases of segments on dorsum dull ferruginous. Legs brownish-fuscous: posterior pair whitish-ochreous. Forewings moderate, posteriorly somewhat dilated, costa gently arched, apex round-pointed, termen obliquely rounded: ochreous-brown: a white costal streak from base to ¾: cilia ochreous-brown. Hindwings pale grey: cilia whitish-ochreous.

N.S.W.: Glen Innes, in March; one specimen.

EULECHRIA CIRRHOPEPLA n.sp.

κιρροπεπλος, clothed in yellowish.

♂. 20-22 mm. Head pale ochreous. Palpi ochreous-whitish, external surface fuscous except at base. Antennæ whitish ochreous: ciliations in ♂ 1. Thorax whitish-ochreous, anterior edge sometimes fuscous-tinged. Abdomen dull ferruginous on dorsum, apices of segments whitish, tuft pale ochreous. Legs pale ochreous: anterior and middle pairs fuscous anteriorly. Forewings rather narrowly oblong, not dilated, costa gently arched, more strongly at base, apex rounded, termen obliquely rounded: whitish-ochreous; cilia whitish-ochreous. Hindwings grey; cilia whitish-ochreous.

The thorax and abdomen of this species are stoutly built.

N.A.: Port Darwin in November and December; four specimens received from Mr. G. F Hill, and Mr. F. P. Dodd.

EULECHRIA LEPTOCHORDA, n.sp.

λεπτοχορδος, with fine lines.

♂. 25-26 mm. Head, thorax, and palpi grey-whitish. Antennæ whitish: ciliations in ♂ 2. Abdomen whitish, bases of segments dull ferruginous. Legs grey-whitish; anterior pair fuscous anteriorly: posterior pair ochreous-whitish. Forewings elongate, not dilated, costa moderately arched, apex round-pointed, termen very obliquely rounded; pale grey, with numerous, fine, whitish streaks parallel to veins: cilia whitish. Hindwings and cilia pale grey.

N.Q.: Magnetic Island near Townsville, in July: three specimens.

EULECHRIA PLAGIOSTICHA, n.sp.

πλαγιοστιχος, with oblique lines.

♀. 22 mm. Head white. Palpi white, second joint, except apex, and a subapical ring on terminal joint, fuscous. Antennæ grey. Thorax white, anterior margin and a subapical bar dark fuscous. Abdomen grey, paler towards base. Legs whitish: anterior tibiæ and tarsi fuscous; middle pair with apex of femora, and a subapical ring on tibiæ, fuscous. Forewings elongate-oval, costa rather strongly arched, apex round-pointed, termen very obliquely rounded: white; markings dark fuscous; a moderate, basal fascia slightly produced on costa; an outwardly oblique streak from $\frac{1}{3}$ dorsum to middle of disc: a triangular spot on costa before middle, touching dorsal streak before extremity: an inwardly oblique streak from $\frac{3}{4}$ costa; a second, dorsal streak from tornus, parallel to first, slightly posterior to costal streak; a subapical spot; a fine, terminal line; cilia grey-whitish. Hindwings grey, paler towards base; cilia whitish, towards apex grey.

Q.: Brisbane, in March; one specimen.

EULECHRIA PYCNOGRAPHA, n.sp.

πυκνογραφος, thickly marked.

♂♀. 20-23 mm. Head white. Palpi fuscous; inner surface of second joint, except at base, and terminal joint, except apex, white. Antennæ fuscous: ciliations in ♂ $\frac{3}{4}$. Thorax white, anterior margin broadly fuscous. Abdomen grey tinged with ferruginous, apices of segments and tuft ochreous-whitish. Legs fuscous; posterior pair ochreous-whitish. Forewings elongate-oval, costa moderately arched, apex rounded, termen very obliquely rounded; white: some fuscous irroration on dorsum; markings fuscous, well-defined; a short, oblique streak from base of costa; a discal spot at $\frac{1}{3}$, and a second beneath it on fold, these often confluent, forming a broad, transverse bar connected with costa by some fuscous irroration; an inwardly oblique, broad streak from $\frac{2}{5}$ costa; from the costal end of this arises a straight fascia to tornus: a longitudinally oval spot below middle of disc precedes this fascia; a sigmoid fascia from costa before apex to tornus, thick towards costa, slender towards tornus: a fine, interrupted, subterminal line; cilia ochreous-grey-whitish. Hindwings and cilia grey.

This and the following two species belong to the *variegata*-group. The oblique streak from base of costa is a good distinguishing point.

N.S.W.: Ebor, in January: six specimens.

EULECHRIA VICINA, n.sp.

Vicinus, neighbouring.

♂♀. 20-23 mm. Head white. Palpi white; apex of terminal joint, and external surface of second joint, except at apex, fuscous. Antennæ fuscous; ciliations of ♂ $\frac{3}{4}$. Thorax white, anterior margin broadly fuscous. Abdomen grey, apices of segments and tuft ochreous-whitish. Legs fuscous; tarsi annulated with whitish; internal surface of posterior pair ochreous-whitish. Forewings elongate-oval, costa moderately arched, apex rounded, termen very obliquely rounded: white, with fine, grey irroration; markings fuscous-grey; costal edge at base blackish; a fine, subcostal streak from base to $\frac{1}{4}$; a discal dot at $\frac{1}{4}$, a second beneath it on fold, a third in middle, a fourth beneath and beyond third; a straight fascia from $\frac{2}{3}$ costa to tornus; a sigmoid fascia from costa before apex to tornus, broad towards costa, narrow towards tornus; some terminal dots; cilia grey, bases mixed with white. Hindwings and cilia grey.

Allied to the preceding, but with markings less pronounced, and with more general irroration, discal dots smaller and more discrete; especially distinguished by the subcostal streak from base (not costal as in *E. variegata*).

N.S.W. Ben Lomond and Ebor, in January; four specimens.

EULECHRIA LEUCOSTEPHANA, n.sp.

λευκοστεφανος, white-crowned.

♂♀. 22-24 mm. Head white. Palpi fuscous, mixed, especially on internal surface, with whitish. Antennæ fuscous; ciliations in ♂ $\frac{2}{3}$. Thorax fuscous: tegulæ, apices of patagia, and a large, posterior spot, white. Abdomen dark grey. Legs fuscous, with some whitish irroration; posterior pair grey. Forewings rather elongate, not dilated, costa moderately arched, apex round-pointed, termen obliquely rounded; white, with more or less fuscous irroration; costal edge at base blackish; markings dark fuscous; a very short, slender, subcostal streak from base; a discal dot at $\frac{1}{3}$, a second beneath it on fold, a third, not always present, above middle, and a fourth at $\frac{2}{3}$; a streak from fourth dot to tornus; a broad, inwardly oblique streak from $\frac{5}{6}$ costa, soon narrowing and angled outwards, and continued parallel to termen to tornus; a submarginal series of dots; cilia whitish, bases pale fuscous. Hindwings grey: cilia whitish, bases grey.

The markings are dark fuscous, not grey, as in the preceding species; and the subcostal streak much shorter.

N.S.W.: Mt. Kosciusko(5000 feet), in January; five specimens.

Eulechria eutheta, n.sp.

εὔθετος, well arranged.

♂. 11 mm. Head white; face grey. Palpi white, basal half of second joint fuscous. Antennæ fuscous; ciliations in ♂ 1. Thorax dark fuscous, with a large, posterior, white spot. Abdomen fuscous, tuft whitish. Legs fuscous; posterior pair whitish. Forewings not dilated, costa rather strongly arched, apex round-pointed, termen nearly straight, oblique: white: markings dark fuscous: a broad, inwardly oblique fascia from $\frac{2}{5}$ costa to $\frac{1}{3}$ dorsum, giving off a strong process along fold to tornus: a large, triangular spot on costa at $\frac{2}{3}$, its apex coalescing with a broad, terminal fascia; cilia white, on apex and tornus fuscous. Hindwings grey, near base whitish; cilia grey, on dorsum whitish.

Q.: Brisbane, in March; one specimen.

Eulechria axierasta, n.sp.

ἀξιέραστος, worthy of affection.

♂. 10-11 mm. Head ochreous-fuscous; face whitish. Palpi whitish, apex of terminal joint fuscous. Antennæ fuscous; ciliations in ♂ 1. Thorax ochreous-fuscous. Abdomen fuscous. Legs ochreous-whitish; anterior tibiæ and tarsi fuscous annulated with white. Forewings rather narrow, costa rather strongly arched, apex rounded, termen obliquely rounded; whitish; markings ochreous edged with fuscous: a small fuscous suffusion on base of dorsum: a sub-basal median spot or dot; an outwardly oblique fascia from $\frac{1}{3}$ costa to dorsum beyond middle, and a second, rather broader from $\frac{2}{3}$ costa to tornus; an ill-defined terminal or subterminal fascia: cilia whitish, with a few fuscous scales, sometimes pinkish-tinged on costa. Hindwings and cilia pale grey.

Q.: Coolangatta, in October: Toowoomba, in November: two specimens.

Eulechria diploclethra, n.sp.

διπλοκληθρος, twice barred.

♂♀. 13-14 mm. Head white. Palpi white, basal half of second joint fuscous. Antennæ fuscous: ciliations of ♂ $1\frac{1}{2}$. Thorax fuscous; tegulæ, and sometimes a posterior spot, white. Abdomen ochreous-whitish, dorsum, except apices of segments, dull ferruginous. Legs ochreous-whitish; anterior pair fuscous. Forewings moderate, posteriorly somewhat dilated, costa moderately arched, apex rounded, termen obliquely rounded; white: markings fuscous; a narrow, basal fascia sometimes produced on costa; an antemedian fascia sharply defined anteriorly, suffused posteriorly; a second fascia from costa before apex to tornus: a narrow, interrupted, terminal fascia: cilia whitish. Hindwings and cilia grey-whitish.

Q.: Mt. Tambourine, in November: two specimens.

Eulechria semantica, n.sp.

σημαντικος, distinct.

♂♀. 14-20mm. Head yellow-ochreous. Palpi yellow-ochreous: external surface of second joint, except apex, dark fuscous. Antennæ dark fuscous; ciliations in ♂ 1. Thorax yellow-ochreous; tegulæ dark fuscous. Abdomen ochreous; apices of joints paler. Legs whitish; anterior pair dark fuscous; middle pair spotted with dark fuscous. Forewings elongate-oval, costa moderately arched, apex round-pointed, hindmargin very obliquely rounded; yellow-ochreous; markings dark fuscous: a narrow, basal fascia prolonged as a broad streak along costa to $\frac{2}{5}$: an elongate spot on costa beyond middle, and a small, oblique mark before apex: several minute dots on apex and termen: cilia yellow-ochreous. Hindwings grey: cilia yellow-ochreous.

Q.: Mt. Tambourine, in November, December, and January: seven specimens.

EULECHRIA EURYGRAMMA, n.sp.

εὐρυγραμμος, broadly marked.

♂♀. 18mm. Head pale ochreous-yellow. Palpi fuscous; apical half of second joint ochreous-whitish. Antennæ fuscous; ciliations in ♂ 1. Thorax fuscous, with a posterior, ochreous spot. Abdomen fuscous; tuft ochreous. Legs ochreous: anterior and middle tibiæ and tarsi fuscous, with whitish-ochreous annulations. Forewings moderately broad, not dilated; costa arched at base, thence nearly straight; apex rounded, termen obliquely rounded; pale ochreous-yellow: a broad, transverse, fuscous fascia before middle, biconcave, with a slight, posterior projection below middle: a second, fuscous fascia from $\frac{3}{4}$ costa to tornus: a broad, fuscous line from second fascia along costa and termen to fascia again at tornus; cilia fuscous, apices pale ochreous, except at tornus. Hindwings fuscous: cilia fuscous, apices pale ochreous beneath apex.

N.Q.: Stannary Hills: three specimens received from Dr. T. Bancroft.

EULECHRIA BATHROGRAMMA, n.sp.

βαθρογραμμος, with basal marking.

♂♀. 11-16 mm. Head whitish-ochreous. Palpi fuscous; apex of second joint, and terminal joint, except towards apex, ochreous-whitish. Antennæ pale fuscous; ciliations in ♂ 1. Thorax whitish-ochreous: bases of patagia fuscous. Abdomen whitish-ochreous, bases of segments brownish. Forewings not dilated, costa rather strongly arched, apex round-pointed, termen very obliquely rounded; whitish-ochreous; markings fuscous; a narrow, basal fascia, slightly produced on costa: a small, costal spot on $\frac{1}{3}$, sometimes obsolete; a larger spot on costa beyond middle: a minute, discal dot at $\frac{1}{3}$, a second beneath it on fold, a third above middle, and a fourth transversely crescentic at $\frac{2}{3}$; a line from $\frac{5}{6}$ costa obliquely inwards, acutely angled outwards beneath costa, then curved, parallel and near termen to tornus; a terminal series of dots; cilia whitish-ochreous, apices greyish. Hindwings grey-whitish; cilia ochreous-whitish.

Q.: Montville, Dulony, and Eumundi, near Nambour, Brisbane, Coolangatta, and Bunya Mountains; in October-December, and March. This is a "scrub"-species.

EULECHRIA ATMOSPILA, n.sp.

ἀτμοσπιλος, with smoky spots.

♂. 19 mm. Head, thorax, and palpi whitish-grey, with a few darker scales. Antennæ whitish-grey; ciliations in ♂ $1\frac{1}{2}$. Abdomen grey-whitish, with three or four, ferruginous bars before apex. Legs whitish; anterior pair grey. Forewings rather broadly dilated, costa moderately arched, apex rounded, termen obliquely rounded; whitish-grey; markings and a few scattered scales dark fuscous; a dot on base of costa; a subcostal dot near base; a spot on base of dorsum; a dot in disc at $\frac{1}{3}$, a second beneath it on fold, and a third at $\frac{2}{3}$; a subcostal median dot; a series of dots from $\frac{2}{3}$ costa, at first subcostal, then near termen to tornus; a rather large, circular spot above tornus, extending to near third discal dot; cilia whitish, with some fuscous irroration at tornus. Hindwings broad; whitish, irrorated with pale grey; cilia whitish, with a grey, sub-basal line towards tornus.

Q.: Killarney, in November; one specimen, received from Mr. R. Illidge.

EULECHRIA THRENODES, n.sp.

θρηνωδης, mournful.

♂♀. 17-18 mm. Head ochreous-whitish. Palpi ochreous-whitish, outer surface of second joint, and anterior edge of terminal joint, fuscous. Antennæ pale fuscous; ciliations in ♂ $1\frac{1}{2}$. Thorax ochreous-whitish more or less suffused with pale fuscous. Abdomen ochreous-whitish, bases of segments more or less ochreous-fuscous. Legs whitish-ochreous; anterior pair pale fuscous anteriorly. Forewings not dilated; ochreous-whitish; costal edge near base fuscous; sometimes a pale fuscous, discal dot at $\frac{2}{3}$, but this is usually obsolete: cilia ochreous-whitish. Hindwings grey; cilia ochreous-whitish.

Distinguishable from *E. corsota* by the longer, antennal ciliations; from *E. exanimis* by the absence of a fuscous spot on base of patagia: from *E. pallidella*, by the darker hindwings.

N.Q.: Kuranda, near Cairns, in October: Townsville, in September and January.—N.S.W.: Tabulam, in December. Eight specimens.

Eulechria catharistis, n.sp.

καθαριστις, spotless.

♂♀. 14-20 mm. Head and thorax whitish. Palpi whitish, external surface of second joint and apex of terminal joint fuscous. Antennæ grey-whitish; ciliations in ♂ $1\frac{1}{2}$. Abdomen whitish, bases of segments brownish-ochreous. Legs ochreous-whitish: anterior pair fuscous-tinged. Forewings moderately broad, not dilated; whitish; cilia whitish. Hindwings grey-whitish or grey; cilia whitish.

E. pallidella has more whitish hindwings, and longer, antennal ciliations (2). *E. homochroa* has narrower, ochreous-tinged forewings, and shorter, antennal ciliations ($\frac{2}{3}$).

Q.: Eumundi near Nambour, in November and December: Brisbane, from November to April; Toowoomba, in April; Stanthorpe, in November: twenty specimens.

Eulechria homochroa, n.sp.

ὁμοχροος, of one colour.

♂♀. 12-16 mm. Head and thorax pale ochreous. Palpi pale ochreous, outer surface of second joint fuscous except at apex. Antennæ ochreous-grey-whitish; ciliations in ♂ $\frac{2}{3}$. Abdomen pale ochreous. Legs fuscous; posterior pair pale ochreous. Forewings rather narrow, not dilated: uniform pale ochreous; cilia pale ochreous. Hindwings grey-whitish; cilia whitish-ochreous.

Distinguished by the pale ochreous, narrow forewings, and short, antennal ciliations.

Q.: Brisbane, in February and March: Southport, in November; Stanthorpe: six specimens.

EULECHRIA TEPHROCHROA, n.sp.

τεφροχροος, ash-coloured.

♂. 15-17 mm. Head ochreous-whitish. Palpi ochreous-whitish; external surface of second joint, except apex, brownish-fuscous; terminal joint dark fuscous towards apex anteriorly. Antennæ grey-whitish; ciliations in ♂ 2½. Thorax ochreous-whitish, more or less suffused anteriorly with brownish-fuscous. Abdomen ochreous-whitish, bases of segments on dorsum dull ferruginous. Legs fuscous; posterior pair ochreous-whitish. Forewings rather narrow, not dilated, costa gently arched, apex rounded, termen very obliquely rounded; ochreous-whitish, sometimes with a few fuscous scales in disc; a median, fuscous, discal dot slightly beyond ⅓, a second beyond it on fold, and a third at ⅔, but these may be faintly marked or absent; a series of fuscous dots close to termen more or less marked; cilia ochreous-whitish. Hindwings ochreous-whitish, faintly greyish towards apex; cilia ochreous-whitish.

Near *E. exanimis*, which has the forewings proportionately broader, and the antennal ciliations considerably shorter (1½).

Q.: Rosewood, in September; seven specimens.

EULECHRIA GALACTINA, n.sp.

γαλακτινος, milk-white.

♂♀. 14-19 mm Head white. Palpi white; second joint dark fuscous anteriorly except at base and apex. Antennæ whitish; ciliations in ♂ 3. Abdomen whitish grey; tuft whitish. Legs whitish; anterior and middle pairs dark fuscous anteriorly. Forewings elongate, costa moderately arched, apex rounded, hindmargin obliquely rounded; white; in male, without markings; in female, with three, fuscous, discal dots; cilia white. Hindwings and cilia white.

N.Q.: Cairns and Cardwell; abundant, from August to October.

EULECHRIA THETICA, n.sp.

θητικος, menial.

♂♀. 16-17 mm. Head, palpi, and thorax fuscous. Antennæ fuscous, obscurely annulated with dark fuscous; ciliations in ♂ 3.

Abdomen fuscous, bases of segments on dorsum ferruginous. Legs fuscous; posterior pair whitish. Forewings rather broad, dilated posteriorly, costa strongly arched, apex rounded, termen obliquely rounded; fuscous; markings dark fuscous; a discal dot at $\frac{1}{3}$, a second slightly beyond it on fold, and a third at $\frac{2}{3}$; a few, scattered, dark fuscous scales; a terminal series of dots; cilia fuscous. Hindwings fuscous, paler towards base; cilia fuscous-whitish.

An obscure species of the *convictella*-group; fortunately the long, antennal ciliations furnish a good point of distinction.

Q.: Killarney, in November; four specimens.

Eulechria delospila, n.sp.

δηλοσπιλος, plainly spotted.

♂♀. 20 mm. Head grey, irrorated with whitish. Palpi grey, apex of second joint whitish. Antennæ grey; ciliations in ♂ 1. Thorax fuscous. Abdomen whitish, with lateral, fuscous streaks, dorsum, except apices of segments, ferruginous. Legs fuscous, with whitish annulations; posterior pair whitish. Forewings moderate, somewhat dilated posteriorly; grey-whitish, with dark fuscous irroration and spots; base of dorsum suffused with fuscous, a discal dot at $\frac{1}{4}$, a second slightly beyond it on fold, and a third in middle; a line of spots from before middle, at first subcostal, slightly indented at apex, then near and parallel to termen, then subdorsal to before middle; cilia grey, bases barred with dark fuscous. Hindwings and cilia pale grey.

This species belongs to the *sicella*-group.

Q.: Stanthorpe, in November; six specimens, at rest on the granite-rocks.

Eulechria eucrypta, n.sp.

εὔκρυπτος, well-concealed.

♂. 18 mm. Head pale fuscous. Palpi fuscous, second joint whitish towards apex. Antennæ with apices of joints triangularly dilated, fuscous; ciliations in ♂ 1. Thorax fuscous, mixed with whitish-ochreous. Abdomen grey. Legs fuscous; posterior pair mostly ochreous-whitish. Forewings posteriorly dilated, costa moderately arched, apex rounded, termen obliquely rounded;

fuscous, mixed with whitish-ochreous; markings dark fuscous, obscure: a dot at $\frac{1}{3}$, with a second beneath it on fold, and a third above and before middle; a pale spot beyond middle edged anteriorly and posteriorly with dark fuscous; a fine, interrupted line near and parallel to termen, and a similar line on termen: cilia pale fuscous, apices ochreous-whitish. Hindwings pale grey; cilia whitish-grey.

Q.: Adavale (in western interior), in April and May: three specimens.

Eulechria melanogramma, n.sp.

μελανογραμμος, inscribed with black.

♂. 14-17 mm. Head and thorax dark fuscous. Palpi dark fuscous: apices of second and terminal joints whitish. Antennæ dark fuscous: ciliations in ♂ 1. Abdomen fuscous-whitish, bases of segments, except first, ferruginous. Legs dark fuscous: tarsi annulated with whitish. Forewings moderate, not dilated: fuscous, with numerous, dark fuscous streaks: a costal streak from base to middle; a median streak to end of cell, interrupted by whitish in cell; submedian and dorsal streaks, with a short, whitish streak between them towards base; streaks on veins interrupted by whitish near extremities, and ending in whitish, terminal dots; cilia fuscous, barred with whitish, apices grey-whitish. Hindwings and cilia grey.

Q.: Brisbane, in September, October, and December; seven specimens.

Eulechria mesochra, n.sp.

μεσωχρος, pale in the middle.

♀. 14-17 mm. Head blackish; face whitish-ochreous. Palpi whitish-ochreous, with a few blackish scales; terminal joint, except apex, blackish. Antennæ blackish, annulated with whitish-ochreous. Thorax whitish-ochreous: tegulæ, bases of patagia, and a few posterior scales, blackish. Abdomen pale ochreous, variably suffused with fuscous. Legs dark fuscous, tibiæ and tarsi annulated with whitish-ochreous: posterior pair pale ochreous, with some fuscous irroration. Forewings narrow-elongate; pale brownish-ochreous, with patchy, fuscous irroration; markings blackish; a dot on costa near base: a short, broad streak on base of dorsum; a discal dot at $\frac{1}{3}$, a second close beneath it on fold, and a third at $\frac{2}{3}$; an apical spot; a triangular, tornal spot connected with third dot; cilia on apex blackish, on termen pale ochreous, with some blackish scales, on tornus grey. Hindwings grey; base sometimes pale ochreous; cilia grey, towards tornus pale ochreous.

Q.: Brisbane, in October, November, and April; three specimens.

Gen. Callithauma.

Callithauma Turn., Trans. Roy. Soc. S. Aust., 1899, p.15.

Type, *C. basilica* Turn. This genus is closely allied to *Tisobarica*, from which it differs only by the absence (or extreme shortness) of the male antennal ciliations. The posterior tibiæ are rough-haired above, not smooth-scaled, as stated in my description. To this genus must be referred *Hoplitica callianthes* Meyr.

Mr. Meyrick's division of the Oecophorinæ into those with, and those without, antennal ciliations, must not be applied too rigidly.

Callithauma basilica.

Callithauma basilica Turn., *op. cit.*, 1899, p.15.

Q.: Toowoomba, in September; Killarney, in October.

Callithauma pyrites

Hoplitica pyrites Turn., *op. cit.*, 1896, p.9.

Q.: Montville near Nambour, in October; Brisbane, in September; Stradbroke Island, in September; Mt. Tambourine, in October and November; Killarney, in October and November; not uncommon.

Callithauma glycera, n.sp.

γλυκερος, sweet.

♂. 12 mm. Head reddish-orange; face whitish. Palpi whitish; second joint with fuscous irroration and apical ring; terminal joint broadly dark fuscous in middle. Antennæ whitish, sharply annulated with blackish. Thorax pinkish mixed with whitish.

Abdomen purple-fuscous; tuft whitish-ochreous. Legs pale fuscous, annulated with whitish; posterior pair whitish. Forewings posteriorly dilated, costa slightly arched, strongly so before apex, apex rounded, hindmargin very obliquely rounded; pink; markings pale yellow, partly outlined with dark fuscous; a short, oblique line from base of costa; a narrow, outwardly curved fascia from costa at $\frac{1}{4}$ to inner margin at $\frac{1}{4}$; a narrow fascia from costa before middle to tornus, dividing and reuniting in disc, so as to enclose an island of ground-colour: a fine, irregularly waved fascia from costa at $\frac{3}{4}$ to termen above tornus; a broad, dark fuscous line along costa from middle to $\frac{3}{4}$, thence continued as a submarginal band to termen above tornus; an orange line on apex and upper part of termen; cilia orange. Hindwings whitish; cilia whitish-ochreous, at apex grey.

Differs in shape of forewing from the other species; the dark, costal and submarginal line is characteristic.

Q.: Killarney, in October; one specimen.

Callithauma leptodoma, n.sp.

λεπτοδομος, slightly built.

♂. 8-9 mm. Head whitish-ochreous; face whitish. Palpi whitish; an apical ring on second joint, and a subapical on terminal joint, dark fuscous. Antennæ whitish, with blackish annulations. Thorax whitish-ochreous. Abdomen whitish. Legs whitish; anterior femora and tibiæ fuscous; anterior and middle tarsi annulated with fuscous. Forewings narrow, costa strongly arched, apex round-pointed, termen obliquely rounded; pale crimson; markings pale yellow, edged and partly mixed with fuscous; an illdefined, basal fascia; a moderately broad, slightly outwardly curved fascia from $\frac{1}{4}$ costa to $\frac{1}{4}$ dorsum; a broader, irregular-edged fascia from midcosta to before tornus, enclosing a spot of ground-colour in middle, and giving off a branch to mid-dorsum; a narrower, curved fascia, mostly suffused with fuscous, from costa before apex to termen above tornus; a line on apex and upper part of termen edged anteriorly with fuscous; cilia pale yellow, towards tornus grey mixed with pale crimson. Hindwings lanceolate; grey-whitish; cilia grey-whitish.

Smaller and more slender than *C. pyrites*, the markings broader, and with much more fuscous irroration; certainly distinct.

Q.: Coolangatta, in September; Killarney, in October; three specimens.

Gen. TISOBARICA.

Tisobarica Walk., Cat. Brit. Mus., xxix., p.812.

Hieropola Meyr., Proc. Linn. Soc. N. S. Wales, 1883, p.363.

A very natural genus, narrower-winged than *Machimia* (*Hoplitica* Meyr.), and with terminal joint of palpi shorter.

TISOBARICA PYRRHELLA.

Hoplitica pyrrhella Turn., Trans. R. Soc. S. Aust., 1896, p.8.

Antennal ciliations of ♂ 2.

Q.: Brisbane, in September and March.

TISOBARICA ERANNA, n.sp.

ἐραννος, lovely.

Hieropola jucundella Meyr., *op. cit.*, 1883, p.364, *nec* Wlk.

This species is very constant in colour and markings, and is certainly different from the following. Antennal ciliations of ♂ 1.

Q.: Brisbane and Toowoomba, in September.—N.S.W.: Newcastle, Sydney.

TISOBARICA JUCUNDELLA.

Tisobarica jucundella Wlk., Cat. Brit. Mus., xxix., p.813; *nec* Meyr., *op. cit.*, 1883, p.363.

♂♀. 12-13 mm. Head whitish; second joint with a narrow, subapical ring, and terminal joint with a broad, median ring, fuscous. Antennæ whitish, annulated with fuscous; ciliations in ♂ $1\frac{1}{2}$. Thorax whitish, anteriorly pale purplish, bases of patagia yellow. Abdomen pale purple-fuscous; tuft and underside whitish. Legs whitish; anterior and middle pairs annulated with fuscous. Forewings rather narrow, costa moderately arched, apex round-pointed, termen obliquely rounded; pale purple, with four fasciæ yellow, narrowly edged with fuscous; first from base of costa very obliquely outwards, then curved downwards to dorsum at $\frac{1}{4}$; second rather broad, evenly curved, from $\frac{1}{3}$ costa to dorsum; third from midcosta to tornus, narrow, interrupted beneath costa, its edges irregular and nearly enclosing a spot of ground-colour on posterior margin; fourth subapical, very broad on costa, narrowing to a point on termen above tornus; a yellow line anteriorly edged with fuscous on apex and upper part of termen; cilia ochreous. Hindwings and cilia ochreous-whitish.

Distinguished from the preceding by the purple colour of forewings; entire, second fascia; broad, fourth fascia; whitish head and thorax, and other points.

Q.: Brisbane, in October; two specimens, apparently attached to *Melaleuca.*—N.S.W.: Sydney (Walker's type).

TISOBARICA LAROTYPA, n.sp.

λαροτυπος, daintily marked.

♂. 13 mm. Head reddish, face white. Palpi whitish; apex and a few scattered scales on second joint, and a subapical ring on terminal joint, fuscous. Antennæ whitish, annulated with fuscous; ciliations in ♂ 1. Thorax red, with a suffused, whitish, median, longitudinal streak; patagia yellow, bases red. Abdomen grey-whitish. Legs whitish; anterior pair with some pale fuscous irroration. Forewings rather narrow, costa moderately arched, apex round-pointed, termen obliquely rounded; pale red, costal portion of disc, except near bese, broadly suffused with grey; markings pale yellow; base of dorsum yellow; a very oblique fascia from base of costa, bent inwards above dorsum to dorsum at $\frac{1}{5}$; a second fascia from $\frac{1}{3}$ costa to mid-dorsum, dilated and containing a spot of ground-colour above middle, constricted and nearly interrupted above dorsum; a third fascia from midcosta to tornus, interrupted beneath costa, dilated and containing a spot of ground-colour in middle, connected by an oblique bar from below middle to dorsal end of second fascia; an incomplete, narrow fascia from $\frac{3}{4}$ costa towards, but not reaching, termen above tornus; a yellow line on apex and upper part of termen; cilia ochreous, apices grey. Hindwings whitish; cilia ochreous-whitish.

Differs from *T. eranna* in the grey suffusion of forewings, with red spot in second fascia, and narrow, fourth fascia. The dark scales on edges of markings are very slightly developed.

N.S.W.: Sydney (near Middle Head), in October; one specimen.

TISOBARICA HEDANOPA, n.sp.

ἑδανωπος, of pleasant appearance.

♀. 12 mm Head yellowish. Palpi yellow, with some reddish suffusion. Antennæ whitish, with blackish annulations. Thorax yellow-whitish, with patchy reddish suffusion. Abdomen ochreous-whitish. Legs ochreous-whitish; anterior tibiæ reddish, anterior tarsi annulated with reddish. Forewings narrow, costa arched near base, thence nearly straight, apex round-pointed, termen very obliquely rounded; pale red, with some patchy grey suffusion mostly in median areas, markings yellow edged with bright red; an outwardly oblique line from base of costa not reaching dorsum: a rather broad, slightly curved, nearly transverse, uninterrupted fascia from $\frac{1}{4}$ costa to $\frac{1}{4}$ dorsum; an obscure spot on mid-dorsum; a very narrow fascia from mid-costa to tornus, dilated and enclosing a spot of ground-colour above middle; a very narrow fascia from $\frac{3}{4}$ costa to termen above tornus, dilated on costa; a fine, yellow line on apex and upper part of termen; cilia ochreous-yellow, on tornus reddish. Hindwings whitish; cilia ochreous-whitish.

Narrower-winged than the other species, the markings edged with red, not fuscous, the grey suffusion differently placed to that in *T. larotypa*, and the nearly transverse fascia at $\frac{1}{4}$ very different.

Q.: Mt. Tambourine, in November; one specimen.

MACHIMIA MODERATELLA.

Depressaria moderatella Wlk., Cat. Brit. Mus., xxix., p.566. *Hoplitica leucerythra* Meyr., Proc. Linn. Soc. N. S. Wales, 1882, p.501; *H. rufimaculella* Turn., Trans. R. Soc. S. Aust., 1896, p.7.

N.Q.: Townsville.—Q : Nambour, Brisbane, Stradbroke Island. —N.S.W.: Glen Innes, Sydney, Bathurst, Mittagong, Mt. Kosciusko (4000 feet).—Vic.: Gisborne.—Tasm.: Launceston.—S.A.: Mt. Lofty.

Machimia eoxantha.

Hoplitica eoxantha Turn., *op. cit.*, 1896, p.7.

Q.: Brisbane and Stradbroke Island, in August; Mt. Tambourine and Warwick, in October.

Machimia atripunctatella.

Hoplitica atripunctatella Turn., *op. cit.*, 1896, p.7.

Q.: Gayndah, in October; Brisbane, in August and September; Toowoomba, in November.

Machimia miltopsara.

Hoplitica miltopsara Turn., Proc. Linn. Soc. N. S. Wales, 1914, p.560.

N.S.W.: Ebor.

Machimia zelota, n.sp.

ζηλωτος, enviable.

♂. 21 mm. Head whitish-ochreous. Palpi whitish-ochreous; external surface of second joint pinkish-tinged. Antennæ pale grey, towards base whitish-ochreous tinged with pink; ciliations in ♂ 1. Thorax leaden-grey; anteriorly broadly whitish-ochreous; two, reddish-ochreous, posterior dots. Abdomen pale ochreous. Legs whitish-ochreous; anterior pair pinkish anteriorly, except coxæ, which are whitish. Forewings moderately broad, not dilated, costa strongly arched, apex rounded-rectangular, termen slightly oblique, rounded beneath; leaden-grey; a pink, costal streak; extreme costal edge whitish; a whitish-ochreous, basal spot; an irregular, whitish-ochreous blotch reticulated with reddish-ochreous, extending from near base of dorsum as a broad streak roughly parallel to costa as far as middle; a dark fuscous, circular spot beneath this before middle of disc; two, dark fuscous spots edged with whitish-ochreous placed transversely in disc beyond middle; a whitish-ochreous, subapical blotch traversed by an interrupted, reddish-ochreous, obliquely transverse line; cilia pale ochreous, towards termen grey. Hindwings and cilia ochreous.

N.S.W.: Glen Innes, in January; one specimen.

MACHIMIA PHŒNOPIS, n.sp.

φοινωπις, reddish.

♀. 14-18mm. Head dull reddish mixed with whitish-ochreous; face whitish. Palpi dull reddish; second joint with base, apex, and most of inner surface whitish. Antennæ ochreous-whitish, sharply annulated with blackish. Thorax dull reddish mixed with whitish-ochreous. Abdomen fuscous-grey, beneath pale ochreous. Legs whitish; anterior pair reddish-tinged; posterior pair pale ochreous. Forewings not dilated, costa arched at base, then nearly straight, apex round-pointed, termen obliquely rounded; ochreous-whitish, mixed with dull reddish; costal edge narrowly pink; no defined markings, but a redder, apical area preceded by an ill-defined, paler fascia from mid-costa to tornus; cilia whitish, irrorated with reddish. Hindwings ochreous-fuscous; towards apex fuscous; cilia grey.

N.A.: Port Darwin.—Q.: Brisbane, in September and November; Mt. Tambourine, in November; Toowoomba, in September. Seven specimens.

MACHIMIA MESOGÆA, n.sp.

μεσογαιος, inland.

♂♀. 16-18mm. Head, thorax, and palpi ochreous-grey-whitish. Antennæ grey, towards base pinkish-white; ciliations in ♂ 4. Abdomen pale ochreous. Legs whitish-ochreous; anterior pair pinkish-tinged. Forewings broadly oval, not dilated, costa arched near base, then straight, apex rounded, termen obliquely rounded; ochreous-grey-whitish; discal spots obsolete, or one or two spots faintly indicated; costal edge pink; cilia whitish, apex pinkish-tinged.

Q.: Adavale, in April; four specimens.

MACHIMIA OCHROPHANES, n.sp.

ὠχροφανης, pale.

♂♀. 19-23mm. Head ochreous-whitish. Palpi whitish; second joint fuscous except on base, apex, and internal surface; terminal joint fuscous anteriorly. Antennæ in ♂ whitish, with fuscous annulations, ciliations $\frac{2}{3}$; in ♀ grey. Thorax ochreous-whitish or pale grey. Abdomen pale ochreous-grey, in ♀ grey, apices of segments ochreous-whitish. Legs whitish-ochreous; anterior pair, except coxæ, fuscous. Forewings suboblong, not dilated, costa rather strongly arched, apex rounded-rectangular, termen rounded, slightly oblique; ochreous-whitish, in ♀ suffused with grey; discal dots obscure or nearly obsolete; sometimes a fuscous dot above middle; a dot at $\frac{2}{3}$; sometimes one or two fuscous scales representing a dot at $\frac{1}{3}$, and another beyond it on fold; cilia ochreous-whitish. Hindwings ochreous-grey-whitish, in ♀ darker; cilia ochreous-whitish.

Very similar to some species of *Eulechria*; the absence of pecten, and short, antennal ciliations should be carefully noted.

Q.: Warwick, in October.

MACHIMIA MICROPTERA, n.sp.

μικροπτερος, small-winged.

♂♀. 12-14 mm. Head, thorax, and palpi fuscous. Antennæ fuscous; ciliations in ♂ 1½. Abdomen ferruginous-fuscous, apices of segments and tuft ochreous-whitish. Legs fuscous; posterior pair and middle femora ochreous-whitish; anterior and middle tibiæ and tarsi annulated with ochreous-whitish. Forewings not dilated, costa arched at base, thence nearly straight, apex round-pointed, termen obliquely rounded; pale fuscous, sparsely irrorated with fuscous; a discal dot at $\frac{2}{5}$, a second beneath it on fold, and a third at $\frac{3}{5}$; cilia pale fuscous. Hindwings ochreous-whitish, at apex tinged with fuscous; cilia whitish, with a basal, pale fuscous line towards apex.

Q.: Mt. Tambourine, in November; fourteen specimens.

MACHIMIA ANÆMICA, n.sp.

ἀναιμικος, bloodless.

♂♀. 12-14 mm. Head, thorax, and palpi ochreous-whitish, with very slight, fuscous irroration. Antennæ whitish; ciliations in ♂ 3. Abdomen whitish. Legs whitish; anterior pair with slight, fuscous irroration. Forewings not dilated, costa moderately arched, apex round-pointed, termen obliquely rounded: ochreous-whitish, with very fine, sparse, fuscous irroration; a fuscous, discal dot at $\frac{1}{3}$, a second beneath and beyond it on fold, and a third at $\frac{2}{3}$; cilia ochreous-whitish, with fine, sparse, fuscous irroration. Hindwings and cilia whitish.

Q.: Sandgate, near Brisbane, in September and October; Coolangatta, in December; five specimens.

MACHIMIA MITOSEMA, n sp.

μιτοσημος, thread-marked.

♂♀. 17-23 mm. Head and thorax fuscous, closely irrorated with whitish. Palpi dark fuscous; terminal joint, and apical third of second joint, irrorated with whitish. Antennæ fuscous mixed with whitish; ciliations in ♂ $1\frac{1}{2}$. Abdomen fuscous, apices of segments and tuft whitish. Legs whitish, more or less irrorated with fuscous; anterior surfaces of anterior and middle pairs mostly dark fuscous Forewings not dilated, costa moderately arched, apex round-pointed, termen obliquely rounded; whitish, irrorated with fuscous; numerous, longitudinal, dark fuscous streaks; a whitish dot in disc at $\frac{2}{3}$; cilia fuscous, irrorated with whitish.

Structurally, a true *Machimia*, but very different from other species; colour and pattern evidently a protective adaptation.

Q.: Brisbane, in October-April.—N.S.W.: Tabulam, in December. Eleven specimens.

Gen. HOPLOMORPHA, n.g.

ὁπλομορφος, shield-shaped.

Antennæ without pecten, or with two or three fugitive scales only; in ♂ with moderately long ciliations. Palpi rather long; second joint exceeding base of antennæ, thickened with appressed scales; terminal joint hardly shorter than second, rather stout, strongly recurved. Thorax smooth. Forewings suboblong, moderately broad; 7 to apex. Hindwings somewhat narrower than forewings; 5 from cell nearly midway between 4 and 6, not curved and approximated to 4 at base.

Distinguished from *Machimia* (*Hoplitica*) by the structure of vein 5 of hindwings. A distinct and natural genus. Type, *Cryptolechia abalienella* Wlk.

HOPLOMORPHA ABALIENELLA.

Cryptolechia abalienella Wlk., Cat. Brit. Mus., xxix., p.762.
Hoplitica colonias Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.942.

N.Q.: Herberton.—Q.: Brisbane.—Vic.: Bairnsdale.

HOPLOMORPHA PORPHYRASPIS.

Hoplitica porphyraspis Turn., Trans. R. Soc. S. Aust., 1896, p.8.

Q.: Brisbane, Mt. Tambourine.

HOPLOMORPHA CAMELÆA.

Eulechria camelæa Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.943.

Q.: Stanthorpe.—Vic.: Beechworth, Gisborne.

HOPLOMORPHA EPICOSMA, n.sp.

ἐπικοσμος, adorned.

♂. 14-16 mm. Head fuscous. Palpi dark fuscous; internal surface of second joint whitish. Antennæ dark fuscous; ciliations in ♂ 1. Thorax dark fuscous; posterior third, including apices of patagia, whitish. Abdomen fuscous; anterior extremity and tuft whitish-ochreous. Legs whitish-ochreous; anterior pair dark fuscous. Forewings elongate, costa slightly arched, apex round-pointed, hindmargin very obliquely rounded; whitish; base of costa dark fuscous; costal edge grey, with a short, oblique mark at $\frac{2}{5}$; a large, dark fuscous blotch on inner margin from $\frac{1}{4}$ to $\frac{3}{4}$, attenuated anteriorly, reaching to fold, its upper edge concave, angulated at each extremity of concavity; along its posterior edge is a leaden-fuscous line, surmounted by a leaden-fuscous dot in disc at $\frac{2}{3}$; an outwardly curved, fuscous line from costa at $\frac{3}{4}$ to anal angle, its anterior edge suffused with greenish-grey; along its posterior edge is a narrow, white line not reaching to anal angle; apical area purple fuscous irrorated with leaden-fuscous scales; cilia greenish-grey, bases purplish, irrorated with fuscous. Hindwings ochreous-whitish, apical half fuscous; cilia whitish, at apex fuscous, at anal angle ochreous-whitish.

Q.: Mt. Tambourine, in November and December; two specimens.

Hoplomorpha caminodes, n.sp.

καμινώδης, fiery, red-hot.

♂♀. 13-15 mm. Head and palpi reddish-ochreous. Antennæ grey, towards base reddish-ochreous; ciliations in ♂ 2. Thorax reddish-ochreous, paler posteriorly. Abdomen grey mixed with reddish-ochreous, apices of segments whitish-grey, tuft whitish-ochreous. Legs ochreous-whitish, anterior tibiæ and tarsi, and base of middle tibiæ, reddish anteriorly. Forewings not dilated, costa moderately arched, more strongly towards base, apex rounded, termen obliquely rounded; pale reddish-ochreous, darker towards costa, a dark reddish, dorsal streak, edged with whitish, from $\frac{1}{5}$ to $\frac{4}{5}$, abruptly truncated posteriorly; a fuscous spot, indented posteriorly, before tornus; from this a reddish-ochreous suffusion containing two, minute, fuscous dots extends more than half across disc beyond middle, and is preceded by a whitish dot; a short, outwardly oblique, reddish-ochreous streak from $\frac{2}{3}$ costa; an interrupted, fuscous line from beneath $\frac{3}{4}$ costa to termen above tornus; a fine, fuscous, terminal line; cilia pale reddish-ochreous, on tornus grey. Hindwings dark grey; towards base ochreous-whitish; cilia grey.

In this species, the usual dorsal blotch is reduced to a dorsal streak. The specimen from Killarney is much brighter red, the markings reduced, the dorsal streak crimson-red and not white-edged.

Q.: Brisbane, in October; Mount Tambourine, in December and January; Southport, in December; Killarney, in November; five specimens.

Gen. Lepidozancla, n.g.

λεπιδοζαγκλος, with scaly sickles (palpi).

Palpi long; second joint exceeding base of antennæ, thickened with loosely appressed scales in front, slightly expanded at apex; terminal joint about $\frac{2}{3}$ second, rather stout, acute. Antennæ without pecten. Thorax smooth. Abdomen stout. Forewings with vein 7 to apex. Hindwings normal.

In the absence of the ♂, the correct position of this genus is uncertain. It may be distinguished from *Machimia* by the stouter, second joint of palpi, which is roughened with scales anteriorly.

LEPIDOZANCLA ZATREPHES, n.sp.

ζατρεφης, fat.

♀. 18-22 mm. Head, thorax, palpi, and antennæ pale grey. Abdomen ochreous-grey, apices of segments grey-whitish Legs pale grey; posterior pair grey-whitish. Forewings narrow-oblong, costa straight except near base and apex, apex rounded, termen obliquely rounded; ochreous-grey-whitish; a fuscous discal dot at $\frac{1}{3}$, and a second considerably before it on fold, both of which may be obsolete, and a third in disc beyond middle; sometimes a few fuscous scales in a median line before and after third dot; cilia concolorous. Hindwings and cilia grey-whitish.

Q.: Brisbane, in February and March. Although this species comes commonly to light at my residence, I have never seen any but female examples.

SOME CRYPTOGAMIC NOTES FROM THE BOTANIC GARDENS, SYDNEY.

By the Rev. W. Walter Watts.

(Plate xx.)

This paper deals with Ferns and Mosses. Two new species and one new variety are described. Notes are added concerning other species, including some new records. A new Tribe of the *Polypodiaceæ* is also proposed and defined.

Ferns.

i.

Dryopterideæ: a suggested new Tribe of the *Polypodiaceæ*.

It was long the custom to classify a large section of the *Polypodiaceæ* on the basis of the presence, or absence, of a superior indusium. The species bearing such indusium were classed as the *Aspidieæ* (ἀσπὶς, a shield), while those lacking such indusium were the *Polypodieæ*. Under this classification, the genus *Aspidium* covered a large range of species and numerous sub-genera. But it was at length realised that, by this arrangement, ferns that had many natural affinities, especially in frond-formation and venation, were needlessly and unscientifically kept apart. Hence the conviction that the older classification attached undue importance to the presence, or absence, of an indusium - a conclusion that was strengthened by the discovery of exindusiate forms of indusiate species, and by the fact that, in some supposedly exindusiate species, traces had been found of a small and extremely fugacious indusium.

In these circumstances, an old genus of Adanson's, dating back to 1763, was revived and expanded, viz., *Dryopteris*, a genus, as the name implies, consisting of ferns whose fronds showed a supposed resemblance to the oak-leaf. I have not access to Adanson's original description, but, judging from C. Christensen's "Enumeratio,"* his *Dryopteris* consisted of aspidioid ferns with free veins; *i.e.*, it was the equivalent of Presl's "*Lastræa*" (1836). In recent times, *Dryopteris* has been used in at least two, different senses. On the one hand, it has been made to cover *all* the oakleaf-like ferns, whether indusiate or exindusiate; and, on the other hand, it has been limited to the indusiate ferns alone of this class. In the former case, the indusiate species have received the subgeneric name *Eudryopteris*, while the exindusiate species have constituted the subgenus *Phegopteris*. Where, on the other hand, *Dryopteris* has been limited to the indusiate species, *Phegopteris* has been made a separate genus.

The wider signification of *Dryopteris* has been adopted by Christensen (*op. cit.*), and K. Domin.†. Capt. van Aldewerelt van Rosenberg‡ has divided all the *Polypodiaceæ* into the "Indusiatæ" and the "Exindusiatæ"; and has, therefore, separated *Phegopteris* from *Dryopteris*, placing it in a new tribe, *Phegopterideæ*. Domin, with justice, calls Van Rosenberg's scheme in question§; but in following Christensen and making *Phegopteris* a subgenus of *Dryopteris*, Domin is in danger of seeming to support a classification that includes exindusiate ferns under the *Aspidieæ*; to my mind, an undesirable arrangement, and indeed a contradiction in terms.

It is only fair to Domin to state that he avoids this situation by carefully refraining from any use of tribal divisions under the *Polypodiaceæ*, a procedure, however, that is scarcely to be followed in dealing with a family that includes the great bulk of the ferns of the world.

To avoid, (*a*), the unscientific separation of *Phegopteris* from the vicinity of *Dryopteris*, (*b*), the inclusion of exindusiate ferns

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* Index Filicum, 1906, p. xxi.

† Pteridophyta.

‡ Malayan Ferns, 1908.

§ Van Rosenberg himself (*op. cit.*, p.486) says, in a note on *Phegopteris*, "Its proper place is near *Dryopteris*, from which it differs by the wanting indusium only."

among the *Aspidieæ*, and (*c*), the growing cumbrousness of the genus *Dryopteris*, as defined in Christensen's Index, I venture to suggest the separation of the supposedly oak-leaf ferns, in order to make them a new tribe, *Dryopterideæ*.

The new tribe will include *Dryopteris* in what appears to have been Adanson's original sense (= *Lastræa*), *Nephrodium*, *Phegopteris*, *Goniopteris*, and *Meniscium*, all considered as genera.

I put forward this suggestion after much hesitancy, but in the belief that it will serve the double purpose of bringing within manageable bounds the, at present, unwieldy genus *Dryopteris*, and of promoting the interests of a more natural classification.

In accordance with the requirements of the Vienna Rules, I submit a Latin description, and an analysis, as follows :—

DRYOPTERIDEÆ, Trib.nov.

Stipes ad rhizoma non articulatus; frondes foliorum quercūs memorantes, venis solutis vel plus minusve unitis: sori indusiati vel exindusiati, reniformes vel rotundati vel plus minusve oblongi, ad venas mediales vel terminales, interdum confluentes, indusiis, si exstantibus, soris æquiformantibus.

1. DRYOPTERIS Adans., 1763; *Lastræa* Presl; *Eudryopteris* auctt.
Sori, for the most part, distinctly indusiate; veins free.

2. NEPHRODIUM Schott, 1834; *Aspidium*§ Christ; *Eunephrodium* auctt.

Veins more or less united, especially alongside the costa; sori indusiate.

3. PHEGOPTERIS (Presl) Fée; *Euphegopteris* auctt.

Exindusiate, or indusium early shrivelling and disappearing; veins free. This includes *Leptogramma* (sori oblong or linear).

4. GONIOPTERIS Presl, 1836; *Phegopteris*§ auctt.

Exindusiate, or indusium early shrivelling or disappearing; sori never confluent; veins more or less as in *Nephrodium*. This includes *Stegnogramma* (sori oblong or linear).

5. MENISCIUM Schreb.; *Phegopteris*§ auctt.; *Dryopteris*§ auctt.

Veins uniting as in *Goniopteris*; exindusiate; sori often confluent at the junction of the transverse veinlets and "not rarely running along the excurrent veinlets."

Adopting the above arrangement, our Australian species will stand as follows :—

Dryopteris decomposita (R.Br.) O. Ktze.
D. glabella (A. Cunn.) C. Chr.
D. acuminata (Lowe) Watts.
D. tenera (R.Br.) C. Chr.
D. velutina (Rich.) O. Ktze.
D. albovillosa Watts.
D. Baileyana Domin.
D. lanciloba (Bak.) O. Ktze.
D. dissecta (Forst.) O. Ktze.
Nephrodium gongylodes (Schkr.) Schott; *N. unitum* R.Br
N. pteroides (Retz.) Desv.
N. parasiticum (L.) Desv.
N. truncatum (Poir.) Presl.
N. decorum (Dom.) Watts.
Phegopteris punctata (Thunb.) Mett.
P. setigera (Bl.) Bak.
P. ornata (Wall.) Fée.
P. queenslandica (Dom.) Watts; *Polypodium aspidioides* Bail.
P. tropica (Dom.) Watts; *P. aspidioides* var. *tropica* Bail.
P. rufescens (Bl.) Mett.
P. wurunuran (Dom.) Watts.
Goniopteris urophylla (Wall.) Presl.
G. Danesiana (Dom.) Watts.
G. Hillii (Bak.) Watts.
G. pœcilophlebia (Hook.) Bail.
G. prolifera (Retz.) Pr.
Meniscium triphyllum Sw.

ii.

ATHYRIUM HUMILE Watts, sp.nov.

(Plate xx., fig.1.)

Rhizoma repens, subtenue, dense paleaceum, paleis pallide brunneis, basi lati-ovatis, apice breviter vel longe acuminatis, cellulis diplazioideis, rhizomatulis numerosis, longis, ramosissimis, fuscis ad subatris, madore carnosis. Stipites approximati, subflexuosi, ad 1 dm. longi, basi fusci, incrassati dense paleacei, paleis rhizomaticis conformibus, deinde tenues, pallescentes, plus minusve paleacei, paleis tenuibus, longe et flexuose acuminatis, cum glandibus articulatis pallidis intermixtis. *Frons* anguste ovato-lanceolata, longe acuminata, falcatula, ad 1·5 dm. longa et 5 cm. lata, facie antica fusco-viridi, postica pallido-viridi, haud nitenti, infra pinnata, deinde pinnatifida, gradatim breviter lobata, apice subintegra; *pinnis infimis* subsessilibus, plus minusve distantibus, oppositis vel subopposítis, obovatis, squarrosis vel deflexulis, ad 2 cm. longis et 1 cm. latis; *pinnis mediis* approximatis, sessilibus ad decurrentibus, alternantibus, longioribus (ad 3 cm. longis et 0·75 cm. latis), oblongo-lanceolatis, *supra* gradatim suberecto-patentibus, paullulum sursum curvatis, lobis apicem versus gradatim abbreviatis, in summo apice evanidis; pinnis et lobis omnibus (superioribus exceptis) plus minusve crenato-lobatis, segmentis oblongo-rotundatis, apice interdum crenulatis, segmento primo acroscopico evolutiori; lobis frondis apicem versus subcrenulatis ad integris; *rhachi* parce hirsuta, in superiori dimidio alata; pinnis et lobis *penninervatis*, nervis sæpe indistinctis; faciebus et rhachi et costis cum glandibus articulatis præditis. *Sori* breves, in pinnarum et loborum nervis, juxtacostales, stricti vel subarcuati; *indusio* membranaceo, pallido, margine crenulato vel subcristato, introrsum aperienti. *Textura* subcoriacea.

Damp base of rock in The Rapids, Ellenborough River, the Bulga, viâ Wingham: leg. W. W. Watts, April, 1915.

iii.

NOTES AND RECORDS.

1. HYMENOPHYLLUM PELTATUM (Poir.) Desv.; *H. Wilsoni* Hook.; *H. unilaterale* Willd.

This interesting fern was collected by Mr. J. L. Boorman, on Barrington Tops, in January, 1916. Mr. Wilson published a description, with an admirable figure, of the species in "English Botany, Suppl., t. 2686" (1831), as *Hymenophyllum Wilsoni* Hook., (Brit. Fl., i., 446, 1830). In Hooker and Baker's "Synopsis," p. 67, it is made a variety, "β," of *H. tunbridgense* Sm., but a note is added, "*H. peltatum* (Poir.) oldest name." Christensen also (Index) identifies *H. Wilsoni* with *H. peltatum* (Poir.) Desv., Prod., 333, 1827. Assuming this identity, the name *H. peltatum* must stand. Poiret published his species, in 1808, as *Trichomanes peltatum*. In 1810, Willdenow published it as *Hymenophyllum unilaterale* (certainly the most appropriate name): and in 1830-31, it was, as already stated, described and figured as *H. Wilsoni* Hook.,(specimens collected in Ireland by Mr. Wilson). It is interesting to know that we have this fern, as well as *H. tunbridgense*, in Australia. I have no hesitancy in separating the two species, even on the ground of the unilateral pinnæ of *H. peltatum*, to say nothing of its differently-shaped and entire indusium.

There are specimens in the Herbarium (Sydney) collected on the Snowy River by Mr. W. Bäuerlen, as also specimens from Tasmania (Archer & Gunn), but these have, until now, been placed in the *H. tunbridgense* box. Mr. Boorman's specimens are ample, quite characteristic, and in good condition.

2. Hymenophyllum rarum R.Br.

This southern species was collected on Mt. Wilson by Mr. Boorman and myself, in May, 1915. Not previously recorded north of Illawarra, though Mr. Whitelegge reports having found it in Blackheath Glen.

3. Dryopteris acuminata (Lowe) Watts; *Lastræa* Moore.

A small, dark green, shiny *Dryopteris*, found here and there in New South Wales, has hitherto been identified, for the most part, with *D. decomposita* (R.Br.), from all forms of which it certainly differs. Mr. Thos. Whitelegge, for many years, has regarded it as Lowe's *Aspidium acuminatum* (Fil., vi., t.11, 1857). Lowe's description is scarcely adequate, but his accompanying figure leaves little or no doubt in my mind that Mr. Whitelegge's view is correct. Lowe's species (supposed by him, apparently, to have been Willdenow's *A. acuminatum*, which is, according to Christensen, a syn. of *Nephrolepis biserrata*) was based on specimens grown at Kew, but he did not know to what country it belonged. Many years ago, Mr. Whitelegge sent specimens of our Australian fern to Mr. T. Rogers, of Manchester, who confirmed its identification with Lowe's species. Hooker and Baker

(Syn., p.281) make *Lastræa acuminata* Moore, (1858) a syn. of *Aspidium Shepherdi* Ktze., (Linn., 23, 230, 1850), which Christensen (Index Fil.) identifies with *D. decomposita*. Not having access to Linnaea, I can only keep Lowe's nomenclature: but if *A. Shepherdi* and *A. acuminatum* are identical, then Kuntze's name must have the precedence. *Dryopteris glabella* (Cunn.), is an entirely different plant.

I collected this fern (*D. acuminata*) plentifully, in 1915, on the Bulga Heights, viâ Wingham; and Mr. Boorman and I found ample specimens on Mt. Wilson, in the same year.

Var. CRISTATA, var.nov.

Among the specimens of *Dryopteris acuminata* found on Mt. Wilson by Mr. Boorman and myself, in 1915, was one large plant which exhibited a distinctly cristate habit, and I submit it as a well-marked variety, as follows:—

Frondis et pinnarum apicibus elongatis, sæpe dichotome ramosis, cristatis, ramis erectis vel suberectis, linearibus, marginibus lobatis, lobis acute serratis.

4. PLATYZOMA MICROPHYLLUM R.Br.

This most interesting fern was described by Robert Brown in his "Prodromus" (1810) under the generic name *Platyzoma*. Baron von Mueller, in 1864,* regarded it as a *Gleichenia*, and published it as *G. platyzoma*. Dr. Christ, in 1897,† described this fern under the name *Gleichenia microphylla* (R.Br.). Domin makes it *Gleichenia microphylla* Christ. The fact that Brown published a *Gleichenia microphylla* in close proximity to his *Platyzoma microphyllum* makes this an inconvenient nomenclature; and if his *Platyzoma* is to be included in *Gleichenia*, we must follow Christensen, who adopts F. von Mueller's name, *G. platyzoma*. But *Platyzoma* exhibits such unique characters, especially in the presence of the subordinate filiform leaves, which, though described by Brown (*loc. cit.*), and figured by Guillemin,‡ have been so much overlooked, that it seems to me the genus *Platyzoma* must stand.

* Veget. Chat. Isl., 63.

† Farnkr., p.339.

‡ Icones Lithographicæ (1827). t.13.

Mosses.

i.

Fissidens *(Amblyothallia)* **humilis** Dixon et Watts, sp.nov. (Plate xx., figs. 2*a-d*.)

Autoicus, flore masculo ad surculum brevem terminali; humilis, dense cæspitosus, pallide virens, haud nitidus: *caulis* 3 mm. ad 5 mm. usque altus, simplex vel subsimplex, basi radiculosus, infra laxe supra dense foliosus; *folia* usque ad 18-juga, infima parva, supra sensim majora, ligulato-lanceolata, breviter acuminata, superiora usque ad 1·5 mm. longa et 0·25 mm. lata, omnia immarginata, integra vel prope apicem indistincte subcrenulata, sæpe in unicâ triangulari hyalinâ cellulâ terminata, humida erecto-patentia, subfalcata, sicca appressa, rigida, falcatula, superiora incurva, nervo infra summum apicem evanido, in foliis inferioribus amœne rufo, in superioribus flavo, pellucido, subflexuoso, falcato; *lamina vaginans laminâ apicali* longior, in foliis infimis omne fere folium occupans, *lamina dorsalis* inferne angustata, ad basin nervi enata; cellulis in lam. vaginanti rotundato-quadratis, subpellucidis, 0·005-0·007 mm. in diam., in lam. apicali et dorsali densioribus, minutioribus; perichætium terminale; vaginula cylindrica, fusca, circa 0·26 mm. alta; seta ad 3-4 mm. usque alta, basi subito curvata, flavo-brunnea, deinde substricta, flavescens; *theca* suberecta, symmetrica, humida ovato-oblonga, sicca ovata, sub ore constricta, fusco-viridis, e cellulis exothecii turgidis, laxe hexagonis, subrugulosa; *operculum* $\frac{2}{3}$ vel ultra longitudinis thecæ, rostratum, leniter curvatum, acutum basi brunneum, supra pallidum; *peristomium* simplex, dentes 16, basi connati, erecti (sicca valde incurvi), purpurei, dense papillosi, indistincte trabeculati, intus appendiculati, deinde in cruribus longis duobus, filiformibus, dense papillosis dividi; *spori* flavo-virides, levissimi, circa 0·015 mm.; *calyptra* pallida, longa, mitriformis.

Surculus masculus brevis, 3-4-juga, foliis latioribus, brevioribus, lamina vera omne fere folium occupante, cellulis laminæ apicalis et dorsalis majoribus.

On silt, near the Harbour, Newcastle, N.S.W., leg. Chas. L. Burgess (ex herb. W. H. Burrell).

Comparable with *F. integerrimus* Mitt., but readily distinguished by its smaller size, the form of its leaves, and their acuter apex, the smaller and denser cells of the lamina apicalis, and other characters.

ii.

NOTES AND RECORDS.

1. LEPTOSTOMUM INCLINANS R.Br.; *L. flexipile* C.M.

This fine moss, not hitherto recorded from New South Wales, though often found in Tasmania and Victoria, was collected by Mr. Boorman on Barrington Tops in January, 1916, in ample material in good condition. Our only *Leptostomum*, up to now, has been *L. erectum* R.Br. New South Wales records of *L. macrocarpum* Hedw., existed formerly in the Melbourne Herbarium, but the specimens proved, upon examination, to be *L. erectum*.

2. HAMPEELLA PALLENS (Lacoste) Fleischer.

This unique little moss is a tropical and subtropical species. In Australia, it was first found by Mr Thomas Whitelegge on Cambewarra Mountain in 1885, and was regarded by Dr. V. F. Brotherus as a new genus, *Whiteleggea (australis)*. It was published, however, in the first Part of Brotherus' "Some new Species of Australian Mosses," as *Lepidopilum australe*, the description being based on specimens collected at Harvey's Creek, North Queensland, by the late F. M. Bailey. Mr. Whitelegge found it again, in 1891, at Lilyvale; and I was fortunate enough to find it at several places on the Richmond and Brunswick Rivers, N.S.W., between 1895 and 1901. When my specimens were sent to Dr. Brotherus, he remarked on "this interesting rediscovery of *Whiteleggea australis*," having apparently, up to this point, overlooked its identity with his *Lepidopilum australe*. But in his "Bryales" (Engler's Pflanzenfamilien), we have the remark (p.963) that *Lepidopilum australe* belonged to the new genus, *Whiteleggea*. Before, however, this great work was completed, the distinguished author had discovered that he had been anticipated, and he described and figured this curious moss under the name *Hampeella pallens* (Lac.) Fleisch. It turned out that it had been first found in Java, and published, by Lacoste, in 1872, as *Cladomnion pallens*. In 1881, what proved later to be the same plant was published, by Dr. Carl Mueller, as a new genus, *Hampeella* (*H. Kurzii*). The species, therefore, after a chequered career, has settled down under the name *Hampeella pallens* (Lac.) Fleisch.

Three years ago, I collected it at Tully Falls, N. Queensland, and at different times I have come across it at Wyong, and even at Mt. Wilson, in New South Wales. Mr. Boorman has recently brought it from the Dorrigo, and records having seen it on Mt. Lindsay.

EXPLANATION OF PLATE XX.

Fig. 1.—*Athyrium humile* Watts, sp.n.

Fig. 2.—*Fissidens humilis* Dixon et Watts, sp.n.

a., Plant (nat. size).

b., Plant (enlarged).

c., Male surculus.

d., Leaves (enlarged).

ORDINARY MONTHLY MEETING.

August 30th, 1916.

Mr. A. G. Hamilton, President, in the Chair.

Miss M. J. Collins, B.Sc., Wahroonga, was elected a Member of the Society.

The Donations and Exchanges received since the previous Monthly Meeting (26th July, 1916), amounting to 11 Vols., 84 Parts or Nos., 13 Bulletins, 3 Reports, and 2 Pamphlets, received from 46 Societies, etc., were laid upon the table.

FURTHER OBSERVATIONS ON THE EMERGENCE OF DRAGONFLY-LARVÆ FROM THE EGG,

WITH SPECIAL REFERENCE TO THE PROBLEM OF RESPIRATION.

By R. J. TILLYARD, M.A., B.Sc., F.L.S., F.E.S., LINNEAN MACLEAY FELLOW OF THE SOCIETY IN ZOOLOGY.

(Five Text-figs.)

In March, 1914, I was fortunate enough to observe the process of hatching of some larvæ of *Anax papuensis* Burm., and was able to discover some interesting facts with regard to the pronymphal stage, the nature of the pronymphal sheath, the action of the peculiar organ which I have termed the cephalic heart, and the method by which gas first appears in the tracheal system of the emerging larva. These observations were published in a condensed form in a short paper,* read at the British Association Meeting in Sydney, on August 25th, 1914. Last year, when studying the problem of the physiology of respiration in these aquatic larvæ, I was struck with the importance of the question as to how the tracheal system first becomes filled with gas, and the possibility of a causal connection between the action of the cephalic heart and the expulsion of the blood from the tracheal tubes of the emerging larva. In a recent paper,† I have shown the importance of these questions as part of the larger question of the physiology of respiration in aquatic larvæ, and, in particular, their bearing on what I have termed the "Diffusion Theory" of Aquatic Respiration.

The opportunity of some further research on these difficult problems occurred on March 18th of this year, when I obtained, from the river at National Park, a piece of a large stem of the

* Report of the British Association for the Advancement of Science. Australian Meeting, Sydney, August, 1914, pp.424-425 (1915).

† These Proceedings, 1915, xl., Part 3, pp.422-437, Plate xlvii.

common Water-Milfoil (*Myriophyllum* sp.) containing more than sixty eggs of *Anax papuensis*. These eggs were laid in a regular spiral, down the stem, throughout a distance of about five inches in length, viz., that part of the stem from about an inch below water-level downwards. In the present paper, I propose to give an account of the important results obtained from some experiments carried on with these eggs, together with some further observations made upon the eggs of a Zygopterid dragonfly, obtained from the same locality in November, 1915. These latter were not determined with certainty, but there is little doubt that they belonged to *Austrolestes leda* Selys, a very common species around Sydney.

I desire to thank Dr. H. G. Chapman, Lecturer in Physiology in the University of Sydney, for some valuable suggestions and advice in connection with the experiments carried out on the eggs of *Anax*.

I propose to divide this paper into five sections, dealing with the several problems which present themselves for solution. These are :—

1. The exact origin of the first gas in the tracheae of the emerging larva.
2. The composition of the gas in the tracheal system.
3. The nature and action of the cephalic heart.
4. The effect of abnormal conditions upon embryonic development.
5. Rectal respiration in newly-hatched Zygopterid larvae.

Sections 1-4 represent the studies carried out on *Anax papuensis* (Anisoptera); Section 5 those on *Austrolestes leda* (Zygoptera).

Section 1.—*The Exact Origin of the first Gas in the Tracheae of the Emerging Larva.*

In my former account of the emergence of the larva of *Anax papuensis* from the egg, I pointed out how difficult it was to make accurate observations, owing to the rapidity with which the hatching takes place. The pronymphal stage lasts only a few seconds, and the whole period of emergence occupies only half-a-minute or a little longer. During most of this time, convulsive struggles on the part of the emerging larva make direct observations very difficult. I was unable to see the actual beginning of the entry of the gas into the tracheal system of the larva. In the pronymph, the whole tracheal system is filled with a pale yellowish liquid, indistinguishable from the blood in the general body-cavity or haemocœle, except that it contains no corpuscles. When, after a short but active struggle, the young larva is free from the pronymphal sheath, gas can be seen travelling down the main tracheal trunks from the anterior mid-gut region backwards. I was able to watch this gas gradually occupy the rectal region, where every tiny capillary in the gill-basket can be seen becoming filled with gas, in a very regular and beautiful manner.

Now we cannot be content with the imperfect observation that the gas comes into the tracheæ at some level anterior to the rectum. That is, indeed, an important point, since it removes the initial difficulty of understanding how rectal respiration could be carried on by diffusion of oxygen into the rectal capillaries, from the circum-ambient water. But it is not enough. What we need to find out, and what is precisely the most difficult fact to discover, owing to the rapid nature of the emergence, is *exactly* where, when, and how the first gas enters the tracheal system. The following method of solving the problem suggested itself to me, and proved more successful than I had dared to hope.

It is a well-known fact that dragonfly-eggs are always laid so as to avoid direct contact with the air, even for a few seconds. Such contact seems to be fatal, probably owing to the dessicating influence of air upon eggs constructed especially for submergence under water, or for existence in other moist conditions. In the case of *exophytic* eggs, *i.e.*, those laid *outside* the tissues of plants, a gelatinous envelope protects them from the air during the short time that elapses between their passage from the body of the female and their being dropped into water. In the case of *endophytic* eggs, *i.e.*, those laid *inside* the tissues of plants, the female bores with her ovipositor well into the cambium of the plant, and deposits her eggs in the moist tissues.

Thus it appears that considerable moisture is essential to the survival and development of the embryo. Consequently, the oxygen necessary for the metabolism of the growing embryo cannot be obtained *directly* from the air, but must be absorbed from the moist medium surrounding the egg. It appeared to me, therefore, that if I could lessen the necessary oxygen-supply in some manner, I might succeed in so weakening the embryo, that its emergence from the egg would take a long time to accomplish, instead of being completed vigorously in about half-a-minute. By this means, it would be possible to observe at leisure those processes which could only be imperfectly noted under normally active conditions.

Having brought the eggs of *Anax papuensis* safely home in their piece of stem of Water-Milfoil, I placed them in a fairly large Petri dish, with plenty of water. The stem was then broken up into small pieces, from which a number were selected for examination. From these pieces, *twenty-eight* eggs were extracted without any damage, and were cleared as far as possible from vegetable tissues clinging around them. Several eggs were inadvertently damaged, and were thrown away. *Eight* eggs were cut out from a hard part of the stem, and were left surrounded by small blocks of vegetable tissue. All the pieces of tissue not containing eggs were returned to the Petri dish, which also contained *twenty* eggs *in situ* in the remainder of the Milfoil stem.

The twenty-eight eggs free of vegetable tissues were then placed all together in a small crystal dish, two-thirds filled with tap-water, and covered with a glass slide. The eight eggs enclosed in small blocks of vegetable tissue were similarly placed in a second crystal dish. The Petri dish was also kept covered. The three dishes were only occasionally uncovered for purposes of examination. Fresh tap-water was only added sufficiently to make up for slight losses by evaporation.

If we now denote the twenty-eight eggs as Series A, the eight eggs as Series B, and the twenty normally placed eggs as Series C, we can easily state the object of the experiment. Firstly, Series A has not only been subjected to a serious limitation of possible oxygen-supply to be derived from the water, but it has been entirely deprived of any aid in this direction which the plant-tissues might offer. Secondly, Series B, though presumably partially restricted in its possible oxygen-supply from the water, has the advantage of still being able to obtain some gas from the surrounding plant tissues, assuming that such tissues play a part in the oxygenation of the egg. Thus, Series B becomes a *control* upon Series A. Thirdly, Series C, placed under normal conditions, plays the part of a control upon both Series A and B.

At the start, I examined the eggs to determine to what stage of embryonic development they had attained. I found that *all, except one*, had just completed the revolution of the embryo. This particular one was in Series A, and was kept under careful observation. It finally yielded very remarkable results. As the eggs of *Anax papuensis* normally take about three weeks to hatch, I concluded that my eggs had been laid on or about March 7th, and had still ten or more days to go before hatching. At first, I feared that development had proceeded too far already for my experiments to yield successful results. Fortunately, however, this was not the case.

On March 27th, *i.e.*, nine days after the experiments began, I examined a large number of the eggs with special reference to *pulse*. Those in Series C could not be well examined; but, as one or two eggs in the less opaque tissues showed embryos with the dorsal vessel pulsating fairly regularly, I concluded that all was well in this series, and turned my attention to Series B. Here, again, most of the eggs were not favourably placed for observation, and I was compelled to reduce the amount of vegetable tissue around several of the eggs to very small dimensions. I then found that the embryos appeared to be perfectly healthy, with a pulse of about 70 per minute. Turning next to Series A, I found that, in many of the embryos, I could not detect any visible signs of heart-beat. In a few, the heart was beating very slowly and intermittently—on an average, not more than four or five times per minute. It was thus clear that removal from the vegetable tissues had seriously affected the embryonic development of Series A. I at once introduced a considerable amount of fresh tap-water into the dish, fearing that otherwise I might not succeed in obtaining any larvæ at all from this Series.

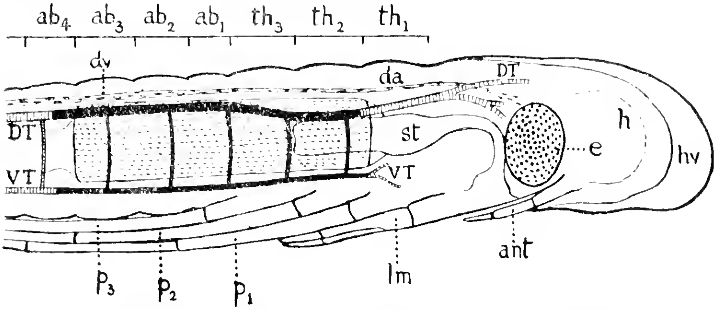
On March 28th, two larvæ had hatched out in Series C, and were normal and healthy. On March 29th, three more hatched out in Series C, and one in Series B. This last was transferred to the Petri dish, where it lived for three days. On March 30th, two more larvæ hatched from Series C, two from Series B, and two also from Series A. But these latter were both dead when I found them, though they could not have been hatched more than three hours before (*i.e.*, the time of my previous examination of the dish).

It was now necessary to spend every available moment watching Series A. For the four days, March 31st to April 3rd, I spent the whole of daylight and portion also of the nights in watching these eggs, only desisting for the shortest possible intervals for meals and rest. On March 31st, I selected in particular one embryo with a very slow but fairly regular pulse of about 20 to the minute, and watched it for four hours. I then desisted for half an hour's rest, and, on returning, found that this egg had hatched, and the larva was practically moribund. The next day, I watched the eggs for fourteen hours, selecting four especially that showed a fairly regular pulse. But I met with no luck, as not a single egg hatched on that day.

On April 2nd, I got up very early, and was rewarded by finding one of the four eggs above mentioned *just in process of hatching*. I was just in time to see the pronymph pass out from the egg-shell. The cephalic heart was acting very sluggishly; in fact, I had barely time to locate it before it subsided. The pronymph failed to pass completely out of the egg-shell, and remained with the last three or four abdominal segments inside it. The pulse of the dorsal vessel was 52 per minute. The larva made repeated attempts to remove the pronymphal sheath, by moving its head up and down, and also by forcing its midgut forwards. The œsophageal valve became deeply sunk into the midgut, where it was worked strongly up and down. The midgut was gradually forced further and further forward, until it came to occupy a considerable part of the thorax, as well as the first three or four abdominal segments. At the end of an hour, the pulse had dropped to 48; after three hours, it had fallen to 44. Half-an-hour later, it was down to 40. It then appeared that the pronymph was completely exhausted. I therefore removed it to a watch-glass, and fixed it immediately in hot water at 95° C.

It will be seen that this pronymph existed for about three and a half hours, and never succeeded in bursting open its sheath. During all this time, my attention was principally concentrated upon the tracheal system. As both egg-shell and pronymph lay upon their sides, and as the struggles of the latter to free itself were not sufficiently violent to displace it from this favourable position, I had a unique opportunity of watching for the appearance of gas. When the pronymph first emerged from the egg-shell, the whole tracheal system was clearly filled with a pale yellowish fluid (which could scarcely be anything else than the clear liquid part of the blood) without any corpuscles. A similarly coloured liquid could be seen passing along the dorsal vessel, accompanied by a small number of oat-shaped corpuscles. The whole head-cavity, and all the thorax and abdomen, except the midgut, also appeared to be full of the same coloured liquid. The midgut showed up as a darker cylindrical barrel or plug, evidently enclosing the remains of the yolk. The dorsal tracheal trunks could be easily made out, and their prolongations into the head could be followed as far as the eyes. The rectum could be distinguished, but no details of the tracheation of the gills could be made out. The ventral trunks could be picked up only with difficulty, as they were so much smaller than the dorsals. At no time was I able to see the visceral trunks, owing to the dark mass of the midgut being placed so close to them.

For three hours, I watched the tracheal system of this pronymph *without detecting any sign of gas in it*. A few minutes later, I thought that the dorsal trunks were beginning to become a little more distinct. Watching very intently, I now perceived that their outline was becoming definitely harder, and that the yellow liquid was most certainly being slowly replaced by gas. In ten minutes, the outline of the dorsal tracheal trunks in the meso- and metathorax, and in the first four segments of the abdomen, had become so hardened up that it was quite evident that this portion of the tracheal system was now filled with gas. Turning my attention to the ventral trunks, I found that these also were just in process of being filled with gas. At the end of a quarter of an hour, the parts of the tracheal system filled with gas were the dorsal and ventral trunks between the two ends of the midgut (in this case, in segments 1-4 of abdomen and 2-3 of thorax), and the five branches connecting them. This is shown in Text-fig.1, where the parts filled with gas are represented in black. No gas could be seen in the visceral tracheæ, which remained, as before, practically invisible.



Text-fig.1.—Anterior portion of pronymph of *Anax papuensis* Burm., to show the entry of gas into the tracheal system. Lateral view. Diagrammatic. The part of the tracheal system into which the gas entered is represented in black; the midgut is lightly shaded; (×55): *ab*$_1$-*ab*$_4$, abdominal segments; *ant*, antenna; *da*, dorsal aorta; DT, right dorsal tracheal trunk; *dv*, dorsal vessel or heart; *e*, compound eye; *h*, head of larva; *hv*, head-vesicle; *lm*, labial mask; *p*$_1$-*p*$_3$, legs; *st*, stomodaeum or foregut; *th*$_1$-*th*$_3$, thoracic segments; VT, right ventral tracheal trunk.

During the next five minutes, the gas in the dorsal tracheæ extended gradually as far back as the sixth abdominal segment, and slightly forward into the prothorax. It never reached the branchial basket and the head, nor did any get into the visceral trunks viâ their connection with the dorsals, which, in this pronymph, lay in the anterior portion of segment 7. As no further changes took place, and the pronymph was evidently utterly exhausted, it was killed as described above.

It seems to me very important to emphasise *the very gradual and even appearance* of the gas in the tracheæ. *No separate bubbles of gas were to be seen:* in other words, *the gas did not come in at separate points*, but passed slowly into the tracheæ over a large area represented by two thoracic and four abdominal segments (roughly defined by the limits of the midgut). The process, as I watched it, can only be compared with the *slow development* of a retarded photographic plate. At first, it was impossible to say whether any change had taken place or not, and it was only after several minutes that one could realise the steady growth in distinctness of outline in the tracheæ into which the gas was entering.

By great good fortune, a second egg hatched out about an hour and a half after the one which I was observing. This egg had been placed close alongside the latter, as it appeared to me to be on the verge of hatching. I had forgotten its existence, until, quite suddenly, the head-capsule of the emerging pronymph appeared in the field of vision, and pushed gently against the pronymph which I was watching. This pronymph was even weaker than the one I had been watching, and only succeeded in getting about half-way out of the egg-shell. I could not locate the cephalic heart at all, and it must have ceased pulsating before the pronymph came into my field of view. As this egg-shell and pronymph were also lying on their sides, I took a fine needle, and gently pushed them so that they came to lie exactly alongside the one I was observing. Thus I had the midgut regions of two pronymphs under observation at the same time. The most important result of this was, that when the changes began in the tracheal system of the first pronymph, the tracheal system of the second, remaining filled with liquid, served as a most valuable means of gauging the extent of the change. But for this, I doubt if I should have noticed the gradual beginning of the change at all.

The behaviour of the second pronymph was not exactly the same as that of the first. After remaining weak and inert for about two hours (by which time the first pronymph had been just disposed of), I found that it had become much more vigorous, making many attempts to burst the pronymphal sheath, all of which, unfortunately, were failures. A count of the pulse, during the most active of these attempts, showed 70 beats to the minute. A few minutes later, I took a fine brush, and coaxed the pronymph out from its egg-shell. It at once began to bend up and down vigorously, and made frantic efforts to break its sheath. Soon after, I noticed the pulse quicken greatly, and a count gave 120 beats to the minute. On searching for the cause of this, I found that the sheath had burst dorsally over the sixth abdominal segment, and that the larval intestine was projecting through the slit. This, of course, meant a speedy death to the larva. This second pronymph, therefore, lived just over two hours, and no gas appeared in its tracheal system during that period.

Watch was continued throughout April 3rd. On that day, two more pronymphs emerged, both, unfortunately, after dark, and at a time when I was only able to pay occasional visits to the microscope. Completely tired out with the four days' watching, I was in no mood to continue the watch far into the night, and contented myself with noting that the general course of events, in the cases of these two, was very similar to that in the first pronymph. The tracheal system showed no signs of gas until about three hours after hatching; and the gas, when present, did not extend beyond the limits stated in the first case. Both these nymphs were found dead in the morning, having failed to burst their sheaths.

Before describing the remaining experiments made upon these eggs, it would be best to give in tabular form the full record of emergences for the Series A, B, and C, in order that references to the table may make these experiments clearer.

Table showing hatchings of Eggs of *Anax papuensis*, March 28th-April 11th, 1916.

Date.	Series A.	Series B (control upon A).	Series C (control upon A and B).
	28 eggs in tap-water without vegetable tissues.	8 eggs in tap-water with small pieces of vegetable tissues *in situ* around them.	20 eggs in original stem of Water-Milfoil, with plenty of water in Petri dish.
March—			
Tues. 28th	—	—	2L
Wed. 29th	—	1L	3L
Thurs. 30th	2L	2L	2L
Fri. 31st	1L	2L	3L
April—			
Sat. 1st	—	1L	4L
Sun. 2nd	2P	—	3L
Mon. 3rd	2P	—	—
Tues. 4th	—	—	2L
Wed. 5th	1P	—	1L
Thurs. 6th	—	—	—
Fri. 7th	1P*	1L	—
Sat. 8th	1L	—	—
Sun. 9th	—	1L	—
Mon. 10th	2L	—	—
Left over on April 11th	16 dead embryos	nil	nil
Total hatched	6P+6L	8L	20L

L denotes that the emerging embryo reached the full larval stage, P that it did not succeed in getting beyond the pronymphal stage. None of the larvæ obtained from Series A lived more than two or three hours. The pronymph marked * was from the unreversed embryo, and came out of the egg-shell *backwards*.

Section 2.—*The Composition of the Gas in the Tracheal System.*

The question next arose—What could be the composition of the gas which I had seen enter the tracheal system from the body of the pronymph? It seemed to me, as soon as I observed the phenomenon, that it must be one of two things, viz., (*a*) carbonic acid gas, or (*b*) oxygen. The former would naturally appear to be the most likely solution, since CO_2 is the only gas formed in large quantities within the body of a living animal. On the other hand, one naturally recoiled at the idea that such a gas should completely fill the *respiratory system* of the larva. The second solution, that it might be oxygen, would require the existence of some oxygenating substance in the blood, which would act on the CO_2 produced by metabolism in the developing embryo, and release oxygen therefrom, in some manner analogous to that of chlorophyll in the leaves of plants. But, though the blood of Odonata is always of a yellowish or greenish colour, we have it, on the high authority of Cuénot,* that the pigments *hæmoxanthine*, *hæmochlorine*, and *hæmoprasine*, which are the only substances that might conceivably perform such a function, are quite absent from the blood of these insects.

It seemed necessary, in any case, to obtain some definite result by experiment, and not to rely upon arguments alone, however conclusive they might appear. Unfortunately, by the evening of April 3rd, as the table already given will show, most of my eggs had already hatched, and I could not expect to obtain many more larvæ. I was forced, therefore, to limit my experiments, both in variety and in the number of larvæ on which they could be performed. I decided to employ only two test-solutions, whose combined results should indicate, with considerable certainty, the composition of the gas in the tracheæ. These were

(*a*) a 10% solution of caustic potash.

(*b*) a 4% solution of Azol.†

As a stand-by, I also prepared, (*c*) a 4% solution of caustic soda, in case solution (*a*) should prove too strong.

Control Experiments:—As a control upon the experiments, two live larvæ were taken from the Petri dish (Series C), and killed by being placed in a tube of water, in which a single drop of chloroform had been well shaken up. They were then removed to tap-water in a crystal dish, and the times taken for the tracheal system to collapse were noted.

* Etudes sur le sang et les glandes lymphatiques dans la série animale, 2[me] partie. Invertébrés. Arch. Zool. expér. 2[me] série. ix., 1891.

† Azol, the proprietary name for an excellent, one-solution, photographic developer, which acts as a very strong reducing agent. The correct strength for use on plates is 1 part in 24 of water, or roughly 4%.

Result:—The rectal capillaries collapsed in from 2-3 hours, the main tracheal system (whole length of dorsal trunks) in from 5-6 hours.

Experiment 1.—Two larvæ, aged from one to two days old (strongly pigmented), were placed alive in 10% solution of KOH. The solution was regularly sucked into the rectum and expelled again, causing considerable irritation to the larvæ, both of which died within an hour. A close examination showed that the rectum became swollen and somewhat opaque. The rectal capillaries remained quite unaffected, except where the gill-tissues became very badly damaged. The main tracheal system was not affected in any way.

Conclusion.—No appreciable CO_2 present in the tracheal system of larvæ 1-2 days old.

Experiment 2.—Two larvæ, which emerged from Series C on April 4th, were taken before they were two hours old, and placed alive in 10% solution of KOH. Both died within half-an-hour, after having repeatedly sucked the solution into the rectum and expelled it again. In three-quarters of an hour, the dorsal trunks began to collapse from the region of the rectum forwards, but the rectal capillaries remained unaltered. At one hour, the dorsal trunks were very badly collapsed. At two hours, all the tracheæ in the abdomen had collapsed, except the rectal capillaries, which remained only partially collapsed. At three hours, the whole tracheal system had collapsed, including the parts in the head and thorax, but there still remained a number of the rectal capillaries only partially collapsed. At four hours, all the capillaries had collapsed (*cf.* Control Experiment).

Conclusion.—The gas in the tracheal system of larvæ 1-2 *hours* old is CO_2, except in the rectal capillaries, which are, at any rate, partially filled with some gas not extracted by KOH.

Experiment 3.—Two larvæ were taken from Series B and C respectively, the latter between two and three days old (strongly pigmented), the former between six and twelve hours old (just beginning to become pigmented), were placed alive in 4% solution of Azol. The larvæ lived for two or three hours, and appeared to suffer little inconvenience or irritation, though the liquid was repeatedly sucked into the rectum. In both larvæ, the main tracheal system remained intact *for twelve hours* (a very striking result, *cf.* Control Experiment). In the younger larva, the rectal capillaries remained absolutely intact at the end of twelve hours (again, *cf.* Control Experiment). In the older larva, the rectal capillaries collapsed partially at the end of three hours.

Conclusion.—The action of the Azol is clearly resisted by chitin, and hence, no safe conclusions can be drawn as to what gas was present in the main tracheal system. In the rectal capillaries, there was little or no oxygen present in the case of the younger larva, but enough oxygen was present in the case of the older larva to affect the stability of these tubes when it was withdrawn by the Azol.

Experiment 4.—A moribund larva, taken from Series A, soon after hatching, was placed in a solution of 4% NaOH. This larva remained inert, without sucking the solution into its rectum, and died within an hour. *Result*, same as stated for the larvæ in the Control Experiment.

Conclusion.—No guide as to composition of gas. Either the solution was too weak to penetrate the chitin, or else the fact that the larva was moribund, and did not draw the solution into its rectum, prevented contact between the solution and the most permeable part of the animal (*i.e.*, the thin, chitinous cuticle of the rectal gills).

Besides the larvæ used in the above experiments, a single larva emerged from Series B on April 9th, at a time when I was unable to make use of it, and two moribund larvæ emerged from Series A on April 10th, dying before I could make use of them. No more larvæ emerged, and no less than *sixteen* dead embryos remained inside eggs of Series A until April 20th, when they were thrown away.

The results of my experiments, few though they were in number, appear to point definitely in the following direction:—While there is no appreciable quantity of CO_2 in the tracheal system of larvæ more than a day old (Expt. 1), yet, in larvæ only an hour or two old, the whole system is filled with CO_2, except the rectal capillaries, where there is a mixture of gases (Expt. 2). Also, though the Azol solution appeared to be unsuitable for penetration of chitinous membranes, yet the fact that it extracted some of the gas from the rectal capillaries of a 2-3 days old larva, and failed to do so in the case of a 6-12 hours old larva, suggests that the proportion of O in the gills of the former was considerably greater than that in the gills of the latter (Expt. 3). We are thus led, on all three counts, to the definite conclusion that, (i.) *the original gas which fills the tracheal system of the larva during the process of hatching is* CO_2, but that, (ii.) *the establishment of regular rectal respiration sets up a process of diffusion between the rectal capillaries and the water in the rectum, whereby the* CO_2 *in the tracheal system is gradually withdrawn, and replaced by air, or a mixture of nitrogen and oxygen not differing much from the ordinary composition of air.*

It is easy to show that these results are in agreement with the physiological aspects of the problem. Firstly, the exertions of the larva to burst open both the egg and the pronymphal sheath involve a sudden and rapid increase of metabolic activity. Thus, just at the period when large quantities of CO_2 are being liberated by the activities of the larva, gas replaces the liquid in the tracheæ. If this gas be CO_2, as our experiments suggest, we have solved at once the problem of what the larva does with the large amount of CO_2 liberated by its new exertions, and why it is that the gas comes into the tracheal system in the manner it does. Secondly, if we grant that this gas is CO_2, the gradual change to air, or a mixture of gases not differing appreciably from air, is not only to be expected as a result of rectal respiration, but must inevitably take place, by the ordinary laws of diffusion. For, in the tracheal system of the newly-hatched larva, the pressure of CO_2 will be 760 mm., or atmospheric pressure. But in the aërated water of the rectum, the partial pressure of O is approximately 150 mm., that of N approximately 610 mm., and that of CO_2 less than 1 mm. It follows that the

CO_2 in the tracheæ must *eventually* be replaced *almost completely* by a mixture of O and N closely resembling air. (As the larva must be continually using up the O, it is not necessary to assume that the *total* amount of gas in the tracheæ at any given moment, if analysed, must have the *exact* composition of air). The rate at which the exchange takes place will be governed by the morphological conditions in the rectum. As the expanse of the rectal chamber is limited, only a certain amount of aërated water can be drawn in at one time. Hence, if this water bathes any given length of cylindrical tracheal tubing, it is clear that, the smaller the bore of the tube, the quicker will the exchange of gases take place. The rate of exchange of gas may be roughly taken as inversely proportional to the area of the cross-section of the tube, *i.e.*, to the square of the diameter of the tube. Also, any increase in the length of tube exposed to the water will facilitate the rate of exchange. Thus *the ideal conditions for a rapid exchange are fulfilled in the case of a large number of exceedingly fine tubes having a great portion of their length bathed by the water.* This is exactly the morphological condition developed in the rectal gills of Anisopterid larvæ.*

Section 3.—*The Nature and Action of the Cephalic Heart.*

In my previous study upon the larva of *Anax papuensis* (*l.c.*), I described the action of the peculiar pumping-organ of the head, and suggested for it the name of the *cephalic heart.* Owing to the rapidity of the act of hatching, and the fact that this organ

* *Note.*—In a letter received from Mr. G. L. Purser, B.A., of Trinity College, Cambridge, in which he discusses my paper on the Physiology of the Rectal Gills, he remarks on the peculiar problem of the first appearance of gas in the tracheæ:—"I don't see why the gas should appear just where it does. My idea is this: the gas appears first in the thickest part of the embryo; it appears just when the larva is making a series of strong muscular efforts for the first time. Why, therefore, should it not be CO_2? The gas appears where CO_2 will be most concentrated; it appears *when* it is most concentrated." This letter was received only a few days after my experiments were completed, and was, therefore, written some time before them. I desire, therefore, to give Mr. Purser due credit for the first conception of the idea stated in his letter.—R.J.T.

is only in action for about half-a-minute, it is most difficult to determine its exact nature and position. We know that it is situated above and somewhat posterior to the mouth, and below the dorsal aorta; that at first it is very small, that it increases rapidly in size and in the force of its pulsations; and then, after performing about twenty-five regular double-beats in half-a-minute, subsides very quickly. In appearance, it is two-chambered, but whether there are actually two pulsating chambers, or a single one constricted at some point by the tentorial structures of the head, I had not been able to determine. With Balfour Browne,* I agree that this organ pumps a pale yellowish liquid, which can be none other than the liquid part of the blood. I did not observe any corpuscles passing through the organ. Balfour-Browne states that the blood is pumped upwards and backwards. This appears to me also to be correct as regards the first few pulsations of the organ; after that, I confess that I could not follow a definite course of the blood, and I must hold to the opinion that most of the blood pumped into the anterior chamber (or *auricle*, as I previously termed it) was again pumped out into the posterior chamber (or *ventricle*), and served to cause the immense distension of that chamber which takes place just before the larva bursts its pronymphal sheath. What the exact nature of the organ is, and whence and whither the blood was actually pumped, I had not been able to determine.

In entering upon the experiments already detailed in Section 1 of this paper, I had strong hopes that the general retardation of the process of hatching might be accompanied by a corresponding retardation in the action of the cephalic heart, and that thus I might be able to examine this organ more minutely. It will be seen already, however, that these hopes were frustrated, since the cephalic heart barely came into action before it subsided again, at the birth of the pronymph, and failed altogether to come into action again during the whole of the pronymphal stage, lasting over three hours. Indeed, it is very probable that

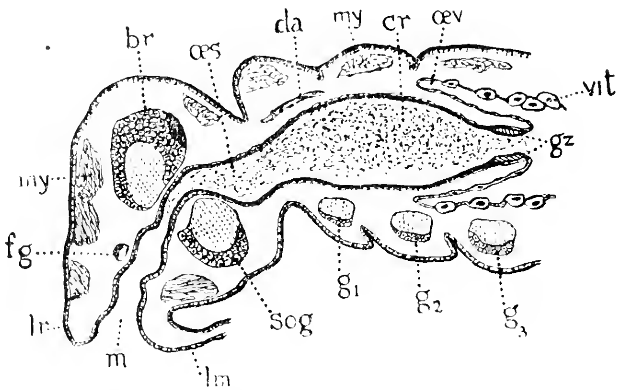
* "The Life-History of the Agrionid Dragonfly." Proc. Zool. Soc. London, 1909, pp.253-285.

the failure of the larva to emerge from the pronymphal sheath was correlated with its failure to bring this strong pumping apparatus into action, to aid in the required distension of the head.

My one remaining hope of discovering something about this important organ lay in a study of sections of a pronymph. As already stated, the pronymph studied on p.394 was removed in a moribund condition, after it had lived for three and a half hours, and was fixed in hot water. Though it was almost dead when the hot water was poured upon it, the sudden contact with this liquid caused it to burst the pronymphal sheath, and flow completely out of it. Thus the animal that I had fixed was, in a sense, the true larva, but *with the form of the pronymph*: for its eyes and head did not expand to the true larval form, its labium and legs remained directed backwards as in the embryo, and its abdomen was still of the slender form seen in the pronymph. This little animal was carefully double-embedded in celloidin and paraffin, and cut into sagittal sections of 7 μ thickness. One of these, a little to the right of the median sagittal plane, is shown in Text-fig.2.

In order to understand this section, I have also shown, in Text-fig.3, a drawing which I made, by means of the camera lucida, of the anterior portion of the same pronymph, at about two hours old. It must be remembered that the cephalic heart had ceased to beat almost directly after the pronymph had hatched. Thus we cannot see the shape and position of that organ in the drawing; and if we want to search for it in the sections, we must bear in mind that it had either collapsed, or assumed some stable form prior to the period of fixation. Text-fig.3 shows us the exact course of the blood-circulation in the head-region during the pronymphal stage, and also the peculiar position of the midgut, pushed forward into the thorax, with the oesophageal valve and gizzard sunk deeply into it, and the crop projecting in front of it, just below the end of the dorsal aorta.

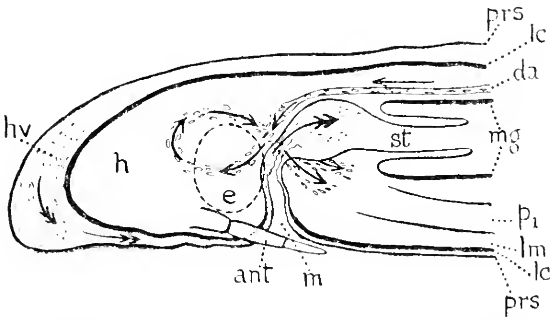
Now, if we study the series of sections, we at once notice the very remarkable fact that, at the time of fixation, *the anterior* *œsophageal region is strongly distended with blood, in which, however, no corpuscles are visible.* A search through the whole series of sections likewise fails to show the presence of any special organ which might be interpreted as the collapsed cephalic heart. There is nothing to be seen except the usual organs of the head and thorax present in any insect-larva. If we combine these two facts together, the conclusion is very strong that the cephalic heart is really only *a special temporary development in the œsophagus*, and that, therefore, the pumping of the liquid blood must take place *through the mouth.*



Text-fig. 2.—Nearly median, sagittal section through pronymph of *Anax papuensis* Burm., with the pronymphal sheath removed. To show mass of blood-coagulum, without corpuscles, distending the œsophagus and crop. (× 100): *br*, brain; *cr*, crop; *da*, dorsal aorta; *fg*, frontal ganglion; g_1-g_3, thoracic ganglia; *gz*, gizzard; *lm*, labial mask (cut off); *lr*, labrum; *m*, mouth; *my*, muscle; *œs*, œsophagus; *œv*, œsophageal valve (junction of fore- and midgut); *sog*, subœsophageal ganglion; *vit*, vitellophags in wall of midgut.

Let us now see how this conclusion agrees with the observed facts of the hatching of the egg. Before the pronymph emerges, there is a large "*head vesicle*" fitting closely under the pedicel of the egg. When the cephalic heart comes into action, the liquid in this vesicle (which must obviously be a space between the pronymphal sheath and the true larval head) is withdrawn, the head of the larva swells up greatly, and, by this means, the pedicel of the egg is pushed aside, and the pronymph emerges. After a short period of time (from a few seconds to half-a-minute at the most in *Anax*), the activity of the cephalic heart increases rapidly, the head again swells up, but this time to almost twice its previous size, and the larva escapes through the dorsal splitting of the pronymphal sheath.

Now there is no possible connection between the "head-vesicle" and the interior of the embryo, except viâ the larval mouth. If the cephalic heart be merely a temporary formation in the œsophagus, acting somewhat in the manner of a sucking-pharynx, it would be able to exhaust all the liquid in the "head-



Text-fig.3.—Head and portion of thorax of pronymph of *Anax papuensis* Burm., to show, (*a*) course of blood-corpuscles in the head-region (single arrows), and (*b*) suggested course of liquid blood (lymph) drawn into œsophagus by action of cephalic heart (double arrows). Diagrammatic. (×60): *ant*, antenna; *da*, dorsal aorta; *e*, eye (dotted outline); *h*, larval head; *hv*, head-vesicle; *lc*, larval cuticle; *lm*, labial mask; *m*, mouth; *mg*, midgut; p_1, foreleg; *prs*, pronymphal sheath; *st*, stomodaeum or foregut.

vesicle," by sucking it into the lumen of the œsophagus. Text-fig.3 shows, in a diagrammatic manner, how this would be done. The accumulation of all this volume of liquid in the anterior part of the œsophagus, together with the extra pressure caused by the forward movement of the midgut, would be quite sufficient to cause the splitting of the pronymphal sheath, as well as the lifting-up of the egg-pedicel.

As regards the two-chambered structure of the cephalic heart, a reference to the section in Text-fig.2 shows the exact position where the tentorium would cause a definite constriction in the œsophagus, if that organ were to distend itself in any manner. The passage through this tentorial foramen, below the brain(*br*) and above the suboesophageal ganglion (*sog*) is small, and the tentorial bars are hard and rigid. Moreover, the œsophagus, both at this point and throughout its entire length, is capable of very great expansion, as may be seen in any transverse section of that organ, both by reason of the longitudinal pleating or infolding of its epithelium, and the strength of its muscular tunic. It seems reasonable to suppose that the division into two chambers is caused by the tentorial compression. The notes and drawings that I made for my previous paper show the point of constriction placed somewhat further back than the position of the tentorium. I think, however, that too much weight must not be placed upon this fact, as it was manifestly impossible to make accurate drawings of all the different parts of the larva, during the single half-minute of vigorous struggle for emergence. If, however, future observations should confirm my original drawings,* then there is reason to suspect the existence of a special sphincter muscle at some definite position on the œsophagus. Such a structure would have to be searched for in transverse sections.

Section 4.—*The effect of abnormal conditions upon embryonic development.*

We can now turn to some problems of a more general nature arising from the experiments described in Section 1.

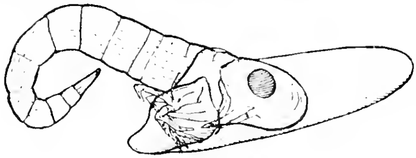
If we examine the table of results given on p.398, we see that Series B and C gave identical results, *viz.*, in both cases all the

* These will be found in Fig.24 of my book, "The Biology of Dragonflies," shortly to be published by the Cambridge University Press.

eggs hatched, and yielded healthy larvae. We must conclude, therefore, that the restriction of the amount of water allowed to Series B, and the covering-over of the crystal dish (except on rare occasions for a few moments) by a glass slide, to prevent free aëration of the water, had no appreciable effect upon the course of development.

The only difference between Series A and Series B was *the removal of the vegetable tissues* from around the eggs of the former series. The results, as we have seen, were disastrous. Sixteen embryos died, six reached the pronymphal stage, and six just got as far as the larval stage, but were too weak to go on living. We can only conclude that *the vegetable tissues play an important part in the oxygenation of the embryo.*

Let us now consider the peculiar case of the pronymph in Series A, which emerged on April 7th (marked 1P* in the Table). As already stated, this was the only embryo in Series A, which, when first subjected to the conditions of the experiment, had not undergone the process of reversion. The fact that it was already behind the rest of the eggs in development might suggest some inherent weakness in this particular individual; but there is no reason to suppose that it would not have gone on developing normally, if left to itself. That it was not parasitised is clear from the fact that it finally hatched out. Also, since the eggs were all laid together in a regular spiral, on the single piece of stem, we have no reason to believe that it was not one of the same batch of eggs as all the rest. The fact that, in Series C, under normal conditions, the eggs continued to hatch over a period of nine days, shows us that considerable variations in the length of embryonic existence are to be expected. This egg merely happened to be the most backward of the whole set. The effect of the new conditions upon it was most marked, because it had developed less far under normal conditions. It was, however, a very unexpected and extraordinary thing, to my mind, that the process of reversion, which should have normally followed in this case within a day or two, should be completely prevented, and that the embryo should go on developing, as it did, *head* *downwards*, and still continue to live. Yet such was the case, and the final result, which I have depicted in Text-fig. 4, is both ludicrous and pathetic. The mature embryo emerged as a pronymph "tail-foremost," until it finally became caught in the egg-shell, and died while still only partially free!



Text-fig. 4.*

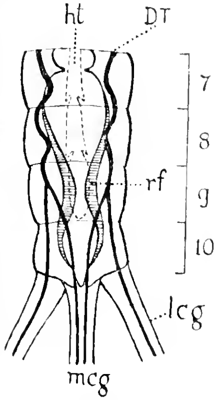
Section 5.—*Rectal Respiration in newly-hatched Zygopterid larva.*

In November, 1915, a large number of eggs of a common Zygopterid dragonfly (probably *Austrolestes leda* Selys, but not determined with certainty) were found in the tissues of a reed at National Park. These were kept *in situ* in the reed, in water in a Petri dish. Some of them were parasitised by a small Hymenopterous insect new to science. The majority, however, hatched out about a week after they were taken. No attempt was made to observe the actual process of hatching in this case. The principal object which I had in mind was the examination of the caudal gills and tracheal system of the young larvæ. The eggs were examined several times a day. Consequently, a number of freshly hatched specimens, ranging from a few minutes up to two hours old, and all of them perfectly transparent, came under my observation.

The most striking discovery about these larvæ was that, from the time of hatching onward for half-an-hour or more, *regular rectal respiration was carried on with great rigour.* The action is exactly like that observed in the young larva of *Anax*. The rectal cavity is alternately expanded and contracted, so that water is drawn in and expelled quite regularly. No true *tracheal gills* are to be seen, such as are visible from the first in the rectum of *Anax*; but there are two, slightly opaque, longitudinal folds, placed latero-ventrally, and evidently carrying a thickened

* Abnormal hatching of pronymph P* of *Anax papuensis* Burm., "tail-foremost" (× 30).

epithelium, which project into the rectum, rising and falling with a somewhat undulating motion. These folds are shown in Text-fig.5. I could not detect any sign of a mid-dorsal fold, such as can be seen in older larvæ. No tracheæ can be seen in these folds.



Text-fig.5.*

When the larva is half-an-hour old, or a little older, the regular movements of the rectum cease. Thereafter, the rectum is, for the most part, closed. But, every now and again, it is opened for a short period, during which the movements are again renewed. Larvæ were watched from time to time until they were one or two days old, always with this same result. We must conclude, therefore, that *intermittent rectal respiration* is carried on by young Zygopterid larvæ during the first day or two of their existence, but that it is only *regular and rigorous for a short period directly after hatching.*

Calvert† has given an excellent summary of the present state of our knowledge of rectal respiration in Zygopterid larvæ. His own experiments on the larvæ of *Calopteryx maculata* (*l.c.*, p.438) are of more value than all the isolated observations of previous authors. By the use of carmine-particles, he proved that this larva expels water regularly from its anal aperture, 33 or more times per minute. He also made similar observations on larvæ of *Hetærina* (*l.c.*, p.440), and *Argia* (*l.c.*, p.442), in both of which he proved that rhythmic pulsations of the rectum were carried

* Last four abdominal segments of newly-hatched larva of *Austrolestes leda* Selys; (× 100); dorsal view, to show the paired, latero-ventral, rectal folds(*rf*). DT, dorsal tracheal trunk; *ht*, heart (dotted outline); *lcg*, lateral caudal gill, with single main trachea; *mcg*, median, caudal gill, with two main tracheæ; *rf*, rectal folds; 7-10, abdominal segments.

† "Studies on Costa Rican Odonata. vii. Internal Organs of Larva, and the Respiration and Rectal Tracheation of Zygopterous Larvæ in General." Ent. News, Philadelphia, xxvi., pp.435-447, 1915.

on. No observations appear to have been made, up to the present, on newly hatched or very young larvæ.

As a general rule, the caudal gills of newly-hatched Zygopterid larvæ are exceedingly slender, almost filiform, and fringed with long, delicate hairs, few in number and irregularly placed. Whatever may be our opinion on the efficacy of these organs at a later period, when they have taken on their final form, and developed within themselves a rich tracheal system, nobody, we suppose, would claim that they are very efficient organs of respiration in the newly-hatched larva. If we combine this well-known fact of the slender and weak formation of these organs with the results of the experiments carried out in Section 2 on the larva of *Anax* (experiments which, one can scarcely doubt, must hold good for the great majority of dragonfly larvæ), we see at once the reason for the vigorous rectal respiration carried on in the case of our Zygopterid larvæ during the first half-hour after hatching. *It is not merely an ordinary act of respiration, but is necessary for the quick replacement of the* CO_2 *in the tracheal system by air.* Once the tracheal system has reached the normal state, so that the necessary supply of oxygen to the tissues is assured, rectal respiration will be governed, in larvæ of different kinds, by *the efficacy of the total of other respiratory activities.* Respiration through caudal gills, through lateral abdominal gills when they occur, and through the integument in such cases as it may occur, all differ from rectal respiration in being *practically continuous*, carried on without special efforts on the part of the larva. Consequently, if the caudal gills have a poor tracheal supply, or a very tough integument, or if the general integument of the larva be unsuitable for respiration by diffusion, the call on the larva for rectal pulsations must be heavier. If the caudal gills are accidentally lost, we should expect that the rate of rectal respiration would be increased. Similarly, we might expect to find a higher rate of rectal respiration towards the end of each instar, when the general integument tends to become tough and hard, than at the beginning, when it is soft and delicate. Experiments along these lines should lead to interesting conclusions as to the true respiratory value of the caudal gills and general integument.

It remains true, in spite of the fact that rectal respiration has now been shown to be carried on both in newly-hatched and in well-grown Zygopterid larvæ, that *no true tracheal gills* are developed in the rectum of these larvæ. The diffusion of CO_2 outwards into the rectal water-supply, and the diffusion of air inwards, is undoubtedly effected through the rectal epithelium *without any specialisation of the tracheal supply of that region*, and the exchange must be regarded as being primarily one between the blood of the larva and the water in the rectum, quite irrespective of the tracheal system, which is bound to benefit sooner or later by the change. Where the Anisoptera differ from the Zygoptera is in the fact that a set of definitely new structures, viz., *tracheal gills*, of great complexity and efficacy, have been developed in the rectum in such a manner as to do away with the need for any other method of respiration, and to bring the necessary oxygen direct from the water to the tracheal system, by means of the thousands of minute capillary loops which lie in the projecting gill-folds. The thickened folds of rectal epithelium in Zygopterid larvæ are structurally not homologous with the gills of Anisopterid larvæ, but rather with their *basal pads*, to which they bear a close morphological resemblance, especially in the more archaic types. It would seem, therefore, highly probable that the *elimination of* CO_2 may be one of the principal functions of these pads, seeing that, before special tracheal gills were developed, such elimination must have proceeded outwards *pari passu* with the entry of air inwards, by diffusion.

In conclusion, we would suggest that there is some definite correlation between the general asthenogenetic trend of development of the Zygoptera as a whole, and their failure to develop any single set of highly efficient respiratory organs in the larval stage. They cannot compete on equal terms with the highly-endowed Anisopterid larvæ in this respect. Inherent weakness in the respiratory system is as fatal to the development of a strong evolutionary line as inherent inability to obtain food easily.

Only in the case of the *Pseudostigmatinæ* does this inability seem to have been removed (not unlikely, it appears, by bringing the stigmata themselves into play for breathing air directly); and the result has been, in this case, the evolution of a race of giants.

Summary.

i. *Conclusions to be drawn from Sections 1-4 concerning Anisopterid larvæ.*

A. *The Gas in the Tracheal System, and the Method of Respiration* (Sections 1 and 2).

1. Before hatching, the tracheal system of the embryo contains no gas, but only a clear pale yellowish liquid, which is the liquid portion of the insect's blood, resembling lymph.

2. During the short pronymphal stage, this liquid is replaced by gas throughout the region coterminous with the midgut; *i.e.*, the gas enters practically simultaneously into the dorsal and ventral trunks and their five pairs of connecting tracheæ in that region. What happens in the visceral trunks could not be observed.

3. By a rapid extension, the gas passes forwards into the head, and backwards into the posterior abdominal segments, until it fills the whole tracheal system, including all the capillaries of the rectal gills.

4. The gas in the tracheæ is almost certainly carbonic acid gas.

5. Regular respiration viâ the rectum sets up a process of diffusion between the capillaries of the rectal gills and the circum-ambient water, so that CO_2 passes out into the water, and a mixture of O and N, closely resembling air, passes into the capillaries, until, finally, the partial pressures of all these gases become the same in the tracheal system as in the water (*i.e.*, N, 610 mm.; O, 150 mm.; CO_2, less than 1 mm.). The experiments suggest that a considerable time must elapse before this final equilibrium is fully established.

B. *The Nature and Action of the Cephalic Heart* (Section 3).

While this organ could not be examined actually *in situ* and in action, the following suggestions are made concerning it, and need to be tested by further experiments if an opportunity offers itself—

1. The Cephalic Heart is probably not a separate structure, but simply a temporary formation in the œsophagus.

2. It pumps liquid blood (without corpuscles) from the "head-vesicle," *i.e.*, from between the pronymphal sheath and true larval head, viâ the larval mouth, into the œsophagus.

3. The consequent distension of the œsophagus, aided by forward pressure of the midgut, enables the larva, (*a*) to lift the pedicel of the egg, and (*b*) to burst the pronymphal sheath dorsally on the head.

4. The apparent two-chambered condition of this organ is probably due to the rigidity of the tentorial framework, which constricts it while in operation.

C. *General* (Section 4).

1. Deprivation of oxygen for the developing embryo is effectively brought about by removal of the vegetable tissues in which the egg was laid, and restriction of the amount of water and access of fresh air.

2. Of twenty-eight embryos so deprived of oxygen, sixteen died without hatching, six reached the pronymphal stage, and six reached the true larval stage, but died soon afterwards.

3. Eight embryos in eggs confined in small blocks of vegetable tissue, but otherwise subjected to restriction of the amount of water and access of fresh air, in the same way as those in 2, all reached the complete larval stage, and showed little or no signs of impaired health.

4. The single embryo which had not undergone reversion, before being subjected to the treatment described in 1, *continued to develop without reversing*, and finally emerged as a pronymph "tail foremost."

ii. *Conclusions to be drawn from Section 5, concerning Zygopterid larvæ.*

1. Rectal respiration is carried on regularly and vigorously during the first half-hour or so of larval existence.

2. This vigorous respiration is necessary in order to effect a quick exchange of the CO_2 in the tracheal system for air derived from the rectal water-supply.

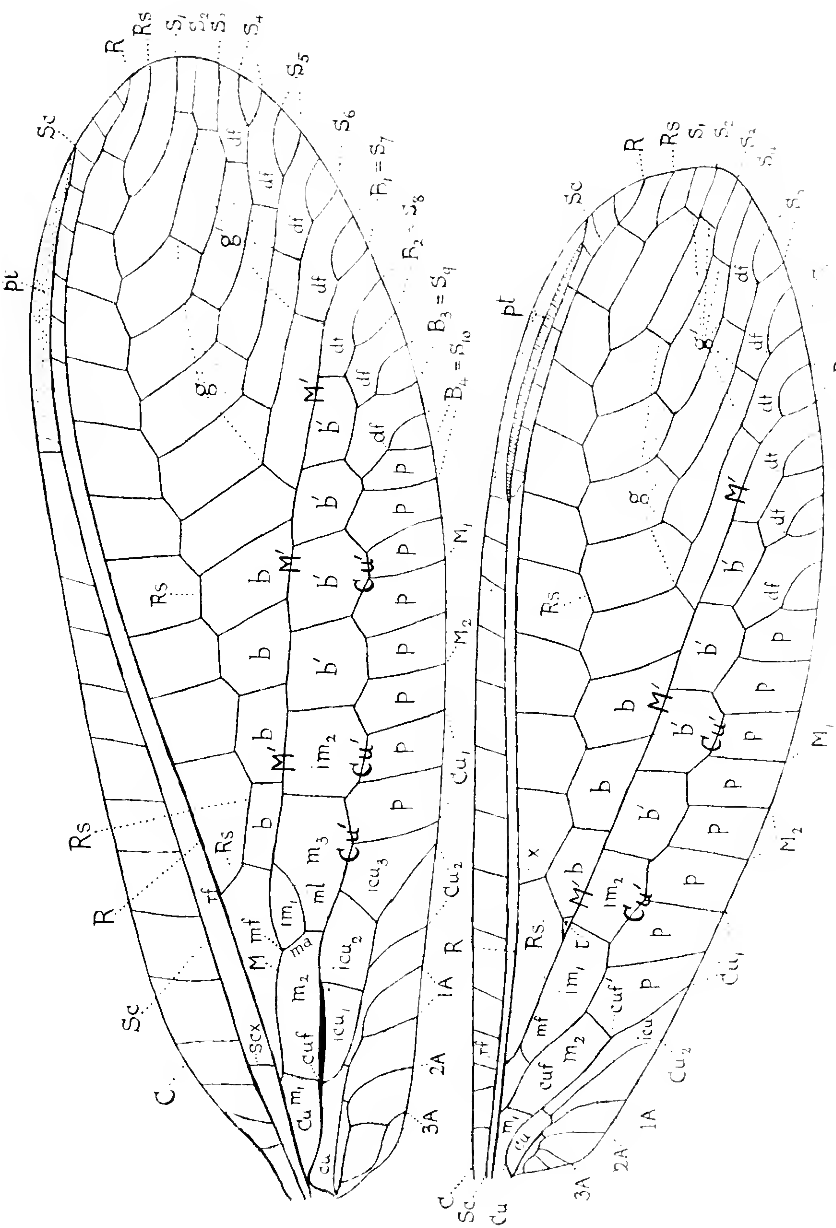
3. Thereafter, for the first two days of larval existence, rectal respiration is intermittent only.

4. This indicates that, for the rest of larval life, rectal respiration is only *accessory*, and is regulated by the sum-total of efficiency of the other means of respiration used by the larva.

5. No true rectal tracheal gills are developed in young Zygopterid larvæ, but two latero-ventral folds of thickened epithelium are seen to play a prominent part in the rectal movements. No special tracheal development can be seen in these rectal folds.

[Printed off, 8th September, 1916.]

R J T. del



Venation of *Chrysopa signata* Walk.

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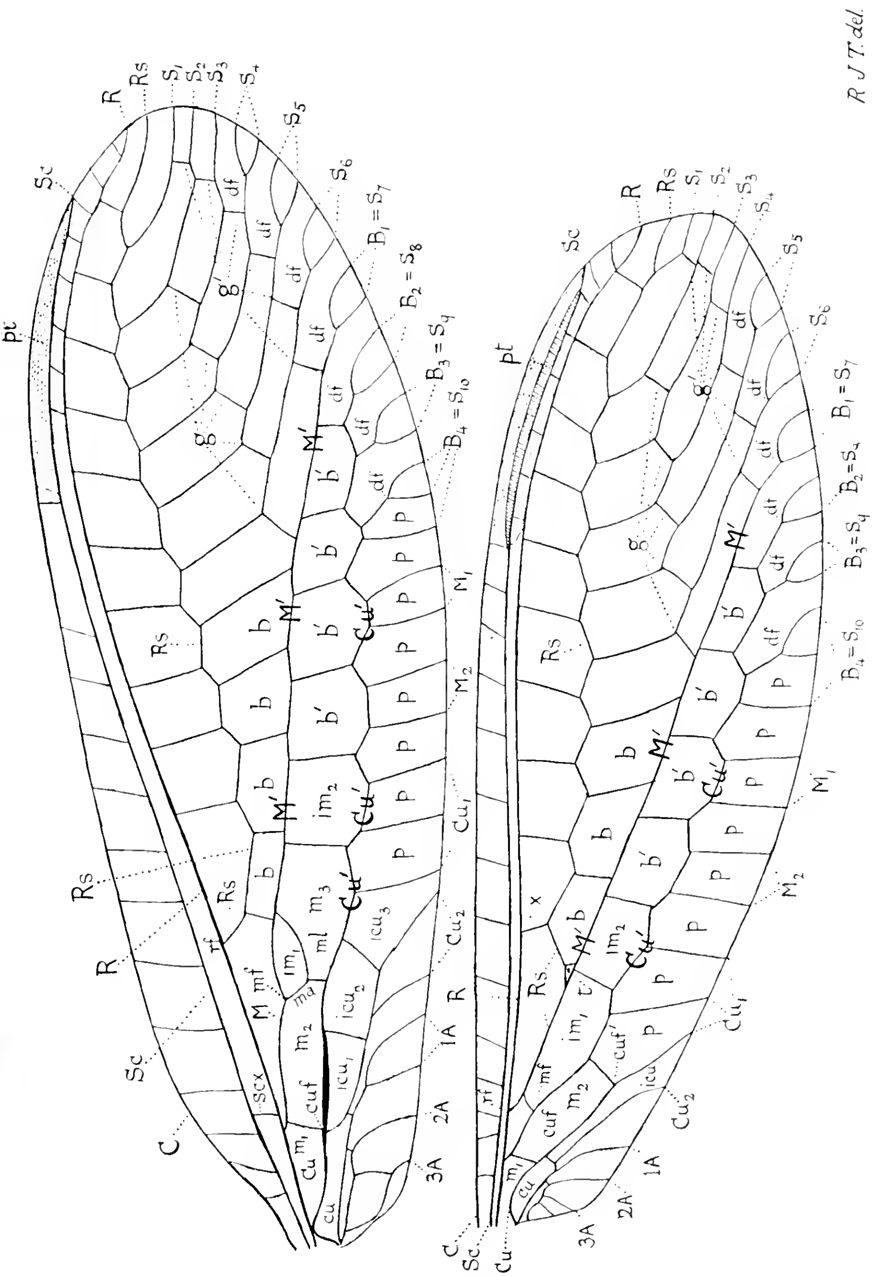
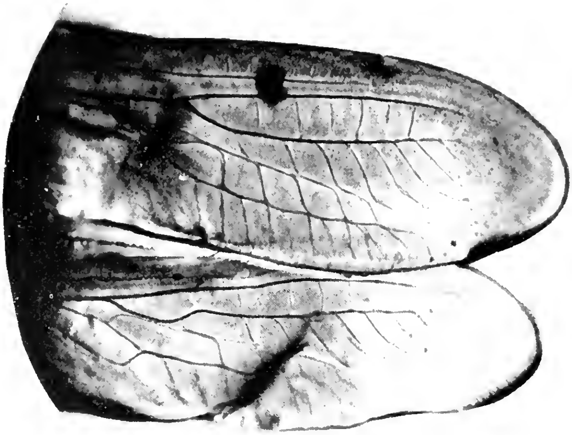
[Printed off, 8th September, 1916.]



Venation of *Chrysopa signata* Walk.



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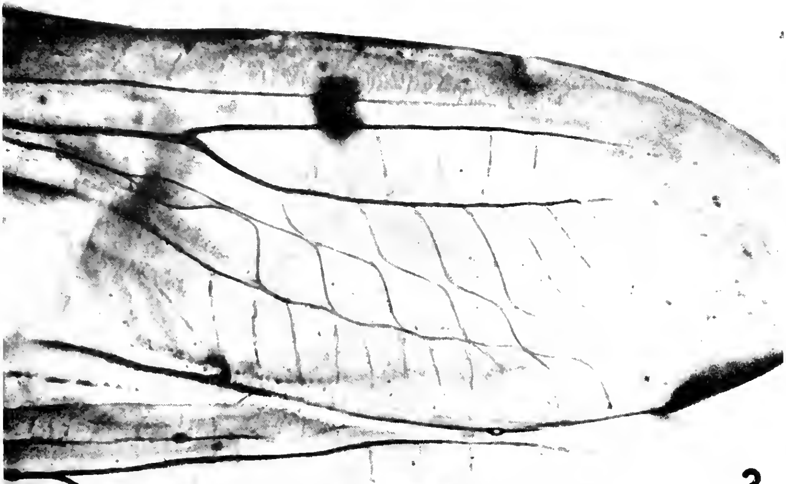

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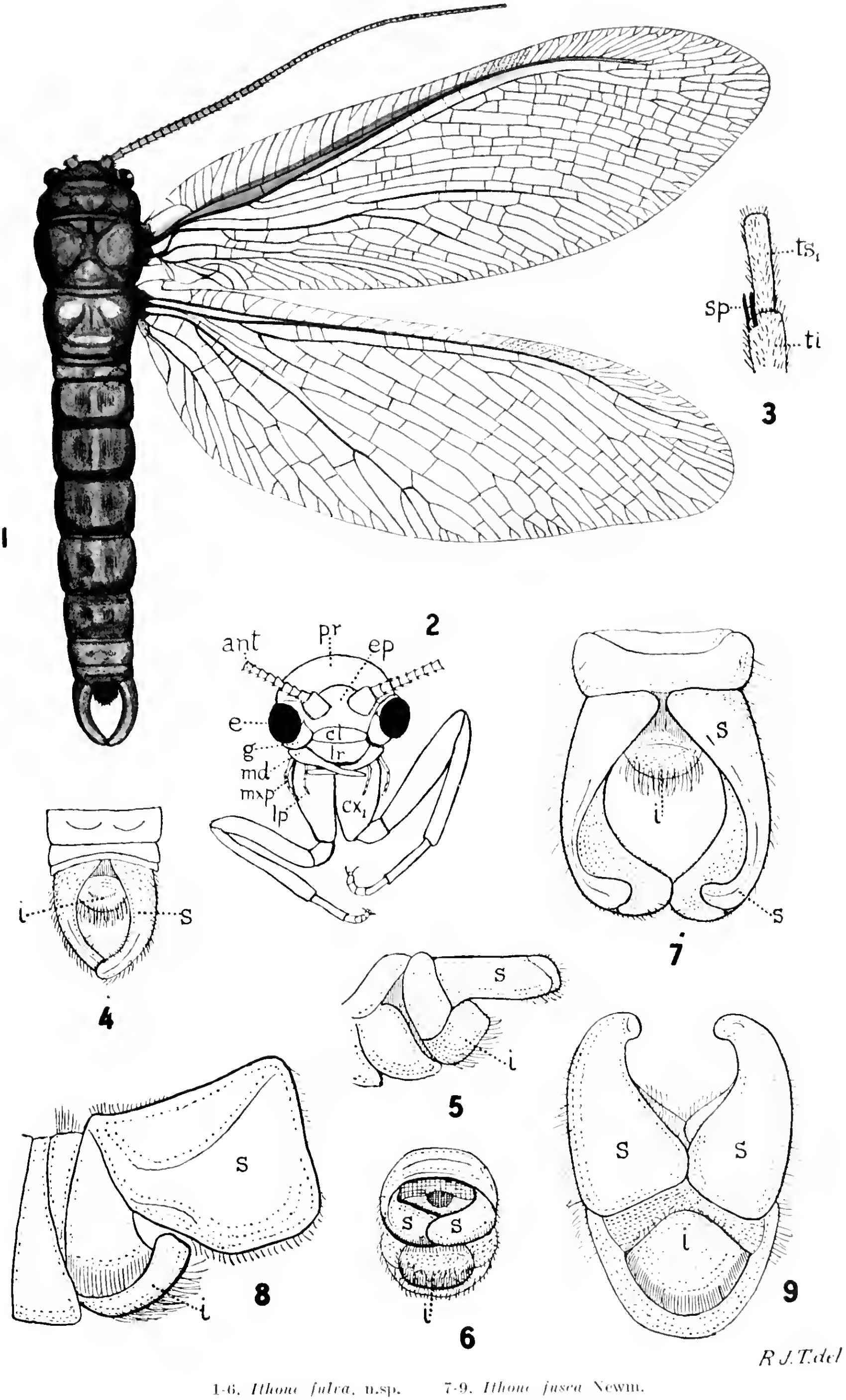
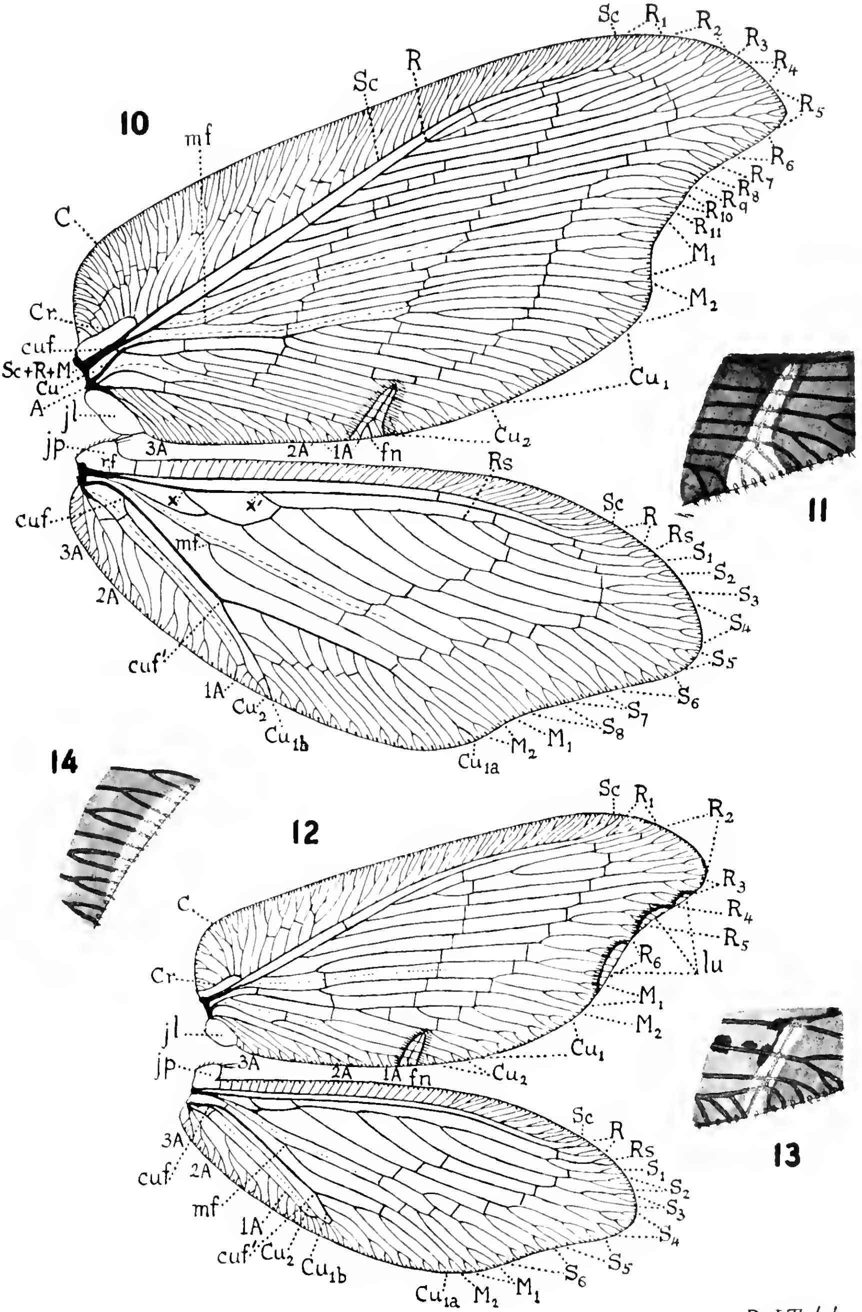
1-3. Pupal wing-tracheation of *Chrysopa*.

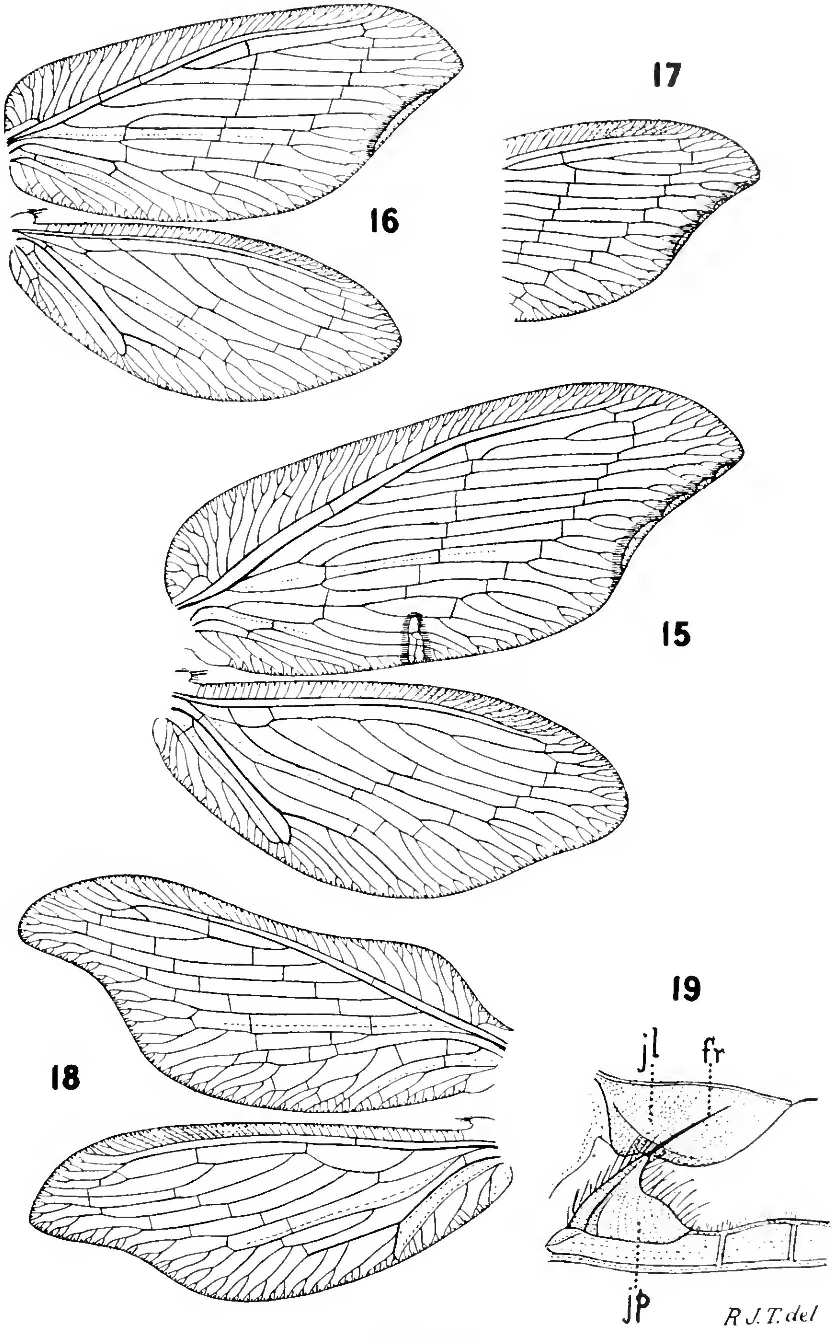


1-6. *Ithone fulva*, n.sp. 7-9. *Ithone fusca* Newm.

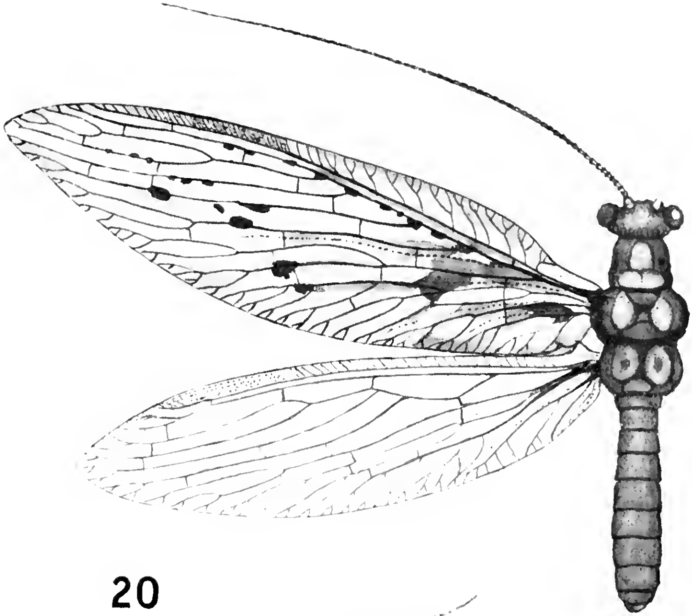


R.J.T. del

10-11. *Drepanepteryx phalænoides* (Linn.). 12-14. *Drepanacra humilis* (McLachl.).



Drepanarca spp.



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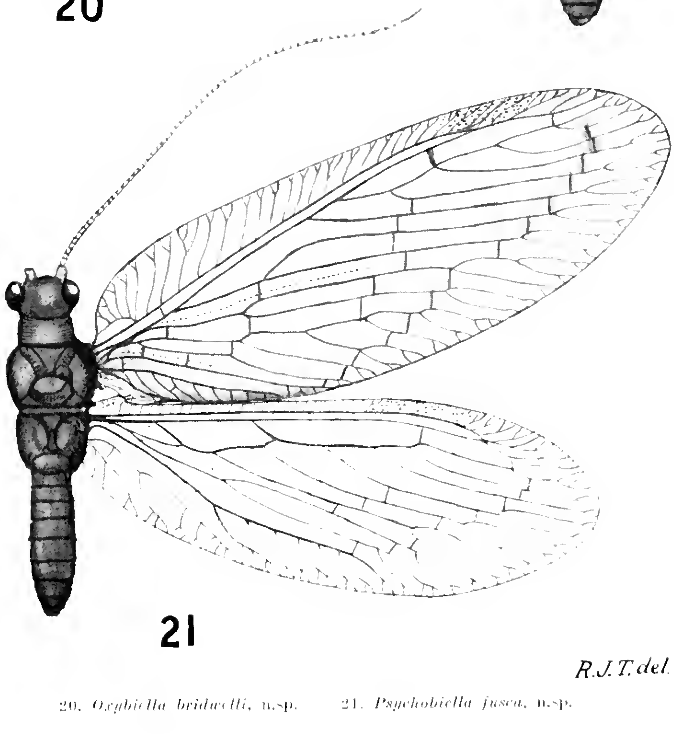

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20. *Oxybiella bridwelli*, n.sp. 21. *Psychobiella fusca*, n.sp.

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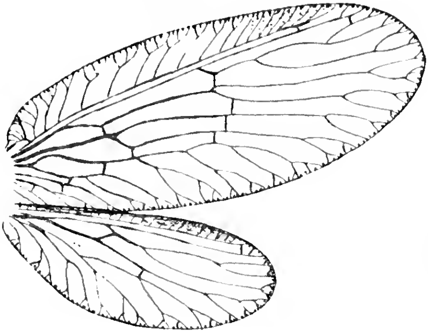

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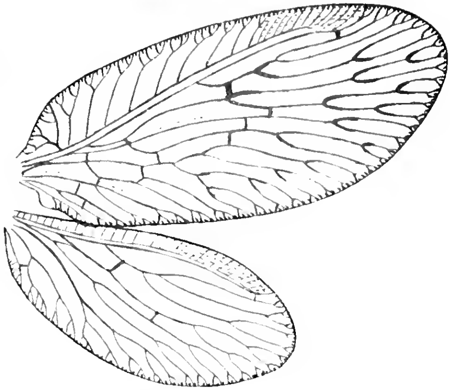

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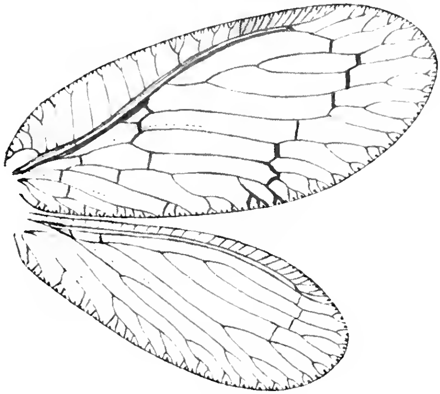

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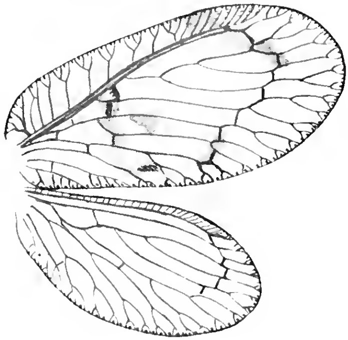

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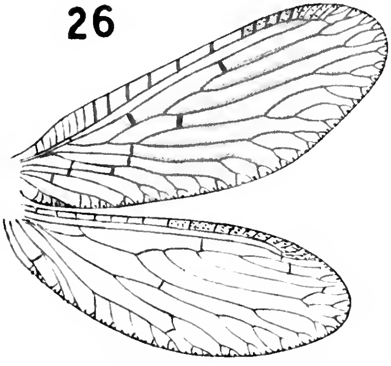

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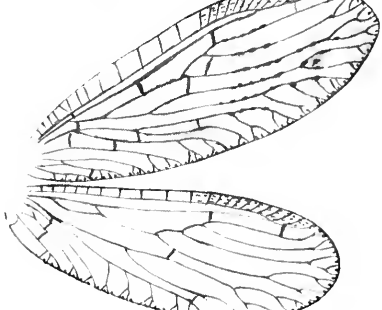
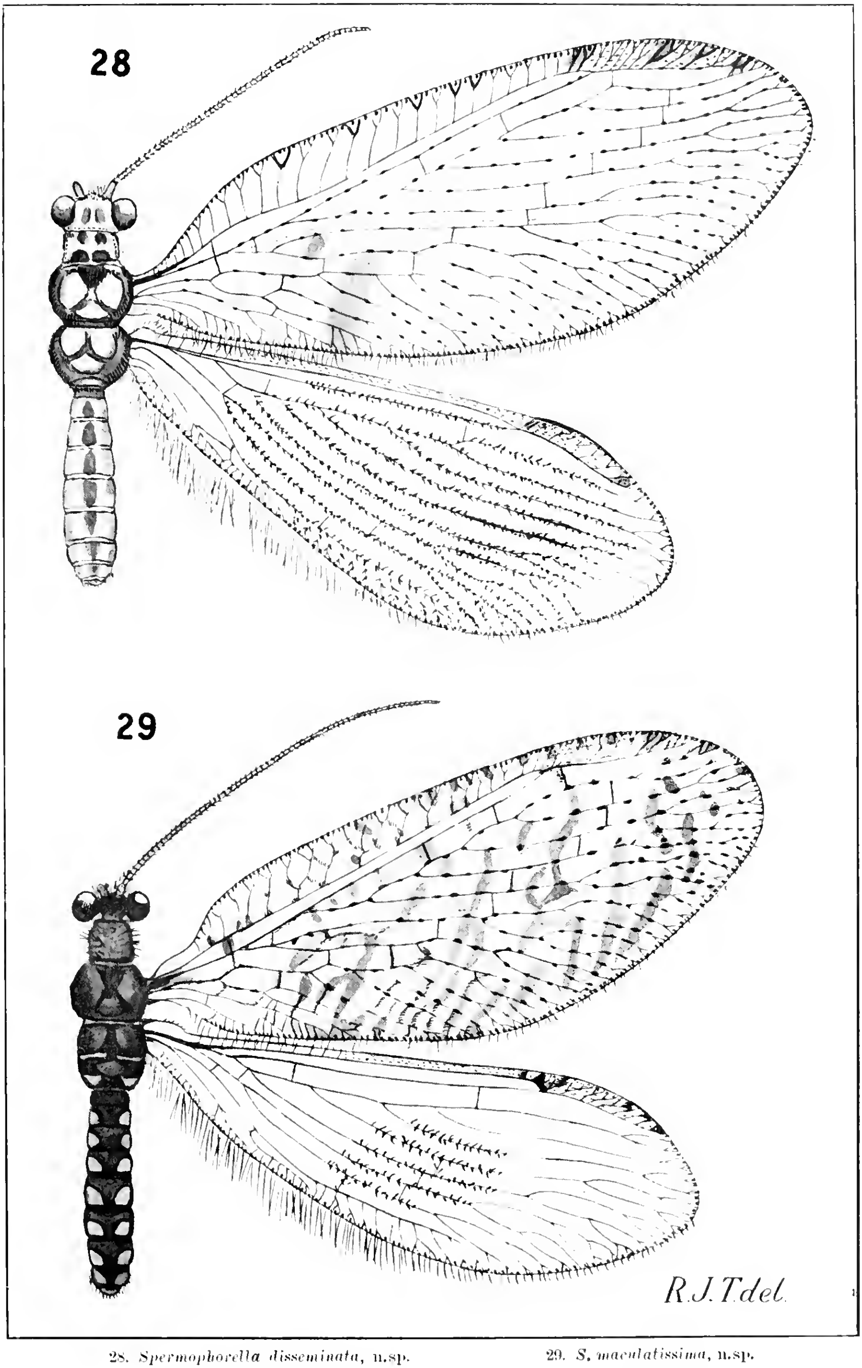
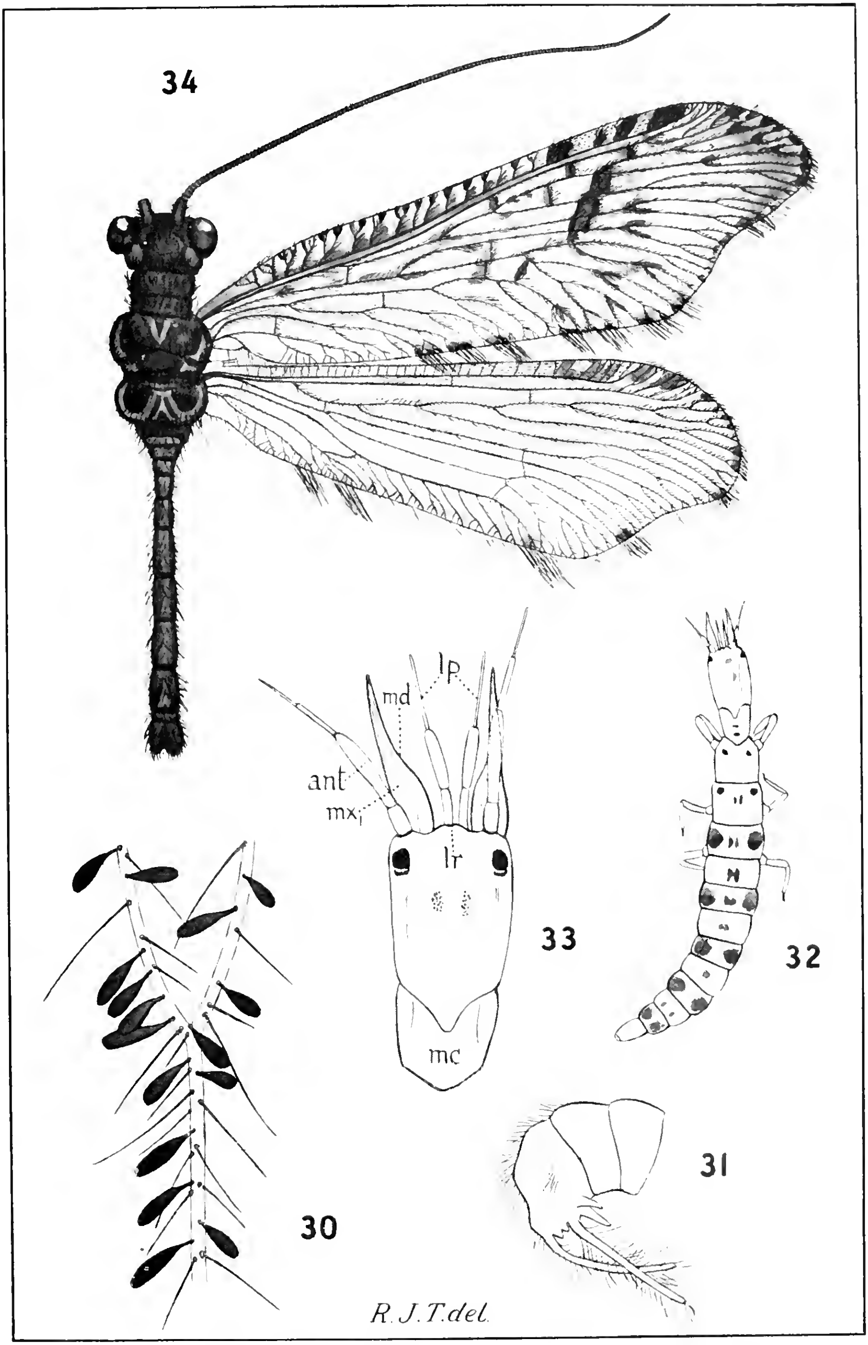


R.J.T. del

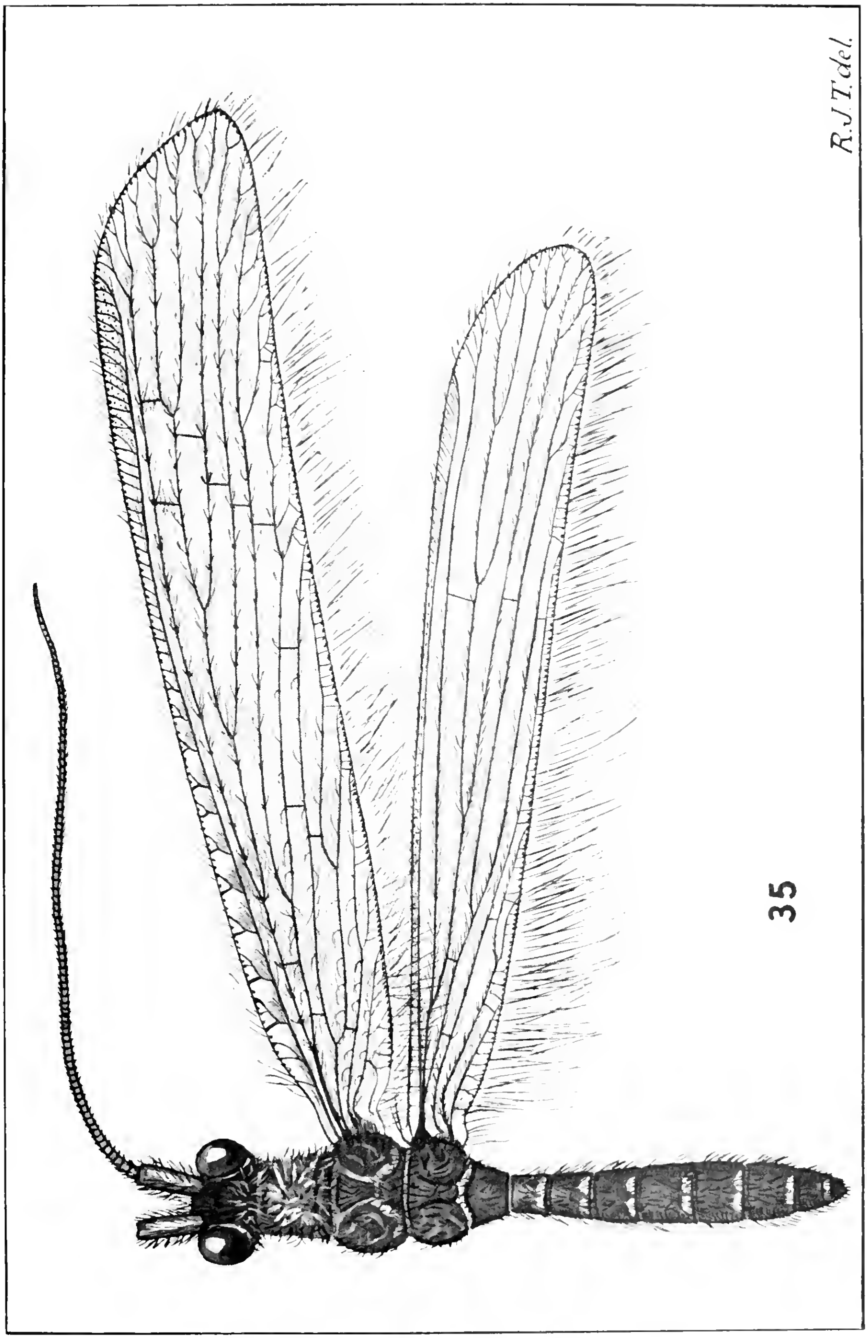
22-23. *Notiobiella* spp. 24-25. *Carobius* spp. 26-27. *Sisyra* spp.



28. *Spermophorella disseminata*, n.sp. 29. *S. maculatissima*, n.sp.



30-33. *Spermophorella disseminata*, n.sp. 34. *Trichoma gracilipenne*, n.sp.



35. *Stenobiella hirsutissima*, n.sp.

NOTES FROM THE BOTANIC GARDENS, SYDNEY.

Parthenogenesis in Aquatic Phanerogams.

By A. H. S. Lucas, M.A., B.Sc.

Elatine triandra Schrank [Elatinaceæ].

Plants of Elatine were brought under my notice by Mr. J. Brooks, who has charge of the freshwater aquaria at the Botanic Gardens, Sydney, in February last. The plants were growing submerged in a glass tank. They had grown vigorously for some months, with roots fixed in the soil at the bottom of the tank. Now, fragments were being detached freely, with rootlets growing out into the water. Mr. Brooks wanted to know—"Why are the plants breaking up in this way?"

Capsules in various stages of development were growing on the plants, but no flowers or flower-buds could be discovered. There were no signs of calyx-lobes, corolla, stamens, or even bracts. A few of these capsules contained apparently fully developed, brown seeds presenting the characteristic sculpturing.

Thinking that by modifying the conditions we might be able to induce normal flowering, I asked Mr. Brooks to plant some in earth in a flower-pot surrounded by water, and to expose these gradually to full sunlight.

A few days later, I discovered the plant growing in the Lily-Pond of the Centennial Park, Sydney. Large, floating fragments, up to 9 inches in length, with abundant roots, bore fruits similar to those formed in the tank. At one spot, the floor of the pond was dry, owing to the prolonged drought. Here the plant was growing on firm mud. The leaves were very much shorter, and the plant altogether smaller, than in the submerged form; but it bore numerous, small flowers, with 3, broad, green sepals; 3, spreading, red pistils; and 3 stamens I brought some home, with the surrounding mud, and planted them in an ordinary flower-pot. I did not place the pot in water, but kept it well watered, and exposed it to sunlight. The plants spread, and continued to flower well into the month of May. Mr. Brooks' plants naturally took longer to accustom themselves to the greater change of conditions, but, early in April, they were in full flower. Thus, the suggested experiment had succeeded. It was plain that the condition necessary to produce flowers was exposure of the growing plant to air and sunlight.

I then tried the converse experiment of placing some of the flowering plants in soil, at the bottom of a glass jar, which I filled with water. They did not resent the sudden change, but speedily grew out into the elongated form with longer leaves, and now (in May) are producing the capsules of the submerged form freely.

The capsules of the submerged form closely resemble those of the flowers, and, as no stamens are present, we have a clear case of parthenogenesis.

GLOSSOSTIGMA SPATHULATUM Arnott [SCROPHULARIACEÆ].

In another glass tank in the Gardens, were growing vigorously, a number of plants of a *Glossostigma*, which, while spreading freely in the water, never rose to the surface. The roots were fixed in the soil at the bottom. These plants also bore capsules of various stages, in none of which could I detect floral envelopes or stamens. The plants had been growing for years in the tank, but had never produced flowers.

We experimented with these in the same way as with *Elatine*. Mr. Brooks placed his in a flower-pot in ordinary mould, and placed the pot in a large saucer filled with water. In about a month, the plants had quite accommodated themselves to the new habitat, and produced a number of tiny, blue, perfect flowers. I arranged my plant in a diminutive, artificial pond I had made, so that part of the creeping stem was fixed by the roots to soil at the bottom, and the other part, unsevered, extended over a small bank of earth at the side of the pond. Thus, part of the plant was submerged, and part exposed to air and direct sunlight. It seemed at home at once, and both plants grew quickly. The submerged part spread far and wide over the bottom of the pond, and formed capsules; and, in less than a fortnight, the terrestrial portion had spread over the bank (which was now and again inundated, when the pond was filled up) and formed the fully developed, blue flowers. The number of stamens was constantly 2, and, therefore, our plant must be placed as *G. spathulatum* Arnott. The other Australian species, *G. Drummondii* Benth., and *G. elatinoides* Benth., have 4 stamens.

It was naturally a pleasure to have thus succeeded in obtaining the normal flowers. Curiously, perhaps the only passage in the severe pages of the Flora Australiensis which is "tinged with emotion," occurs in relation with this plant. Bentham quotes a remark of O'Shanesy, who gathered this species at Rockhampton, that "the numerous little blue flowers look like tiny drops of dew." (Vol. iv., p.502).

We had thus succeeded in inducing flowering in both plants. In a submerged state, they do not produce a distinct calyx, petals or stamens, but freely produce capsules. To test the fertility of the seeds produced in the submerged capsules of *Glossostigma*, I asked Mr. Brooks to sow the seeds. He placed some in soil exposed to air, and dropped some on to the soil at the bottom of a tank containing water. Both sets germinated, the latter with extreme freedom.

Thus habitual parthenogenesis is seen to occur in *Glossostigma spathulatum*—so long as the plant remains entirely submerged. When the plants obtain a footing on mud uncovered with water, they will develop flowers in the season, and produce ovules fertilised in the usual way. Incidentally, we may find a reasonable answer to Mr. Brooks' original question in regard to *Elatine*. The submerged plant tends to break up into fragments or sections in the season proper for flowering. These fragments float, and, as we saw in the pond in the Centennial Park, under natural conditions will have a chance of reaching a mooring ground, and thus of attaining to a terrestrial habitat convenient for flowering.

We have not yet experimented with the seeds of *Elatine*, produced in the submerged capsules, but the mature form of the seeds found makes it nearly certain that they are fertile.

These two instances of parthenogenesis in two, submerged plants of so widely separated families seem to lead up to the conception, that such a habit is likely to be very generally characteristic of plants growing under similar conditions. At all events, I have obtained considerable evidence in favour of this view. Further investigation is in progress, and I hope to bring further results before the Society, as opportunity occurs for experimentation.

Note on the Species of *Elatine*.

The plant experimented on is our common *Elatine*. The Southern species, in which Bentham includes the Australian form, has been labelled *E. minima* Fisch. & Meyer, (Linnæa, x., 73), *E. gratioloides* A. Cunn., (Ann. Nat. Hist., iii., 26, on New Zealand forms), *E. americana* Arnott, by von Mueller, and *E. americana* Arnott, var. *australiensis* by Bentham. *E. triandra* of Schrank was founded in 1791; and *E americana* Arnott, in 1814.

Bentham says "The Australian species is considered by some as endemic, by others as identical with an American one." And again, "This plant, whether a distinct species or a variety of the N. American one, ... is very variable." He then notes various forms, those under water with elongated stems, and very few with petals. There is no doubt that the external form varies at once, as we have seen, even in the same individual, when the conditions change.

Britton and Brown, in their "Illustrated Flora of the Northern United States," 1897, ii., p.437, give descriptions and figures of both *E. americana* and *E. triandra*. Of *E. americana* they state, "Sepals, petals, stamens, styles 2 (rarely 3 in terrestrial forms)"; and of *E. triandra*, "Sepals commonly 2; petals, stamens, and stigmas 3." In our specimens, the trimerism of all the parts is conspicuous. Thus Bentham writes (*l c.*), "The N. American plant" [*i.e.*, *E. americana*] "differs chiefly in the flowers almost constantly dimerous, which does not occur in any southern specimens I have examined."

Inasmuch as the number of stamens present in the flowers is one of the chief points relied on in the differentiation of species of *Elatine*, the discrepancy in the numbers seems fatal to the inclusion of our plants, with flowers almost constantly trimerous, in *E. americana*, with flowers almost constantly dimerous. On the other hand, there is much less reason for separating the Australian form from the older species, *E. triandra*.

I have been able to compare our plants with specimens, in the Herbarium of the Botanic Gardens, of *E. americana* and *E. triandra*, both from the United States. The facies of the Australian form agrees well enough with either—as do the dimensions of parts—but the predominance of trimerism of parts brings it into much closer relation with *E. triandra*. The differences appear to be too small to justify the creation of a new species, and I propose, therefore, to include our Elatine in *E. triandra* Schrank.

REVISION OF THE AMYCTERIDES.

Part v. *Molochtus* and *Cubicorrhynchus*.

By Eustace W. Ferguson, M.B., Ch.M.

Molochtus Pascoe.

Pascoe, Journ. Linn. Soc., xii., 1873, p.18.

Type of genus, *M. gagates* Pascoe.

Large, or very large species. Head convex, separated from rostrum by a transverse impression; supraorbital crests in the form either of a raised ridge, or of two, dentiform tubercles. Rostrum deeply concave above, the lateral margins strongly raised. Prothorax rotundate or subquadrate, with two, small spicules at anterior and two at posterior lateral angles, these more marked in the female; disc closely granulate. Elytra broad, flattened more or less on disc, strongly declivous; striate, the punctures often transverse, crossing interstices as a series of transverse wrinkles; interstices granulate or tuberculate. Undersurface in the male concave at base and granulate, at least at base of abdomen; in the female, convex, non-granulate. Anterior coxæ contiguous. Legs stout. Tarsi broad, with claw-joint flattened above, broad and parallel-sided in greater part of its length.

The position of *Molochtus*, in relation to other genera, has been variously regarded by different entomologists. In describing the genus, Pascoe referred it to the neighbourhood of *Talaurinus*, at the same time noting that the type-species (*M. gagates*) was not very unlike *Cubicorrhynchus maximus* Macl. Sloane (Trans. Roy. Soc. South Aust., 1893, p.232), in describing *Acantholophus granulatus*, stated that it seemed to him the affinities of *Molochtus* were more to *Cubicorrhynchus* and *Acantholophus*. Lea (Die Fauna Südwest-Australiens, ii., 1909, p.222) regarded *C. maximus* as certainly congeneric with *M. gagates*, and placed that species under *Cubicorrhynchus*, thus deleting the genus *Molochtus* altogether.

To my mind, though unquestionably related to *Cubicorrhynchus*, the genus *Molochtus*, as exemplified by *M. gagates*, seems worthy to be maintained as distinct. Also, I do not regard *C. maximus* as congeneric with *M. gagates*; it seems to me unquestionably congeneric with *Ac. granulatus* and *Ac. Blackburni* (= *Ac. simplex* Blackb.), though the position of these three species is open to question. The head, in all the species of *Molochtus*, is very strongly convex, the intercristal portion being feebly transversely concave, and separated from the rest of the head by a more or less distinct impression; the crests are represented either by a feebly elevated ridge, or by two, small, dentiform projections. The rostrum does not differ materially from that of *Ac.*(?) *maximus*, but is decidedly more excavate than that of *Cubicorrhynchus*, with the lateral margins more strongly raised. The prothorax is quadrate or rotundate, with two, small denticles in the region of the antero-lateral angle, and two more near the postero-lateral angle. In the male, these, or some of them, may be obsolete, but they are always well marked in the female, which also has the prothorax invariably narrower. The granules on the thorax are always more or less flattened, and closely set. The elytral sculpture is fairly characteristic, though that of *Ac.*(?) *maximus* is not unlike; the interstices are granulate, the granules being generally depressed, though, in some forms of *M. gagates*, they become conical tubercles posteriorly and laterally: they are separated by more or less distinct, transverse impressions, often extending over two or more interstices; the whole sculpture is often confused, and difficult to describe. The metasternum and ventral segments, at any rate the basal two, are strongly granulate, a feature which I have not noted in *Cubicorrhynchus*. The tarsal structure, however, is the feature to which I attach most importance in separating the two genera. In *Molochtus*, the fourth or clawjoint is broad, flattened above, with subparallel sides throughout the greater portion of its length, and not narrowed till quite close to the base. In *Acantholophus* and *Cubicorrhynchus*, the clawjoint is not flattened above, and is gradually widened from base to near apex.

Two species of *Molochtus* have, in past years, been described, *M. gagates* Pasc., (*l.c.*, p.18), and *M. tibialis* Sloane, (Trans. Roy. Soc. S. Aust., 1893, p.229); while I have recently named a third, *M. hercules*, (Trans. R. Soc. S. Aust., xxxix., p.74, 1915). To this number, I have now to add a fourth species, *M. rotundicollis*.

Geographical Distribution.—The species are all inhabitants of the western half of the continent, stretching from west of Lake Eyre in Central Australia to the seacoast of Western Australia; the genus appears to be absent from the south-west corner. The range of *M. tibialis* and *M. hercules* appears to be almost co-extensive with that of the genus. *M. gagates* is known principally from the neighbourhood of Geraldton and the Murchison River, though inland, at Cue, its place is taken by *M. tibialis*; I have also a specimen labelled Central Australia. *M. rotundicollis* occurs on the Ashburton and Gascoyne Rivers.

Table of Species.

1(4). Supraorbital crests represented by a slight ridge.
2(3). Anterior tibiæ not emarginate in the male............. *M. gagates* Pasc.
3(2). Anterior tibiæ with a subapical emargination in the male........ .... *M. tibialis* Sl.
4(1). Supraorbital crests bidentate.
5(6). Prothorax subquadrate, size large........................ *M. hercules* Ferg.
6(5). Prothorax rotundate, size comparatively small... *M. rotundicollis*, n.sp.

Molochtus gagates Pasc.

Pascoe, Journ. Linn. Soc, xii., 1873, p.18, Pl. ii., fig.9.

A recent visit to the British Museum has enabled me to examine the type, a female, of this species, and to confirm its identity with the species so named in Australian collections It is closely allied to *M. tibialis* Sloane, but may be readily distinguished by the shorter and stouter legs, the difference being more marked in the male; this sex further differs from the male of *M. tibialis* in lacking the subapical emargination of the front tibiæ.

There are, in my collection, two forms, which I regard as belonging to this species, differing in the elytral sculpture, one form having the elytral tubercles distinctly larger than in the other, which is the typical form.

I have specimens of the typical form from Champion Bay and Mullewa; and of the more strongly tuberculate form from Onslow, Murchison River, and Central Australia

Molochtus tibialis Sloane.

Sloane, Trans. Roy. Soc. S. Aust., xvi., 1893, p.229; Lea, *ibid.*, 1903, p.113.

In his description, Sloane has given a number of characters differentiating *M. tibialis* from *M. gagates* Pasc.; Lea, however, has pointed out that these differences will not hold, and, after examination of a number of specimens, I find that they will not, without modification. The differences in the head, rostrum, and prothorax do not appear to be constant; and I do not think that they can be made much use of in separating the species. The elytral sculpture varies considerably; some of the specimens, including the types, have the sculpture flatter and more obliterate than in others, which approach closely to the less strongly sculptured form of *M. gagates* (see under that species); but I have never seen specimens of *M. tibialis* with sculpture approaching that of the more strongly tuberculate form of *M. gagates*. There is, however, another difference which will enable the males of the two species to be readily determined, and that is the leg-structure. In *M. tibialis*, the tibiæ are longer, and the anterior tibia has a subapical emargination or notch on the undersurface. The females of *M. tibialis* have also longer tibiæ than the females of *M. gagates*, but the difference is only really apparent when specimens of the two species are compared together.

The specimens of *M. tibialis* in my possession include, in all probability, the types; the female type is marked as such, but there is also a male from Fraser Range (the type-locality) which agrees exactly with Sloane's description and measurements, whereas none of the South Australian Museum specimens agree exectly with Sloane's measurements.

The species has a wide range, from Central Australia to the coast-board of Western Australia in the neighbourhood (at least) of the Ashburton River.

Molochtus hercules Ferg.

Trans. R. Soc. S. Aust., xxxix, p.74, 1915.

Hab.—W.A.: Kookynie, Kalgoorlie, Cue.—Central Australia: Hermannsburg.

Molochtus rotundicollis, n.sp.

♂. Size comparatively small; elongate-ovate. Black; without clothing; setæ light brown, for the most part absent from the upper surface.

Head separated from rostrum above by a deep V-shaped impression, becoming indistinct towards the sides; strongly convex, the intercristal portion separated from the rest of the head by a transverse impression; the extreme posterior portion finely transversely strigulose, elsewhere finely and irregularly reticulate, intercristal puncto-granulate; supraorbital crests composed of two, small, dentiform tubercles, the posterior slightly the larger, conjoined at base. Rostrum widely and deeply concave above; the lateral margins raised, curved inwards and broadened at base; convex in profile, anterior end bluntly acuminate, less so than in *M. hercules*; upper surface rather coarsely punctate. Prothorax (5 x 6 mm.) broad, strongly rounded on sides, the anterior lateral denticles hardly traceable, the postero-lateral ones small, but evident; anterior margin without ocular lobes; disc widely depressed in centre, with a feeble, deeper, median impression traceable anteriorly; closely set with flattened granules, separated by fine, impressed lines arranged in a concentric manner around each half of the disc, the central impressions on each side running transversely; sides granulate above, the granules becoming smaller and fewer towards the coxæ; with impressed lines arranged concentrically with those on disc. Elytra (10 x 7 mm.) broad, flattened on disc, sides rather strongly rounded at base, more gradually to apex; apex not acuminate; base not emarginate, humeral angles rounded; striæ narrow, punctures small, the ridges between not granulate; interstices not raised, with small, obscure granules more definite on declivity and towards sides. Undersurface feebly concave over metasternum and base of abdomen, all the segments granulate, the granules largest on the second ventral segment, smallest on the metasternum, on the fifth interstice coalescing near apex to form a series of transverse strigæ. Tibiæ simple, with a row of granules on undersurface; tarsi and claw-joints as in the genus.

♀. Differs from the male in being more ovate. Head more obsoletely punctate; rostrum with lateral margins less widened at base. Prothorax (4 × 5 mm.) narrower, not widely dilatate, less strongly rounded on sides; disc not so widely depressed, but with a deeper, median, impressed line; granules less flattened, with the concentric impressions less definite; lateral margins with denticles more strongly developed. Elytra (11 × 7 mm.) rather longer than in the male, apex not acuminate, base with shoulders rounded; sculpture as in the male. Undersurface more convex, basal segments slightly flattened, not granulate, but with a somewhat shagreened appearance; apical segment rather feebly, transversely rugulose. *Dimensions:* ♂, 16 × 7 mm; ♀, 16 × 7 mm.

Hab.—W.A.: Onslow, Ashburton River, Carnarvon (ex C. French).

Type in Coll. Ferguson; cotypes in National Museum, Melbourne.

This species is allied to *M. hercules* Ferg., but differs in the strongly rounded prothorax, in the non-acuminate elytra, with the basal angles rounded, and in the more granulate undersurface, as well as in its smaller size.

A second male before me has the prothorax less strongly dilatate; the head is also more obsoletely punctured.

Cubicorrhynchus Lacordaire.

Lacordaire, Gen. Coleopt., vi., p.314.

Size small to moderate, never very large. Head convex, separated from rostrum by a transverse impression: supraocular crests present, simple. Rostrum short, wide, flat or feebly depressed above, the lateral margins not strongly raised. Scape long; second joint of funicle generally longer than first. Prothorax rounded or dentate at sides; subapical and basal transverse impressions well marked, the latter often hidden from above; disc granulate. Elytra suboval, basal angles generally strongly rounded; disc regularly striate-punctate; interstices granulate, occasionally showing extraordinary sexual characters. Undersurface generally depressed at base of abdomen in the male, convex in the female. Femora and tibiæ showing, in many species, marked sexual characters; tarsi with clawjoint not flattened as in *Molochtus*.

The genus *Cubicorrhynchus* was described by Lacordaire for a group of species of which he knew of no described example, although he alluded to several known under MS.-names, as probably belonging to the genus. His generic diagnosis leaves it quite clear, however, to what group of species he intended the name to belong; and Macleay has rightly claimed the name for those species which now bear it.

This genus, and *Molochtus*, are the first of a section of the Amycterides which seems, to me, distinct from the Psalidura-Talaurinus-Sclerorinus complex; and which contains two large genera, *Cubicorrhynchus* and *Acantholophus*, as well as a number of smaller ones. I do not propose at present to define the limits and characters of the different sections of the family; as such will require much further study. I merely indicate here the existence of these sections, in passing from one to another.

The essential characters of *Cubicorrhynchus*, as distinguishing it from its immediate allies, lie, to my mind, in the rostral structure. In *Cubicorrhynchus*, the rostrum is short and broad, and the upper surface is at most feebly concave, the lateral margins not being raised; although, in profile, they are more or or less convex. The rostrum is separated from the head, above, by a transverse, linear impression; in a few species, this line turns backwards along the inner sides of the crests. The presence of supraorbital crests is constant, although these vary somewhat in direction and development. There are also two small granules present in most species, although in some they are absent; and they are present in a few species at present referred to *Acantholophus*. The prothorax varies in different species; in the most typical examples of the genus, the prothorax is strongly and evenly rounded on the sides, whereas in others it is strongly dentate, this form reaching its highest development in *C. spinicollis*, which has been regarded by some authorities as being generically distinct. With this, I do not agree, as the transition between the various species of *Cubicorrhynchus* is too gradual to admit of a violent separation of this species: moreover, in the females of the species with rounder prothorax, the sides are distinctly ridged as in the dentate species. The presence of a subapical and a basal, transverse impression is constant, while the median line is, as a rule, impressed. The elytra are, as a rule, subovate, with the humeral angles strongly rounded, and strongly declivous posteriorly. The disc is regularly striate, the punctures open, and rather indefinite, never very large: the interstices are, as a rule, granulate, though the granules may be obsolescent on the disc; they are situate rather to one side of the interstice, in some cases simulating intrastrial granules. Some of the species, in addition, present extraordinary features, in the development of spines or tubercles. The undersurface is, in the male, gently concave over the metasternum and basal, ventral segments, whereas, in the female, the undersurface is convex. The front coxæ are, in a few species, separated; in the others, they are contiguous. The legs, and in particular the posterior tibiæ, show extraordinary features of specific importance. These are present in the male only, and it is impossible, in many cases, to distinguish the females from each other, although the males may be readily identified.

Of the Amycterides described previously to the institution of the genus, only three can be referred to it.

C. Bohemani Bohem., (Schönh., Gen. Curc., vii. (1), 1843) is a well known Western Australian species; while *C. crenicollis* Waterh., (Trans. Ent. Soc., 1854), and *C. Dohrni* Waterh., (*l.c.*) are also Western Australian species, and readily identified from their descriptions.

The name *C. morosus* has been in use for a species of *Cubicorrhynchus*, but incorrectly so. I have seen the type of *Amycterus morosus*, and it is a Sclerorinus; although the species which

Boheman and later entomologists identified as *A. morosus* Boisd., certainly is a Cubicorrhynchus.

Macleay (Trans. Ent. Soc. N. S. Wales, 1865) added five new species to the genus. Of these, I would exclude *C. maximus* from the genus, and refer it provisionally to *Acantholophus*; while *C. sepidioides* is regarded by Lea as a synonym of *C. calcaratus*. The other species are distinct, though *C. piceo-setosus* should possibly be regarded as a variety only of *C. maculatus*. Subsequently, Macleay (*op. cit.*, 1866) described three additional species, *C. angularis*, *C. spinicollis*, and *C. eximius*. The first of these is a synonym of *C. Bohemani*, while *C. eximius* has been referred by Lea to *Acantholophus*.

Pascoe* described two species, *C. cichlodes* and *C. sterilis*. Sloane has made the former of these the type of a new genus, *Notonophes*.

Blackburn was the next entomologist to add any further species to the genus; the descriptions of these are distributed over a number of papers. *C. Mussoni*† is a very distinct species; as is also *C. taurus*.‡ *C. dilataticeps*|| is not a species of *Cubicorrhynchus*, and I have already referred it to *Notonophes*. *C. tortipes*§ is a synonym of *C. Bohemani* Bohem. *Hyborrhynchus aurigena*¶ is a species of *Cubicorrhynchus*, and is closely allied to *C. spinicollis* Macl.

Sloane** described two species, *C. occultus* and *C. modestus*. I have seen the types of these, and they are distinct species; unfortunately the type of *C. modestus* is a female.

Lea has added three species to the genus, besides commenting on the types of a number of Macleay's species. *C valgus*†† is a very curious species, but may prove to be the male of *C. modestus*;

* Journ. Linn. Soc., xii., 1873.

† Proc. Linn. Soc. N. S. Wales, 1892, p.124.

‡ Trans. R. Soc. S. Aust., 1895, p.220.

|| Report Horn Exped., 1896, p.293.

§ Trans. R. Soc. S. Aust., 1897, p.96.

¶ *L.c.*, 1899, p.89.

** Trans. R. Soc. S. Aust., 1893.

†† Die Fauna Südwest-Australiens, p.221.

*C. maculicollis** is closely allied to *C. maculatus* Macl.; while *C. globicollis*† is a thoroughly distinct species.

I have recently described six new species, *C. strigicollis*, *C. quadraticollis*, *C. substrigosus*, *C. curvipes*, *C. aureomaculatus*, and *C. rectipes*;‡ *C. quadraticollis* now proves, however, to be synonymous with *C. sterilis* Pasc.

In the present paper, seven new species are described, which, with the elimination of synonyms and species removed to other genera, make a total of twenty-eight species in the genus.

Geographical Distribution.—The genus is almost universally distributed in Australia, but is unrecorded from Tasmania. I have never met with it in the Sydney district or on the Blue Mountains; it seems absent from the entire area of the Hawkesbury Sandstone formation. On the western slopes and inland plains, specimens of one or more species of Cubicorrhynchus are plentiful, and are, indeed, very characteristic of the inland areas. In South and Western Australia, it seems equally common. The genus has not been recorded, however, from North Australia or North Queensland, though it probably occurs in the inland portions, but not in the jungle-areas. The dentate forms are almost exclusively western.

Table of Species.

1(8). Anterior coxæ separated.
2(5). Anterior femora bent almost at right angles.
3(4). Third elytral interstice with a large, backwardly directed spine at declivity; fifth interstice with a row of outwardly directed, spinose tubercles.. *C. Dohrni* Waterh.
4(3). Third interstice without such a tubercle; fifth interstice with a row of erect tubercles, extending down declivity .... *C. Bohemani* Bohem.
5(2). Anterior femora strongly, but more evenly curved.
6(7). Size moderately large; head granulate; posterior tibiæ less strongly bent than in *C. valgus*.............................. *C. occultus* Sl.
7(6). Size small; head not granulate; posterior tibiæ with lower end bent forwards, almost at right angles..................... *C. valgus* Lea.
8(1). Anterior coxæ contiguous.

* Deutsch. Ent. Zeitschr., 1910, p.163.

† Mém. Soc. Ent. Belgique, 1910, p.84.

‡ Trans. R. Soc. S. Aust., xxxix., pp.76-83, 1915.

9(22). Prothorax rounded at the sides.
10(15). Prothoracic granules more or less closely set.
11(12). Posterior tibiæ with more or less pronounced sexual characters.
A. With a strong subapical spine .... *C. calcaratus* Macl.
B. With a strong subtriangular incrassation about the middle .... *C. taurus* Blackb.
C. Short, almost straight, with three rows of large granules, the outermost row most conspicuous..........*C. serratipes*, n.sp.
D. Longer, with a moderately strong, antero-posterior curvature, and also incurved; granules strong, but less conspicuous.
Setæ light yellowish-brown.................. { *C. maculatus* Macl.; *C. maculicollis* Lea.
Setæ dark.. *C. piceosetosus* Macl.
12(11). Posterior tibiæ in the male not markedly differing from the female.
13(14). Size moderately small (11 mm.); supraorbital crests very small; base of elytra not emarginate................ *C. sordidus*, n.sp.
14(13). Size smaller (8 mm.); base of elytra feebly emarginate......... .... *C. Illidgei*, n.sp.
15(10). Prothorax with granules more or less dispersed.
16(17). Prothorax non-strigose.................................... *C. globicollis* Lea.
17(16). Prothorax strigose.
18(21). Strigosity pronounced, the granules very small.
19(20). Prothorax strongly rounded on the sides......... *C. strigicollis* Ferg.
20(19). Prothorax less strongly rounded, with a distinct impression at middle of lateral margin................................ *C. sterilis* Pasc.
21(18). Strigosity less marked, obscured by granules... *C. substrigosus* Ferg.
22(9). Lateral margins of prothorax dentate, or with at least a granulate ridge in posterior portion.
23(40). Supraorbital crests not as in *C. auriculatus*.
24(37). Lateral margins strongly dentate.
25(30). Dentation in the form of two spinose tubercles anteriorly, and a granulate ridge in posterior half.
26(29). Prothoracic granules small; obscure; setæ small.
27(28). Small species; elytra suboval........................ *C. spinicollis* Macl.
28(27). Somewhat larger, more parallel-sided............ *C. aurigena* Blackb.
29(26). Prothoracic granules notably larger, bearing long setæ......... .... *C. setosus*, n.sp.
30(25). Lateral margins more irregularly dentate.
31(34). Elytral granules large, nitid.
32(33). Posterior tibiæ gently, but distinctly, curved..................... .... *C. aureomaculatus* Ferg.

33(32). Posterior tibiæ straight .... *C. rectipes* Ferg.
34(31). Elytral granules more or less obscured by clothing.
35(36). Posterior tibiæ strongly curved......................... *C. curvipes* Ferg.
36(35). Posterior tibiæ much less strongly curved...... *C. crenicollis* Waterh.
37(24). Lateral margins not strongly dentate.
38(39). With a granulate ridge posteriorly, and two minute spicules anteriorly; granules on disc remotely separated.... *C. sparsus*, n.sp.
39(38). With a posterior, granulate ridge only; granules on disc closely set... *C. minor*, n.sp.
40(23). Supraorbital crests laid back, with the inner surface directed forwards.
41(42). Granules on prothorax distinct..................... *C. auriculatus*, n.sp.
42(41). Granules on prothorax very small, concealed by clothing, almost obsolescent....................................... *C. Mussoni* Blackb.

Notes on the Table.

The table has, of necessity, been drawn up from males only, consequently *C. modestus* has been omitted.

C. maculicollis Lea, may be distinct from *C. maculatus* Macl., but I am not prepared to tabulate the differences.

CUBICORRHYNCHUS BOHEMANI Bohem.

Boheman, Schönh., Gen. Curc. vii., (1), 1843, p.83: *C. angularis* Macl., Trans. Ent. Soc. N. S. Wales, 1866, p.331; *C. tortipes* Blackb., Trans. Roy. Soc. S. Aust., 1897, p.96.

♂. Size large. Head with scattered granules; supraorbital crests small, little projecting. Prothorax (4·5 × 5 mm.) strongly rounded on sides; median line impressed, carinate in depression; closely set with regular, rounded granules. Elytra (9·5 × 6 mm.) with interstices granulate; on the third and fourth, the granules more strongly raised and subacute posteriorly; fifth interstice with a row of strong tuberculiform granules, largest at edge of declivity and extending halfway down declivity. Anterior coxæ separated; anterior femora with a narrow basal pedicle, then bent forwards almost at right angles; anterior and posterior tibiæ strongly falciform.

♀. More ovate; third and fifth elytral interstices with granules slightly more conspicuous; ventral surface convex; legs more feebly curved. *Dimensions:* ♂, 14 × 6 mm.: ♀, 16 × 7·5 mm.

Hab. – Western Australia: King George Sound, Swan River, Kellerberrin, Cue.

The male of this well known species can be readily recognised by the projection of the fifth interstice. The bent front femora are also present in *C. Dohrni*; in the other species, the anterior femora are more evenly and less strongly curved. *C. Dohrni* differs, *inter alia*, in the very different elytral sculpture. *C. occultus* Sloane, is the species closest in general appearance, but has the fifth interstice much less strongly granulate, and the anterior femora and the tibiæ less strongly curved. *C. valgus* and *C. modestus* are considerably smaller species.

The female is distinguished from the female of *C. Dohrni* by the granulate head, and by the absence of the projections at the declivity; from the female of *C. occultus*, the present species differs principally in its larger size.

CUBICORRHYNCHUS DOHRNI Waterh.

G. R. Waterhouse, Trans. Ent. Soc., 1854, p.5.

♂. Large. Head convex, slightly depressed in front, with two small granules on forehead, lightly strigulose; supraorbital crests short, very little prominent. Rostrum little excavate above; external margins slightly raised. Prothorax (4·5 × 5·5 mm.) rotundate, with a small spicule anterior to middle, and one at postero-lateral angle; moderately closely set with small, round, slightly umbilicate, discrete granules; sides only granulate above. Elytra (10 × 7 mm.) suboval, the upper surface almost flat from side to side, vertically declivous behind; base not emarginate; disc with rows of small punctures, the striæ rather narrow; interstices broad, with small granules, third with slightly more conspicuous granules, the last two or three larger, and the last acutely conical; with a large, backwardly-projecting tubercle, with the apex upturned, extending over the first three interstices, and situated on the edge of the declivity; fifth interstice with a row of outwardly-projecting tubercles, smallest near base, becoming progressively larger, acutely conical and extending to the edge of the declivity, thence turning inwards across fourth interstice; seventh interstice with a row of three spinose tubercles at base, followed by a row of small granules. Prosternum with an obtuse tubercle in front of coxæ: ventral segments sub-nitid, with fine subobsolete punctures. Anterior coxæ separated: anterior femora strongly bent; anterior tibiæ moderately strongly falciform, posterior tibiæ strongly curved forwards in posterior third, intermediate tibiæ with a moderately definite, subapical notch.

♀. Elytra more convex; third interstice with the granules slightly more conspicuous towards the declivity, curved inwards and ending in a short, acute spine; fifth interstice with the granules somewhat larger and more conspicuous than on the other interstices, and larger posteriorly; seventh with a row of three small tubercles at shoulder; prosternal tubercles smaller than in the male; abdomen convex, with scattered punctures; anterior coxæ separated; anterior tibiæ almost straight: intermediate tibiæ not notched; posterior tibiæ less strongly curved than in the male. *Dimensions:* ♂, 17 × 7 mm.; ♀, 16 × 7 mm.

Hab.—Western Australia: Perth.

I have given a full description of the male, as, so far as I know, only the original description, which appears to have been based on a female, has been published. I know of no other species with which this one can be compared. The spines, which are outwardly-projecting, are very different from the tuberculiform granules on *C. Bohemani*, and do not extend down the declivity, but turn inwards across the base to the large tubercle at the end of the third interstice. The fourth interstice thus bears a spine. In specimens from Beverley, W.A., the spines are smaller near the base, and the spine on the fourth is represented by a small acute granule, the row of spines thus appearing interrupted. The tubercles at the base of the seventh interstice are also smaller. The female also differs in having the apical spine hardly larger than the other granules. Possibly the form is distinct, but I regard it as a variety only, as the species seems to vary a good deal in the size of the spines.

A specimen marked "*A. Dohrni* Wat. var. B" was sent to me for examination by Mr. Blair, of the British Museum. It was a large, obese female, with the tubercles larger than usual.

CUBICORRHYNCHUS OCCULTUS Sloane.

Sloane, Trans. Roy. Soc. S. Aust., 1893, p.232.

Hab.—Central Australia: Fraser Range.—W.A.: Kalgoorlie, Coolgardie, Ankertell.

This species is most nearly allied to *C. Bohemani*, from which species it differs in its smaller size, much less strongly granulate fifth interstice, and less strongly curved anterior femora and tibiæ (these structures, however, strongly curved compared with the majority of other species).

CUBICORRHYNCHUS MODESTUS Sloane.

Sloane, *loc. cit.*, p.233.

Hab.—Central Australia: Barrow Range.

I have examined the type of this species; it is very close to the female of *C. valgus* Lea, but, until a male from the type-locality can be procured, it is impossible to identify the two species as one.

CUBICORRHYNCHUS VALGUS Lea.

Lea, Die Fauna Südwest-Australiens (Curculionidæ), p.221.

Hab.—W.A.: Bardoc, Mullewa, Ankertell, Onslow.

CUBICORRHYNCHUS CALCARATUS Macleay.

Macleay, Trans. Ent. Soc. N. S. Wales, 1865, p.294. *C. sepidioides* Macl., *l.c.*, p.294; Lea, Deutsch. Ent. Zeitschr., 1910, p.167.

♂. Size moderately large. Clothing dense, yellowish-brown; prothorax vittate towards sides with white, and with a few white spots on disc; elytra maculate with white.

Head convex; forehead longitudinally impressed in the middle, with two small granules above; supraorbital crests prominent, acute. Rostrum shallowly concave above, lateral margin rather strongly convex in profile. Prothorax (4 x 5 mm.) strongly rounded on the sides; subapical impression conspicuous, median line impressed, with a fine carina along middle; set with small, discrete granules; sides granulate above. Elytra (9 x 6 mm.) suboval, somewhat flattened on disc; striæ moderately deep; interstices flattened basally, without evident granules in anterior portion; granules larger and more conspicuous on the posterior portions of the third and fourth interstices, on the fourth forming a moderately strong projection on either side of the elytra; fifth, sixth, and seventh interstices with rows of smaller but evident granules, on the fifth more conspicuous near shoulder. Undersurface depressed at base; with small. scattered punctures, the apical segments more coarsely punctate. Anterior coxæ contiguous; anterior tibiæ moderately strongly curved; posterior tibiæ strongly curved at apex, with a strong projecting spine on undersurface, above apex.

♀. More ovate; prothorax feebly dentate at sides, with a small tooth anterior to subapical constriction; elytra without prominent granules on the fourth interstice; anterior tibiæ very feebly curved, posterior straight, without spur. *Dimensions*: ♂. 15 × 6 mm.

Hab.—S.A.: Port Lincoln, Mt. Lofty, Blanchetown, Terowie, Ardrossan, Gladstone, Moonta, Port Pirie.

Mr. Lea has identified *C. sepidioides* as the female of *C. calcaratus*; Sir W. Macleay, however, gave the habitat of *C sepidioides* as the Murrumbidgee, which suggests that it is rather a synonym of *C. maculatus*; personally, I agree with Mr. Lea's identification, as the type is much more strongly dentate than the female of *C. maculatus*; probably the locality given is wrong. I think the name *sepidioides* should be dropped, although it is unfortunate that the species was described before *C. calcaratus*, but on the same page.

The male of *C. calcaratus* may be readily recognised by the spur on the posterior tibiæ. The granules on the fourth interstice give the insect somewhat the appearance of a smaller edition of *C. Bohemani*, though, in that species, the granules are largest on the fifth interstice.

A male from Tarcoola differs from the usual type, in having the sides of the prothorax dentate anterior to the middle, as in the female; the prothorax is also more closely granulate.

Another male has the prothoracic granules almost obliterated. A third male has the posterior tibiæ less strongly curved, but with the spur distinct.

Cubicorrhynchus taurus Blackb.

Blackburn, Trans. R. Soc. S. Aust., 1895, p.220.

The type of this species was from Lake Callabonna, in the north-east of South Australia, but the species has a wide distribution. I have seen specimens from Victoria, New South Wales, and Queensland, as well as from South Australia. The species, however, is essentially an inland one, not having been recorded as far east as the inland slopes of the eastern tablelands.

There exists a good deal of difference between the specimens from the limits of this wide range, and, quite possibly, more than one species has been included by me under this name. All the forms, however, possess the curious hump-like thickening on the undersurface of the posterior tibiæ, which I regard as the essential feature of the species.

The Victorian and southern South Australian specimens have a more rounded prothorax than the northern forms, the granules being also less conspicuous; the elytral granules are almost absent on the inner and anterior portion of the elytra. In the specimens from Longreach, Queensland, the elytral granules are quite distinct, and the whole insect is smaller. The New South Wales specimens before me are small, and agree with Queensland examples.

Hab.—S.A.: Lake Callabonna, Oodnadatta, Blanchetown, Adelaide, Lucindale.—Vic.: Lillium, Dimboola.—N.S.W.: Narromine, Coolebah, Moree.—Q.: Longreach, Cunnamulla.

Cubicorrhynchus maculatus Macl.

Macleay, *loc. cit.*, p.295; Lea, Deutsch. Ent. Zeitschr., 1910, p.164; var. *brevipes* Lea, *l.c.*, p.165.

♂ Size moderately large. Clothing dense; on prothorax brownish, with a few small whitish spots: elytra mainly clothed with greyish squames, with interrupted darker marks along the alternate interstices; sides and legs thickly clothed with white; setæ yellowish-brown.

Head convex, slightly flattened in front, separated from rostrum by a distinct, transverse impression; forehead with two small granules above; supraocular crests conspicuous, upright, projecting forwards and upwards. Rostrum short: upper surface very feebly concave, median line not sulcate; lateral margins not raised. Prothorax (4 × 5 mm.) widely rounded on the sides, disc feebly convex from side to side; subapical constriction well-marked; median line distinctly impressed, carinate in middle; closely set with rather small, rounded granules; sides granulate above. Elytra (9 × 6 mm.) suboval, humeral angles rounded; striæ moderately deep, punctures slightly transverse; interstices with feeble granules, concealed by clothing, on the central interstices, with more distinct granules towards the sides. Undersurface depressed at base, coarsely punctate, especially on second and fifth interstices. Anterior coxæ contiguous; anterior tibiæ moderately strongly sinuate; posterior tibiæ with an antero-posterior curvature most marked in upper portion, and with an inward curvature most marked in lower portion; the undersurface of the posterior tibiæ distinctly thickened, all the tibiæ granulate beneath.

♀. Smaller than male, with narrower prothorax, with lateral margins ridged; undersurface convex; tibiæ simple. *Dimensions:* ♂, 13 × 6 mm.

Hab.—New South Wales, Victoria, South Australia.

Type (♀) in Macleay Museum.

The above description was drawn up from a male from Mulwala (Riverina) in my own collection. With it, I group the majority of New South Wales specimens in my collection; but it is quite possible that some of these will prove worthy of specific rank. The chief variation lies in the size of the elytral granules, and in the degree of curvature of the posterior tibiæ. The variety called *brevipes* Lea, is included amongst the number, also the species frequently identified as *C. morosus* Boisd. Much more study and dissection will be necessary before the question of specific distinctness of some of the forms can be regarded as settled.

CUBICORRHYNCHUS MACULICOLLIS Lea.

Lea, Deutsch. Ent. Zeitschr., 1910, p.163.

I have examined the type of this species, but can find no valid feature to differentiate the species from *C. maculatus*. Lea only gives differences in the clothing, which will not hold when compared with unabraded specimens of *C. maculatus*. At the same time, I am unwilling to sink Lea's species out of hand, particularly as I am not prepared to say that, under *C. maculatus*, I have not included more than one species.

CUBICORRHYNCHUS PICEOSETOSUS Macl.

Macleay, *loc. cit.*, p.295.

The type of this species is a female, and evidently closely allied to *C. maculatus*, differing mainly in the darker setæ. I have specimens of species with dark setæ from several places in New South Wales, including Culcairn, Mudgee, Bangalore, and Quirindi. These present certain differences, *inter se*, and may possibly represent more than one species. The Quirindi specimens approach nearest to the type of *C. piceosetosus*, the principal difference being the less strongly granulate elytra. In *C. piceosetosus*, the lines of setigerous granules are more conspicuous than in any of the specimens before me. In the males of all the forms, the posterior tibiæ are more or less strongly curved much as in *C. maculatus*, and it is possible that *C. piceosetosus* should be regarded as a variety only of *C. maculatus*. Until a male from the type-locality (Yass) can be procured, I prefer to treat *C. piceosetosus* as a valid species,

CUBICORRHYNCHUS SERRATIPES, n.sp.

♂. Size moderate. Black; densely clothed with light brown squamosity; prothorax trivittate with white, and with a few white spots; elytra albomaculate; white predominating on sides, sternal segments, and legs; setæ light.

Head convex, somewhat depressed in front, separated from rostrum by a transverse, linear impression; with a few, small, scattered granules; crests moderately strong, rather obtuse. Rostrum short and wide; upper surface moderately concave.

Scape rather slender, moderately strongly incrassate at apex Prothorax (3 × 4 mm.) rotundate, evenly rounded on the sides: disc feebly convex, the subapical impression distinct at sides, less so in the middle: median line distinctly, but not deeply, impressed, with traces of a median carina: moderately closely set with small, discrete, rounded, nitid granules: sides granulate above. Elytra (8 × 5 mm.) suboval, humeral angles rounded, base not emarginate; disc flattened; striæ little impressed, punctures small; interstices not raised, granules small, hardly traceable in the middle, larger and more distinct towards the apex and sides. Lateral interstices without evident granules [Abdomen wanting]. Anterior coxæ contiguous: anterior tibiæ almost straight, with rather coarse granules along undersurface: intermediate tibiæ straight, granulate beneath; posterior tibiæ rather short, practically straight, coarsely granulate beneath: with a conspicuous row of nitid granules along outer edge of undersurface. *Dimensions:* ♂, 12 × 5 mm

Hab.—W.A.: Kookynie (C. French).

Type in Coll. Ferguson.

Although there is but a single specimen, with the abdomen missing, before me, I have described the species, as it is a thoroughly distinct one. The granules on the posterior tibiæ are larger than in any other species I know: they appear to be arranged mainly in three rows, one in the centre, one along the outer, and one along the inner edge of the undersurface: the outer row is the most conspicuous, and can best be seen when viewed from behind.

CUBICORRHYNCHUS SORDIDUS, n.sp.

♂. Moderately small. Black; [specimens almost completely abraded]: setæ yellowish-brown.

Head convex, slightly flattened in front; longitudinally and obliquely strigose, with a few, small granules: separated from rostrum by a transverse impression; supraorbital crests small, very little prominent. Rostrum broad, very slightly depressed in centre: upper surface with a few, obsolete, transverse ridges: lateral margins not raised. Prothorax (2·5 × 3·5 mm.) broad.

strongly rounded on the sides: subapical constriction well marked, median line impressed, subcarinate at bottom of impression; closely set with small, rounded granules; sides granulate above. Elytra (6 × 4mm.) subobovate, strongly rounded at humeral angles, base not emarginate; striæ moderately deep, punctures small, open, indefinite, extending as transverse wrinkles across interstices; interstices feebly granulate, the granules somewhat more distinct towards the sides. Sides non-granulate. Undersurface depressed at base; ventral segments coarsely punctate. Anterior coxæ contiguous; anterior tibiæ rather feebly curved towards apex, granulate beneath; posterior tibiæ practically straight, rather stout, thickened beneath, set with moderately coarse granules.

♀. More ovate; elytra feebly granulate; undersurface strongly convex, with obsolete punctures; tibiæ not thickened beneath. *Dimensions:* ♂, 11 × 4 mm.; ♀, 10 × 4·5 mm.

Hab.—N.S.W.: Jindabyne (H. J. Carter), Bombala (H. V. Macintosh).

This species is typical of a number of forms from various parts of New South Wales. Some of these may be distinct, but I can detect no decided differences between them. Specimens from Lockyersleigh have the posterior tibiæ slightly curved; and one from Coonabarabran has decidedly larger, prothoracic granules; this specimen is probably representative of a distinct species, but I have not sufficient material to decide this point.

CUBICORRHYNCHUS STERILIS Pasc.

Pascoe, Journ. Linn. Soc., 1873, p.19; *C. quadraticollis* Ferg., Trans. R. Soc. S. Aust., 1915, p.79.

The type of this species, which I have recently seen, is a female in good preservation: unfortunately, however, the clothing obscures the sculpture. The prothorax is shaped as in *C. quadraticollis*, with a conspicuous indentation at the middle of the sides; the pronotum is set with very small, widely scattered granules; I believe the derm is strigose between the granules; unfortunately the clothing is too dense to see the sculpture, but the arrangement of the clothing is suggestive. It is possible, therefore, that *C. sterilis* and *C. quadraticollis* are not really conspecific, but I have little doubt that they are so. I have never seen a specimen of *C. quadraticollis* from the type-locality (Melbourne) of *C. sterilis*, the only Cubicorrhynchus I have seen from Melbourne being *C globicollis* Lea, which has quite a differently shaped prothorax. *C. strigicollis* Ferg., which also occurs in Victoria, is likewise close to *C. sterilis*, but has a more rounded prothorax.

Hab.—(*C. sterilis*), Vic.: Melbourne—(*C. quadraticollis*), S.A.: Nairne, Mt. Lofty.

CUBICORRHYNCHUS STRIGICOLLIS Ferg.

Ferguson, Trans. R. Soc. S. Aust., 1915, p.77.

Hab.—Victoria: Nathalia.

CUBICORRHYNCHUS SUBSTRIGOSUS Ferg.

Ferguson, *loc. cit.*, p.79.

Hab.—S.A.: Mt. Lofty, Coorong.

CUBICORRHYNCHUS GLOBICOLLIS Lea.

Lea, Mém. Soc. Ent. Belgique, 1910, p.84.

Hab.—N.S.W.: Albury.—Vic.: Melbourne, Sea Lake.

CUBICORRHYNCHUS ILLIDGEI, n.sp.

♂. Small; elongate-ovate. Black; clothing brownish; setæ long, stout, dark.

Head convex; separated from rostrum by a distinct, transverse impression; front longitudinally and obliquely, rather coarsely strigose, vertex finely and closely reticulo-punctate; with two, small granules on the forehead; supraorbital crests small, noduliform. Rostrum short; upper surface flat, obscurely rugulose, with a small granule on each side of base; external margins not raised, hardly at all convex in profile. Scape moderately robust. Prothorax (2 x 2·5 mm.) comparatively narrow, rounded on the sides, widest slightly in front of the middle, basal angles obtuse; subapical and basal impressions moderately broad, median line shallowly impressed, set with small, somewhat depressed, discrete granules, absent from transverse impressions, and from an area internal to the lateral margins; sides with a few granules above. Elytra (5 × 3·5 mm.) gently rounded on the sides; base gently emarginate, humeral angles feebly marked. not produced; disc gently convex from side to side; seriate punctures rather large; interstices without evident granules. Undersurface subnitid, feebly depressed at base; with rather distinct punctures, coarser on the apical segment. Anterior coxæ contiguous; tibiæ straight, the undersurface feebly sinuate, each side with a row of small granules. *Dimensions:* ♂, 8 × 3·5 mm.

Hab.—Queensland: Mt Tambourine (R. Illidge).

Described from a single male, received some years ago from Mr. Illidge of Brisbane, who has other specimens from the same locality in his collection. This species is not close to any other known to me, and may be recognised chiefly by its small size, feeble crests, prothoracic granulation, and slightly emarginate base of the elytra. The setæ are also unusually long. The type is caked with an ochreous meal, or perhaps mud, which conceals the colour of the clothing; the setæ appear light from some directions.

Cubicorrhynchus minor, n.sp.

♂. Small, elliptical-ovate. Black; densely clothed with grey and brown squamosity, the grey extending as a broad patch across the prothorax, and clothing the median impression, on the elytra the colours irregularly distributed, the brown with a submetallic appearance from some directions; setæ long, stout, dark.

Head convex; separated from the rostrum by a transverse impression, towards the sides extending back and outwards along the inner sides of the supraocular crests; crests elongate, directed backwards and slightly outwards, appearing as processes of the rostrum lying back against the head. Rostrum short, hardly concave above, with two, short, oblique, little evident ridges, converging inwards to base of rostrum: external margins not raised, running back to base of supraorbital crests. Prothorax (1·5 × 2 mm.) narrow, widest slightly in front of the middle; not strongly rounded on the sides, with a rather feeble, granular ridge towards the base; subapical constriction rather feeble; median impression only traceable in front and behind; closely set with rather large, round granules; sides granulate above. Elytra (5 x 3 mm.) suboval, elongate; base not emarginate, humeral angles rounded; disc moderately convex from side to side; striæ moderately deep, punctures small; interstices with small, setigerous granules, more evident towards the declivity and sides; lateral interstices non-granulate. Undersurface flattened, base feebly concave; punctures obscured by clothing, apparently small and separate. Anterior coxæ contiguous; anterior tibiæ feebly curved, posterior straight.

♀. Somewhat larger; undersurface very slightly convex. *Dimensions:* ♂, 7 x 3 mm.; ♀, 8 x 3·5 mm.

Hab.—Western Australia: Ankertell (H. W. Brown).

This species is the smallest one known to me, and may readily be recognised by the peculiar, supraorbital crests, in conjunction with the non-dentate sides of the prothorax. In general habit, however, it appears closer to species like *C. spinicollis*, than to the *maculatus*-section of the genus.

I am not absolutely certain whether I am right in considering the type a male; apart from size, there seems little difference in the three specimens before me; in the one I take to be the male, the undersurface is, however, slightly more flattened than in the other two specimens.

Cubicorrhynchus crenicollis Waterh.

G. R. Waterhouse, *loc. cit.*, p.5.

♂. Comparatively small. Black; prothorax trivittate with grey, elytra maculate, femora with a rather conspicuous, pre-apical, grey ring, knees pale.

Head flattened in front, the transverse impression between head and rostrum hardly traceable; longitudinally rugosely granulate, with two small granules on the forehead; supraorbital crests moderately large, acute, upwardly projecting. Rostrum very shallowly depressed above; lateral margins not raised. Scape moderately stout, thickened at apex, rather strongly curved backwards. Prothorax (2·5 × 3·5 mm.) very feebly convex from side to side; lateral margins strongly dentate, with a deep notch about middle; median line deeply impressed in front and behind, briefly carinate in middle; disc set, moderately closely, with small, round granules; sides with a few granules above and in front. Elytra (6 × 4 mm.) gently rounded on the sides, more strongly rounded off to base: base subtruncate, humeral angles marked by a small granule; seriate punctures small, obscure; interstices set with small granules, obscured by the clothing, more evident on the declivity and towards the sides. Undersurface gently concave at base of abdomen; apical segments with moderately large punctures. Anterior coxæ contiguous; anterior tibiæ evidently, though feebly, curved; posterior tibiæ feebly curved, also feebly curved inwards.

♀. More robust and more ovate; undersurface convex: anterior tibiæ very feebly curved, posterior practically straight. *Dimensions:* ♂, 10 × 4 mm.; ♀, 13 × 5 mm.

Hab.—W.A.: Swan River, Fremantle, Dirk Hartog Islands.

CUBICORRHYNCHUS CURVIPES Ferg.

Ferguson, *loc. cit.*, p.76.

Hab.—W.A.: Geraldtown, Perth.

CUBICORRHYNCHUS AUREOMACULATUS Ferg.

Ferguson, *loc. cit.*, p.80.

Hab.—W.A.: Cue, Onslow, Roebourne.

CUBICORRHYNCHUS RECTIPES Ferg.

Ferguson, *loc. cit.*, p.82.

Hab.—W.A.: Cue.

CUBICORRHYNCHUS SPARSUS, n.sp.

♂. Small, elongate-ovate. Black; clothing dark brown, prothorax with a basal greyish patch, elytra maculate with greyish.

Head strongly convex, hardly depressed in front; separated from rostrum by a transverse impression; closely and finely strigulose, in centre almost reticulate; supraorbital crests small, but prominent, obtuse. Rostrum slightly depressed at base; lateral margins not raised. Scape slender at base, moderately strongly incrassate towards apex. Prothorax (2·5 × 3 mm.) slightly broader than long; lateral margins with two, small, dentiform projections anterior to middle, and with a ridge of small granules extending from middle to base; base truncate, latero-basal angle well marked; subapical constriction moderately well marked; median impression distinct only in basal portion, bordered on each side at base by two, small tubercles; disc elsewhere distantly set with very small granules; sides with a few granules above. Elytra (6 × 4 mm.) obovate, broadest rather anterior to middle; base not emarginate, humeral angles rounded; disc rather strongly convex from side to side; seriate punctures small, the striæ moderately deep; interstices set with small granules, more distinct towards sides; lateral interstices not granulate. Undersurface subnitid, with scattered punctures at base, these coarser and closer together on the apical segment. Anterior coxæ contiguous; anterior tibiæ feebly curved, intermediate and posterior tibiæ practically straight.

♀. More ovate; prothorax with lateral, dentiform projections hardly traceable; elytra broader. *Dimensions:* ♂, 9 × 4 mm.; ♀, 11 × 5·5 mm.

Hab.—W.A.: Darling Ranges (A. M. Lea).

Type in Coll. Ferguson.

I think I am right in sexing the specimens before me; there are four, two small and two larger; but, apart from the larger size, the only difference in the presumed females is the broader elytra. In all, the undersurface appears to be feebly convex at the base; this is usually a female character, but I am certain that the type is a male, as the abdomen is protruded sufficiently to enable the two, apical, dorsal tergites to be seen.

The species is readily distinguished from all the other described species with dentate sides, by the sparseness and fineness of the prothoracic granules.

Cubicorrhynchus setosus, n.sp.

♂. Small, elongate, subparallel. Clothing dense, brownish, on elytra indistinctly maculate with greyish, rostrum and legs clothed with grey; setæ long, light-coloured.

Head convex, slightly concave between the crests, with two, small granules on forehead; supraorbital crests comparatively large, upstanding. Rostrum short, wide: upper surface gently concave. Scape rather robust. Prothorax (2 x 3 mm.) dentate at sides, with two, moderately large, conical projections anterior to middle, and a row of smaller, conical granules, about four in number, posterior to middle; a small, conical granule also present in front of subapical constriction; disc with median line shallowly, but distinctly, impressed, elsewhere closely set with rather large, upright granules, each bearing a long seta; sides granulate above. Elytra (7 x 4 mm.) subparallel on the sides: base not emarginate, humeral angles rounded; striæ moderately deeply impressed, punctures small, indistinct; interstices each with a single row of small granules, more distinct posteriorly and laterally; sides with interstices non-granulate. Undersurface gently concave at base; with scattered, setigerous punctures, rather coarser on the apical segment. Anterior coxæ contiguous, anterior tibiæ feebly curved, posterior feebly curved, also very feebly curved inwards; all the tibiæ clothed with long, setose hair, most noticeable on the undersurface, the posterior with a few, fine granules traceable among the setæ.

♀. More ovate; undersurface more convex, posterior tibiæ practically straight. *Dimensions:* ♂, 10 x 4 mm.; ♀, 11 x 5 mm.

Hab.—North-west Australia, Onslow.

Type in Coll. Ferguson.

Closely allied to *C. spinicollis*, but a larger species, with larger, almost conical granules on the prothorax, and longer setæ, particularly on the prothorax.

The type is possibly immature. as it is of a decidedly reddish colour, other specimens being black. The Onslow specimens differ slightly in the prothorax, and the elytral granules are slightly more evident; I do not think, however, that they are distinct.

CUBICORRHYNCHUS MUSSONI Blackb.

Blackburn, Proc. Linn. Soc. N. S. Wales, 1892, p.124.

This species is very distinct from all other described Cubicorrhynchi with the exception of the following, *C. auriculatus.*

From that species, it differs in the more rounded sides of the prothorax, and in the more obliterate granules, on both prothorax and elytra. The sides of the prothorax, though appearing evenly rounded from above, have the basal half distinctly ridged, this ridge being conspicuous only when viewed from the side. In both species, the supraorbital crests differ considerably from the usual form: instead of projecting more or less forwards from the plane of the head, they project upwards and somewhat outwards, the inner surfaces looking almost directly forwards. I have not, however, thought it necessary to separate these two species generically from *Cubicorrhynchus*. I have specimens of *C. Mussoni* from Walcha and Muswellbrook; these have been compared with specimens from the type-locality (Tamworth) in the Macleay Museum. More recently, I have had an opportunity of inspecting the type in the British Museum, and am able to confirm the identification.

Cubicorrhynchus auriculatus, n.sp.

♂. Moderately small: elongate-ovate. Black; clothed with muddy-brown squames, feebly emarginate with grey: setæ.

Head convex, separated from rostrum by a transverse impression; forehead with two, small granules; supraorbital crests elongate, the apices directed upwards and outwards, the inner surfaces looking forwards as well as inwards. Rostrum with upper surface slightly depressed; median line carinate, two oblique, almost obsolete, internal ridges traceable; lateral margins not raised, slightly depressed at base of crests, somewhat divergent at base. Prothorax (2·5 × 3·5 mm.) feebly convex on disc, with a marked, subapical, transverse impression; median line impressed in basal half; lateral margins with a rather distinct notch about middle, this continued across disc as an indistinct impression, obtusely bidentate in front of notch, and with a row of granules behind notch, running backwards and inwards to latero-basal angle, which is marked and rectangular; disc closely set with large, round granules, with two, rather large, backwardly directed tubercles overhanging the base, in the middle; sides with rather coarse granules above, becoming finer below and reaching almost to coxæ. Elytra (6 × 4·5 mm.) subparallel on sides, shoulders rounded; base, from certain directions, appearing very feebly emarginate; striæ shallow, punctures small, open, rather indefinite; interstices with small granules, the third and fifth slightly more elevated, with somewhat larger granules; lateral interstices non-granulate. Undersurface somewhat depressed at base; with large punctures separated by narrow ridges, forming an irregular reticulum, these punctures most marked on second and apical portion of first segment, obsolescent on metasternum. Anterior coxæ contiguous; anterior tibiæ feebly curved, posterior feebly incurved.

♀. More ovate; undersurface convex, with fewer and smaller punctures, not reticulate. *Dimensions:* ♂, 10 × 4·5 mm.; ♀, 10 × 5 mm.

Hab.—S. Queensland: Dalveen, Darling Downs, Dalby, Daandine, Maryland, Stanthorpe.—N.S.W.: Tenterfield.

The only species known to me at all similar to the above, is the species I have identified as *C. Mussoni* Blackb.; from that species, the present one differs in the coarser, prothoracic granules, and in the different ventral punctures.

The head, with its outwardly and upwardly directed crests, is reminiscent of *Notonophes*, but the structure of the prothorax clearly shows the affinity of *C. auriculatus* to the Cubicorrhynchus-Acantholophus complex. The basal transverse impression or guttering is concealed from above, but can be seen from the side; when viewed from the side, the posterior portion of the lateral margin is seen to bend downwards to the latero-basal angle.

It is possible that *C. auriculatus* and *C. Mussoni* should be separated from *Cubicorrhynchus*, but I do not think that they can be referred to *Acantholophus*.

Cubicorrhynchus spinicollis Macl.

Macleay, *op. cit.*, 1866, p.332.

♂. Small, elongate. Clothing dense, brownish; rostrum and median line of prothorax, anteriorly and posteriorly, clothed with white; elytra variegate with grey; undersurface with a broad, white vitta along each side; setæ short, dark.

Head convex, separated from rostrum by a transverse impression in front, curving backwards along inner side of supraorbital crests; forehead with two, small granules; crests prominent, directed upwards with a slight inclination outwards. Rostrum not excavate, lateral margins not raised, median line slightly depressed, base with feeble indications of two oblique ridges. Scape moderately robust. Prothorax (2·5 x 3mm.) with a strong dentiform tubercle or spine about middle, a slightly smaller one more anteriorly, and a small spine anterior to subapical constriction; lateral margins, from middle to base, formed by a strongly granulate ridge, sloping inwards to base; disc with median line impressed anteriorly and posteriorly, sometimes carinate in middle portion; set with small, upright granules, absent from anterior and posterior portions of the disc, also with two, small tubercles on each side of median line at base; sides with a few granules above. Elytra (5 x 3·5 mm.) suboval, strongly rounded to base, humeral angle with a small granule; disc striate-punctate, punctures small, each set with a small seta; interstices with small granules obscured by clothing, more evident posteriorly and laterally. Undersurface rather feebly concave at base, set with rather small punctures, obscured by clothing. Anterior coxæ contiguous; tibiæ feebly curved, almost straight.

♀. More ovate; undersurface convex. *Dimensions:* ♂, 9 x 3·5, ♀, 9 x 4 mm.

Hab.—W.A.: King George Sound, Kellerberrin.

Closely allied to *C. aurigena* and *C. setosus*, from the latter of which it may readily be distinguished by its smaller size, and smaller, prothoracic granules. The differences between *C. spinicollis* and *C. aurigena* are noted under the latter species.

Some doubt has been cast on the assignment of this species to *Cubicorrhynchus.* In general appearance, the species is strongly suggestive of a small Acantholophus, but the structure of the rostrum is essentially that of a Cubicorrhynchus, and it is united to the typical forms of the genus by intermediate species.

CUBICORRHYNCHUS AURIGENA Blackb

Hyborrhynchus aurigena Blackburn, Trans. R. Soc. S. Aust., 1899, p.89.

Though referred by the author to *Hyborrhynchus*, this species is certainly a Cubicorrhynchus, and allied to *C. spinicollis*. From that species, it differs in being somewhat larger, with more parallel-sided elytra. The internal, oblique ridges on the rostrum are more evident, and the supraorbital crests are larger and more outwardly directed. The prothorax is rather broader, with the lateral spines slightly larger.

My only specimen is a female, which I received from Mr. H. W. Brown; a second specimen was sent to the British Museum, and determined as this species by comparison with Blackburn's type.

A recent visit to the British Museum has enabled me to examine the type of *C. aurigena*; it is probably a male, but the abdomen is displaced: it differs from the specimen I have commented on above in having the supraocular crests smaller: in other respects, it agrees well, and I think the two specimens are conspecific.

Hab.—W.A.: Kalgoorlie, Cue, Beverley.

A REVISION OF THE GENERA WITH MICROSCLERES INCLUDED, OR PROVISIONALLY INCLUDED, IN THE FAMILY *AXINELLIDÆ*; WITH DESCRIPTIONS OF SOME AUSTRALIAN SPECIES. Part i.

(PORIFERA.)

By E. F. Hallmann, B.Sc., Linnean Macleay Fellow of the Society in Zoology.

(Plates xxi.-xxix., figs.1-2; also xxxix., figs.6,7; and Text-figs.1-9.)

Genus Trachycladus Carter.

Definition.—Axinellidæ(?) typically of arborescent habit; with an axially condensed, reticulate skeleton of spiculo-spongin fibre. The megascleres are diactinal and of a single category, varying in form from oxea to strongyla. The characteristic microscleres are spinispirulæ, to which are usually added smooth microstrongyla.

Type-species, *T. lævispirulifer* Carter.

Inclusive of those here added to it, Trachycladus comprises now seven species (together with several varieties), all of which are from the southern and south-eastern coasts of Australia. The hitherto-described species referable to the genus are four, viz., *T. lævispirulifer* Carter (the type-species), and the three described by Lendenfeld, very imperfectly, under the names *Spirophora digitata*, *S. bacterium*, and *Spirophorella digitata*; but, for reasons already indicated in my previous paper, I reject the last-named, relegating it to the synonymy of *T. digitatus*—a redescription of which is given below. The other two species, *T. lævispirulifer* and *T. bacterium*, are apparently unrepresented among those examined by me; but the latter may prove to be identical with *T. pustulosus*, sp.n. The specimens from Port Phillip recorded and briefly described as examples of *T. lævispirulifer* by Dendy(**7**) appear to me to represent at least two distinct forms, which I describe below as varieties of *T. reteporosus*, sp.n., and of *T. digitatus* respectively.

In the characters which it combines, the genus is a most anomalous one; and the question of its relationship affords scope for considerable speculation. The form of the spinispirulæ irresistibly suggests their derivation from spirasters; and this view of their origin receives strong support from the fact that identically similar spicules—which undoubtedly are derived from spirasters—occur in *Spirastrella* (?) *spinispirulifera* (Carter) Dendy(7), and *Spirastrella* (?) *dilatata* (Kieschnick) Thiele(39), and from the fact that, in the latter species (which is apparently unique in this respect among the Spirastrellidæ), the megascleres are united into definite fibres by means of spongin. Also in support of this view, is the fact of the presence of microstrongyla. On the other hand, in structural features of the skeleton, the genus conforms to a type which is characteristic of genera in which the microscleres are sigmata or are such as are known to occur in association with sigmata. Trachycladus, therefore, appears to form a connecting link between the Spirastrellidæ and the sigmatophorous section of the Monaxonida, and provides ground for the view that these two groups are derived from a common Monaxonid stem.*

As the several species agree very closely in by far the greater number of their characters, a preliminary general account of them is desirable in order to obviate to some extent the necessity of repetition in their separate descriptions.

With the possible exception of *T. bacterium*—which is described by Lendenfeld as "eiformig, mit schmaler Basis festgewachsen"—all the species are of ramose habit, typically stipitate and more or less arborescent, with branches which are circular or nearly so in cross-section (occasionally somewhat compressed in *T. reteporosus*), and never of considerable stoutness; in *T. pustulosus* alone, the branches generally remain much abbreviated, closely crowded, and more or less coalesced together proximally, thus sometimes (through excessive reduction and fusion) producing a

* In this connection, I may mention that evidence is not wanting which would justify the hypothesis that sigmata and chelæ have originated from spirasters, perhaps independently; and it is even possible that the acanthosceleres of the Desmacidonidæ are similarly derived.

compact solid mass, or head, with digitiform protuberances (Pl. xxi., fig.5); occasionally, in the case of *T. reteporosus*, the sponge may remain unbranched—consisting simply of a long and slender, undivided stem. According to the species (or variety), the branches may be either cylindrical, distally expanded (*i.e.*, more or less clavate), or gradually tapered. Anastomosis between the branches occurs to a greater or less extent almost invariably, except perhaps in the case of *T. reteporosus*. The mode of branching is probably never dichotomous, though occasionally it may appear so; normally at any rate, the branches arise laterally and adventitiously.

The oscula are of small size, very seldom as much as 1 mm. in diameter, and are generally scattered over the surface irregularly; in *T. reteporosus*, however, they show a decided tendency to be arranged in longitudinal series, especially along the edges of the branches when these are compressed. In *T. pustulosus*, the oscula are restricted almost entirely to the distal parts of the branches, while in *T. bacterium* they are said to occur arranged in groups.

The surface is smooth, or is provided with numerous minute prominences (up-pushings of the dermal layer) produced by the extremities of impinging skeletal fibres. These elevations constitute a marked feature of the surface only in *T. pustulosus* (and *T. bacterium*?) in which they have the appearance of small pimples, and in *T. scabrosus* (Pl. xxi., fig.4; Pl. xxviii., fig.6), in which they take the form of minute sharp conuli; in the remaining species, they are either imperceptible or produce merely the appearance of granulation. In any case, whether surface-elevations occur or not, each point on the surface at the extremity of a skeletal fibre is the location of a small area over which the dermal membrane is adherent to the underlying tissues and free from dermal pores, whilst elsewhere it overlies subdermal spaces and is perforated by numerous pores. The pores are either scattered singly and for the most part subequidistantly, at an average distance apart not much exceeding their own diameter, as, for example, in *T. digitatus* and its varieties (Pls. xxvi., xxviii.);

or they are closely arranged in subcircular, sieve-like groups, as in *T. reteporosus* and *T. pustulosus* (Pl. xxvi., figs.4, 5, 7, 8; Pl. xxvii., figs.5, 6). In the latter species, the surface presents a minutely reticulate appearance.

Dried specimens are whitish on the surface, owing to the presence of a thin dermal crust of spinispiral microscleres; in alcohol, the colour varies in the different species, from whitish-grey to pale orange-yellow. The colour of living specimens—known so far only in the case of *T. reteporosus*, in which it is brilliant orange, red or scarlet—is probably always to some extent determined by, or dependent upon, that of a symbiotic Myxophycean alga, which appears to be invariably present in all the species, often in enormous numbers.

The main skeleton, which is composed of non-plumose spiculo-spongin fibres, is almost exactly similar in its conformation (except, presumably, in *T. bacterium*) to that described by Vosmaer* as typical of the genus *Axinella* (s.str.). In the central region of each branch, it forms an abruptly delimited dense core, or axial fune, composed of ramifying and interuniting longitudinal main fibres additionally connected (more or less obliquely) by a greater or lesser number of transverse fibres, and presenting (in longitudinal section) a somewhat lattice-like arrangement (Pl. xxvi., fig.1); and extra-axially it consists mainly or almost solely of very sparsely ramifying, radial fibres, which arising as branches from the longitudinal fibres (usually at some distance within the axial fune), run outwards to the surface at approximately equal distances apart, and are connected, only at irregular and usually distant intervals, by spongin-ensheathed single spicules and by paucispicular fibres of a single spicule's length (Pl. xxv., fig.1). The fibres are composed chiefly or almost entirely of spicules, which are arranged for the most part parallelly or nearly so (though not, as a rule, very compactly nor in a very orderly fashion); and this arrangement is maintained to the very ex-

* Vosmaer, G. C. J., "On the distinction between the genera *Axinella*, *Phakellia*, *Acanthella*, etc. Zool. Jahrb. Suppl. xv., 1912, p.310, Pl. xvi., figs.5, 6.

tremities of the (radial) fibres, the terminal spicules of which show no tendency to spread penicillately. The outlines of the fibres, as seen in cross-section, are very irregular (Pl. xxvi., fig.9). In the axial region of the skeleton, the fibre-spicules are less compactly and less regularly arranged than in the radial fibres, and the appearance of irregularity is much increased by the presence of many additional spicules lying between the fibres: outside the axial region, interstitial megascleres are exceedingly rare. The characteristic microscleres—the spinispirulæ are scattered always in great abundance throughout all parts of the interior, and at the surface occur closely crowded in a well-defined layer, which constitutes the dermal skeleton. The microstrongyla, when present, are confined to the extra-axial choanosome.

The chief specific differences, in so far as structural features of the skeleton are concerned, are with respect to:—(i.) the density of the axial fune: (ii.) the ratio between the diameter of the fune and that of the whole branch: (iii.) the stoutness of the skeletal fibres: (iv.) the amount of spongin entering into the composition of the fibres; (v.) the frequency of connection between the radial fibres by means of transverse fibres; and (vi.) the angle of inclination of the radial fibres, *i.e.*, their direction relatively to the longitudinal axis of the branch. A further difference, however, is presented by *T. pustulosus*, in which the skeleton is axially condensed only in the stalk and in the lowermost portions of the branches: while in *T. bacterium*, apparently, an axial condensation is not developed. In order most readily to perceive, and also most accurately to determine, the distinctive characters of the skeleton in the different species, it is necessary to study the skeleton freed of the soft parts.

The megascleres are slightly curved oxea and strongyla (and rare styli), occurring intermingled, and connected by intermediate forms; the oxea, on the average, are slightly longer and stouter than the strongyla and not so nearly of uniform diameter, but otherwise differ from them only in the character of their extremities. Both in regard to the shape and the size of the megascleres, the two species differing most widely are *T. scabrosus* and *T. reteporosus*: in the former, strongyla are extremely rare, and the megascleres are almost exclusively sharp-pointed, fusiform oxea, attaining a maximum size of 530 by 27 μ; in the latter, strongyla and oxea are about equally numerous, the oxea are mostly more or less blunt-pointed and but very slightly fusiform, and their maximum size usually does not exceed 300 by 8 μ. In most of the species, a certain proportion of the megascleres (apparently those alone which occur extra-fibrally in the axial region of the skeleton) are found to attain an increasingly larger size as one proceeds towards the older portions of the sponge, with the result that, in the stalk, the maximum size of the megascleres is notably greater than in the uppermost parts of the branches; and these largest spicules, even in the species in which strongyla abound, are almost without exception oxea. The spicules of the fibres are no larger in the stalk than elsewhere.

The spinispirulæ are minute, entirely spinulous, for the most part regularly corkscrew-shaped spicules, rarely of more than two complete turns; in addition, they comprise a series of simpler forms, of various shapes ranging from that of a much contort S, through C-shaped forms, to straight or nearly straight rods (Text-fig. 3). The proportionate number of these simpler forms varies in the different species, but the degree of variability in this respect, as well as in other characters of the spirulæ, is not sufficient to be of diagnostic value. An exception to this rule, however, is possibly afforded by the spirulæ of *T. lævispirulifer*, which have been described by Carter as smooth; but it is more probable that the spicules, in this case, were not examined under a sufficiently high power to render their spination visible.

The microstrongyla are inconstant in occurrence, and they may be either numerous or scarce, or perhaps sometimes entirely absent, in different specimens of the same species; at any rate, this was found to be the case in *T. digitatus* (typical variety), and *T. reteporosus* (var. ?)—of which alone a number of specimens were available for examination. That they are proper spicules, however, and not merely pathological products, is rendered certain by their degree of uniformity in size and shape. Occasional malformed individuals (occurring least rarely in *T. digitatus*) are met with amongst them; and, in *T. pustulosus*, they are in part reduced to spheres: but otherwise they have the form of short straight rods, rounded at the extremities, often centrotylote, always quite smooth, and usually relatively stout.

The canal-system (Pl. xxiv., fig.3; Pl. xxv., fig.2) is of the aphodal type, with oval to spherical flagellated chambers, though with extremely short aphodi. The chambers measure from 25 to 35μ in diameter, and occur closely scattered throughout the entire extra-axial choanosome; within the region occupied by the axial skeleton, however, they are absent, except in the youngest portions of the sponge (*i.e.*, towards the extremities of the branches). In conformity with the symmetry of the skeleton, the main inhalant canals proceed from the subdermal spaces towards the interior in a radial direction, parallel to that of the radial skeletal fibres, and are traceable inwards almost to the axial fune; at their commencement, they are of such diameter as to be very distinctly visible to the naked eye, when a thin layer is pared from the surface (Pl. xxvi., fig.2). The subdermal spaces are inextensive—least so in *T. pustulosus*. The ectosomal layer, or dermal membrane, varies in thickness in the different species, from 50μ in *T. reteporosus* to (occasionally) 140μ in *T. fastigatus*, and, when best developed, has very much the appearance of a thin cortex; it is densely packed with spirulæ usually throughout, or nearly throughout, its entire thickness.

In none of the species were ova or embryos observed.

TRACHYCLADUS SCABROSUS, sp.nov.

(Pl. xxi., fig.4; Pl. xxiii., fig.9; Pl. xxviii., fig.6.)

Diagnosis.—Branches cylindrical, rather slender; of approximately uniform diameter throughout their length, Surface densely beset with small, sharp conuli formed by the extremities of the radial skeletal fibres. Dermal layer comparatively thin; superficially packed with spirulæ. Oscula and pores(?). Skeleton with an extremely dense axial fune of diameter exceeding the length of the radial fibres. Radial fibres directed nearly perpendicularly to the skeleton-axis, mostly between 120 and 170μ in stoutness, composed almost solely of spicules. Megascleres, sharp-pointed fusiform oxea, rarely passing into strongyla, and less rarely into styli; maximum size, $180 \times 23\mu$ in the branches, occasionally as much as $530 \times 28\mu$ in the stalk. Microstrongyla scarce.

Loc.—Off Port Jackson. ("Thetis" Expedition).

External features.—The species is known from a single example (Pl. xxi., fig.4), 108 mm. in total height, consisting of an elongated slender stalk and irregularly disposed cylindrical branches from 2·5 to 4 mm. in diameter. The specimen (which is invested over portion of the exterior by a calcareous bryozoan) is only imperfectly preserved, having evidently suffered some amount of dessication prior to being placed in alcohol—in consequence of which the dermal layer, while remaining quite intact, has to some extent shrunken inwards upon the underlying skeleton. To this circumstance, in all probability, is largely due the marked degree in which the surface is rendered conulose by the outer ends of the skeletal fibres (Pl. xxviii., fig.6): nevertheless, so coarse and stiff are these fibres that, even in the best-preserved specimens, the surface would almost certainly show some decided visible effect of their impingement on it, and at least would be asperous and harsh to the touch. The conuli are seldom much above ⅓ mm. in height, very close-set, and of hard feel; they are such that the surface has much the appearance of that of a fine rasp. The dermal membrane is very thin and very closely adherent, accommodating itself exactly to the sharply contoured surface-inequalities; presumably it has undergone considerable contraction, since neither pores nor oscula are detectible. In consistency, owing partly to its somewhat dried and shrunken condition, but perhaps mainly to its very dense skeleton, the specimen is tough and hard, almost incompressible; the branches are stiffly flexible. The colour is brownish-grey on the surface, and dark brown in the interior.*

Skeleton.—The prepared skeleton, as seen in its entirety (Pl. xxiii., fig.9), is of a faintly brownish, light grey colour, and consists of a very stout and solid looking core, with coarse and stiff, bristle-like, short radial fibres projecting therefrom on all sides, in moderately close array, almost at right angles; when dry, it is hard and brittle. The core occupies never less than half the diameter of the branches, and the radial fibres seldom exceed 1 mm. in length. The latter, which are connected only very sparsely by paucispicular transverse fibres (of a single spicule's length), vary in stoutness from about 110 to 190 μ or so, and are composed almost solely of spicules,—their spongin being insufficient in quantity to form an external sheath, and becoming discernible only after staining. The fibres of the central axis, which also are but very scantily provided with spongin, have their spicules less closely compacted than the radial fibres, and form so dense a lattice-like reticulation that, except in moderately thin sections, the outlines of individual fibres can seldom be distinguished, and open meshes do not appear.

Megascleres.—These are almost exclusively oxea, slightly and usually somewhat angulately curved, fusiform, with gradually and regularly tapered, nearly always acutely-pointed extremities; but strongyla and scarcer styli also occur—more especially in the stalk, where the proportional number of the former may exceed one in fifteen. In the stalk also, occasional anisoxea are

Text-fig. 1.—*Trachycladus scabrosus.* Megascleres: *a*, from the stalk; *b*, from the branches.

met with, as in *T. digitatus* and *T. pustulosus*; and the megascleres are there of notably greater size than elsewhere. The strongyla are mostly not quite cylindrical in shape, but slightly fusiform; they are of lesser length, on the average, than the oxea, and, in the case of the shortest, are relatively much stouter. Although strongyla are present in far greater number than styli, spicules intermediate in form between them and oxea are of less frequent occurrence than those intermediate between styli and oxea. The maximum size of the megascleres is not greater than $480 \times 23\mu$ in the branches, and about $530 \times 28\mu$ in the stalk; the oxea are very rarely less than 330μ in length, and proportionately slender, but the shortest strongyla (which may exceed 20μ in stoutness) fall below 200μ.

Microscleres.—The spirulæ are mostly of between 1 and 2 turns and from 2 to 3μ in stoutness; C-shaped forms are rather scarce, and straight rods rare. The microstrongyla are very scarce, seldom centrotylote, and from 15×3 to $20 \times 5\mu$ in size.

TRACHYCLADUS FASTIGATUS, sp.nov.

(Pl. xxi., fig.1; Pl. xxiii., fig.10.)

Diagnosis.—Profusely branched. Branches elongated and tapering; anastomosing at points of contact. Surface smooth and glabrous. Oscula (?). Dermal layer strongly developed, dense, opaque; with closely packed spirulæ forming a layer 70-140μ thick. Inhalant pores dispersed singly. Skeleton with a rather dense axial fune, of diameter generally less than the length of the radial fibres. Radial fibres directed at an angle of from 35° to 60° with the skeleton-axis; very rarely more than 20-25μ in stoutness; their spicules cemented by a scarcely perceptible amount of spongin. Extra-axial connecting fibres few, mostly unispicular. Megascleres almost exclusively diactinal, mostly more or less rounded off at the ends, very commonly approximating in form to strongyla, but nearly always more or less (slightly) fusiform; only slighter, if at all, of greater dimensions in the stalk than elsewhere; in maximum size very rarely exceeding $520 \times 9\mu$, and at most $560 \times 12\mu$. Microstrongyla abundant in some parts, scarce in others.

Loc.—Great Australian Bight.

External features.—The single specimen (Pl. xxi., fig. 1) is of luxuriantly arborescent habit, and measures 360 mm. in total height, being thus the largest example of the genus yet obtained: the number of its ultimate branches exceeds one hundred and fifty. The branches are elongated and relatively slender, gradually tapered, distally much attenuated and flagelliform; the stoutest are at most 8 mm. in diameter at their base. They are richly and, in places, intricately anastomosed, forming thus, as well as by their multitude, a dense and somewhat tangled mass. Unfortunately the specimen, although in alcohol, is not very perfectly preserved, owing to its having temporarily become partially dried (through breakage of the vessel containing it) while in course of transit from the collecting ground. In consequence of this—mainly, if not solely—the branches are without exception much wrinkled longitudinally, presenting a shrivelled appearance: in life, apparently, their outline in cross-section was circular. The dermal layer, notwithstanding, remains intact, and exhibits no outward indication of having been detrimentally affected: it has the form of a dense and tough, opaque membrane or skin, with an outward appearance and texture much resembling that of rubber; is composed almost entirely of closely crowded spirulæ; and is even now (after possible shrinkage) usually between 90 and 120μ, and occasionally as much as 140μ, in thickness. Into the dermal membrane the skeletal fibres do not enter, nor do their extremities ever cause the surface to appear granular.

Examined with the naked eye, a transverse section of a branch shows, superficially, a sharply delimited dense layer, 0·2 to 0·4 mm. in width, the appearance of which is extremely suggestive of a cortex. Under the microscope, however, the seeming cortex is seen to consist in part of a layer belonging to the choanosome, which layer, unlike the remainder of the choanosome, is so densely packed with parasitic algal rods as to assume a whitish-opaque appearance similar to that of the dermal layer itself. But, in all probability, this is not a constant feature.

Presumably owing to their having become closed—as a result of the contraction undergone by the specimen—oscula are not indicated: in life, they must, at any rate, have been of very small size. The dermal pores, for the most part, have also disappeared: but traces of them remain, sufficient to show that they are distributed singly as in *T. digitatus* and its varieties.

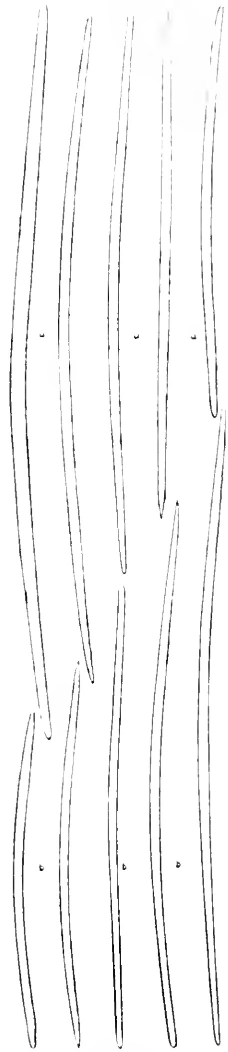
Skeleton.—The prepared skeleton, viewed in the gross (Pl. xxiii., fig. 10), is of a pale creamy-white colour, and shows a sharply-circumscribed, dense core-region, of diameter rarely less than one-third, and frequently exceeding one-half, the total diameter of the branches. The extra-axial skeleton presents somewhat the appearance of fur, being composed apparently only of fine silky-looking *outwardly-directed* (*i.e.*, radial) fibres: under the microscope, however, the radial fibres are mostly found to be connected, though as a rule only at very distant and irregular intervals, by delicate transverse fibres, often in the form merely of single spicules unensheathed by spongin. Even the component spicules of the radial fibres are rarely more than 4- or 5-serial, and the spongin cementing them, seldom sufficient to form a visible sheath, is usually so small in quantity as barely to be perceptible even in stained sections of the skeleton. The main fibres of the axial skeleton, save in the stalk and the basal portions of the older branches, are, for the most part, almost equally deficient in spongin, but the spicules composing them are less compactly arranged than in the radial fibres, and are all mostly somewhat greater in number: they form, with the aid of numerous connecting fibres and spicules, as well as by interunion among themselves, a close and rather intricate meshwork, in which the course of individual main fibres cannot be easily traced.

Megascleres.—The megascleres (which are approximately the same—though, on the average, perhaps not quite so slender—in the stalk as in the branches) comprise a goodly proportion of sharp-pointed oxea: but the great majority are intermediate forms showing every stage of transition between oxea and strongyla; moderately scarce styli also occur. The more sharply pointed spicules are very often irregularly ended, sometimes mucronate.

Their curvature, in proportion to their length, is slight, and often affects only a very limited portion of the central region of the spicule, the actines throughout nearly their whole length remaining straight; they are frequently, therefore, more correctly to be described as symmetrically bent, than as curved. Except in this respect, and in their much greater length, they most resemble, on the whole, the megascleres of *T. digitatus* var. *strongylatus*; the strongyla, however, differ from those of the latter, as well as from those of the other two species in which they occur plentifully, in that they are never quite cylindrical, but always taper slightly, with nearly uniform gradualness, from the middle to either end. Their diameter is rarely more than one-fiftieth of their length, which ranges from about 330 to 560 μ.

Microscleres.—The spirulæ are, without exception, of less than 2 complete turns, and a very considerable proportion (amounting to at least 25%) are of less than 1 turn—*i.e.*, are more or less C-shaped; they frequently attain to 2·5 or 3 μ in stoutness. Rod-shaped derivatives are common, but are very seldom more than 8 μ in length.

The microstrongyla—which in most parts of the sponge are fairly abundant—are, with rare exception, centrotylote and rather slender, very seldom exceeding 2·5 μ in diameter; but occasional stouter ones without the dilatation also occur,



Text-fig. 2.
Trachycladus fastigatus. Megascleres: *a*, from the stalk; *b*, from the branches.

which attain a diameter of 4 or 5μ; the length does not exceed 17μ. Malformed individuals, such as are of frequent occurrence in *T. digitatus* and *T. pustulosus*, are rarely to be found.

TRACHYCLADUS DIGITATUS Lendenfeld, et varr.

General diagnosis.—Branches moderately short, cylindrical to clavate, occasionally (abruptly) pointed, but never, so far as known, gradually tapered. Surface even, smooth to faintly granular. Oscula scattered irregularly over the entire surface, or (in the var. *clavatus*) arranged, or tending to become arranged, in two longitudinal rows on opposite sides of the branches. Dermal membrane varying (in the different varieties) from 50 to 120μ in maximal thickness; with closely packed spirulæ throughout its entire thickness (except in the var. *strongylatus*, in which the spirulæ are confined to a superficial layer). Dermal pores dispersed singly, at a distance apart from one another generally greater than their own diameter. Skeleton with moderately dense axial fune of diameter greater or less than the length of the radial fibres. Radial fibres directed at an angle of between 30 and 60° degrees to the axial direction; varying (in different varieties) from 50 to 90μ in maximal stoutness; with spongin rarely sufficient in quantity to form a distinct ensheathing layer external to the spicules. Megascleres—except in the var. *strongylatus* (in which strongyla are the more numerous)—consisting chiefly or almost exclusively of sharp-pointed oxea; of considerably greater maximum size and generally of more fusiform shape in the stalk of the sponge than in the branches; maximal size in the stalk varying (in different varieties) from not less than 350 × 10μ to 530 × 23μ.

Hab.—South-eastern coast of Australia.

TRACHYCLADUS DIGITATUS, typical form.

(Pl. xxii., figs. 1, 2; Pl. xxiii., fig. 1; Pl. xxvi., fig. 2; Pl. xxvii., fig. 1.)

1887. *Spirophora digitata*; Lendenfeld(**26**), p. 794.

1888. *Spirophorella digitata*; Lendenfeld(**27**), p. 236.

1914. *Trachycladus digitatus*; Hallmann(**13**), p. 429.

Diagnosis.—Branches moderately slender (4 to 6 mm. in diameter): approximately of uniform diameter throughout their length, or slightly pointed terminally. Oscula scattered irregularly. Dermal membrane up to 80 or 90μ in thickness. Radial fibres of greater length than the diameter of the axial fune; rarely as much as 75μ in stoutness. Megascleres almost exclusively more or less sharp-pointed oxea, varying in maximal size (in different specimens) from 300 × 9 to 380 × 11μ in the branches, and from 440 × 15 to 510 × 17·5μ in the branches.

Loc.—Port Jackson.

Introductory.—The following description is based on four specimens (all in the collection of the Australian Museum), two of which are labelled *Spirophora digitata* in Lendenfeld's handwriting. Examination has also been made of a small piece of a British Museum specimen labelled with the same name, and, so far as one can judge from its spiculation,—the fragment being insufficient to provide all the requisite information as regards other characters—this is of the same species. The specimens, nevertheless, are considerably at variance with Lendenfeld's description of *S. digitata*,—according to which the digitate branches are much compressed (4 mm. broad and 2 mm. thick), the surface shows "ein feines Netz erhabener Leisten," and the megascleres are styli. The statement regarding the megascleres one may reasonably presume to be erroneous, inasmuch as styli are otherwise unrecorded as occurring in the genus except sporadically as variants of oxea; but the other discrepancies are only explicable on the assumption either that the specimens (of both Museums) are mislabelled, or that the species is wrongly described in respect of its external characters. The view here taken is that the latter explanation is the true one.* As regards the evidence for the identification of *Spirophorella digitata* with the present species, the reader is referred to a previous paper (**13**, p.429).

* Certainly no implicit reliance can be placed on the description; for it is beyond question that in "Die Chalineen des australischen Gebietes," as already has been proven to be the case in the "Catalogue of Sponges in the Australian Museum," some (if not many) of the descriptions confound two species (by ascribing to the one the external features of the other).

The specimens labelled by Lendenfeld are in a dried and shrivelled condition, and look as if beach-worn, the more exposed portions of the surface being more or less denuded of their dermal layer and appearing as a consequence (owing to the projecting ends of the skeletal fibres) hispid or slightly shaggy. Their appearance is thus considerably different from that of the other two specimens, which are in alcohol and well preserved. As regards the latter, it is to be noted that in one of them, as in the two dried specimens, microstrongyla are present in great abundance, whereas in the other, microstrongyla are extremely scarce; but as both are exceedingly alike in other respects, and, moreover, were collected in the same haul, it is impossible to regard their differences as other than due to individual variation; and it was perhaps owing to Lendenfeld's having examined a specimen provided with only rare microstrongyla that no mention is made of such microscleres in his description of the species.

External features.—The external habit is sufficiently portrayed in the figures (Pl. xxii., figs. 1, 2) illustrating the two better-preserved specimens, the larger of which measures 125 mm. in height. The branches have a diameter of from 4 to 6 mm.; and the peduncle is of about the same stoutness. The surface is smooth, and glabrous or nearly so—the utmost effect occasioned by the impingement of the skeletal fibres upon it being (in the case of the alcoholic examples) a faintly granular appearance here and there; should the sponge be removed from alcohol, however, and allowed partially to dry, the surface assumes a minutely pustulated appearance, much resembling (on a small scale) that of the human tongue. The irregularly, and rather distantly scattered oscula are never much greater than $\frac{1}{4}$ mm. or thereabouts in diameter. Some of the main exhalant canals, in the terminal

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and even the figures cannot always be trusted. In proof of the last assertion, one need only compare, for example, the description with the figure in the cases of the following species:—*Ceraochalina reteplax* (p.785; Pl. xix., fig.17); *Euchalinopsis minima* (p.816; Pl. xviii., fig.3); *Chalinodendron exiguum* (p.819; Pl. xxvi., fig.65); *Chalinodendron minimum* (p.820; Pl. xxvi., fig.71); and *Chalinorhaphis digitata* (p.822; Pl. xxvi., fig.62).

part of their course, run for a short distance close below the dermal membrane, and, being visible through it, present an appearance as of veins radiating to the oscula. The colour (in spirit) is a faintly yellowish pale grey with the least possible tinge of olive-green; at the same time, the sponge has a slightly subtranslucent appearance, somewhat recalling that of wax. The consistency is rather fleshy, moderately soft, yet fairly tough and elastic; the branches stand firmly erect.

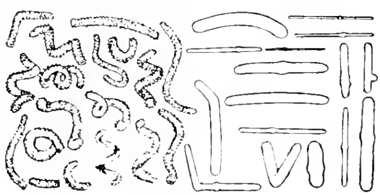
The dermal pores are disposed in the manner shown in Pl. xxvi., fig.2, and Pl. xxvii., fig.1. They vary from 30 to 85μ in diameter, and number, on the average, between 60 and 70 per sq. mm.

Skeleton.—The skeleton, as seen in its entirety (Pl. xxiii., fig.1), is of a light greyish colour, tinted very faintly with brownish pale yellow in the condensed axial region and in its older portions. By reflected light alone, the axial condensation can barely be perceived, being obscured from view by the extra-axial skeleton; but with the opposite illumination,—as when the skeleton is held directly between the eye and the light—it is seen as a sharply delimited, apparently solid core, occupying about one-fourth the diameter of the branches. The extra-axial skeleton appears, at first sight, to consist solely of radially directed fibres—2 to 3 mm. in length—which are inclined to the forward direction of the axis at an angle varying from about 30° in the distal region of the branches to about 45° in the basal; but, on closer inspection, transverse fibres (very rare towards the periphery of the skeleton, but becoming fairly numerous as the axis is approached) connecting these can be made out. The extra-axial skeleton is rather scanty—its effectiveness in concealing from view the axial condensation being due mainly to the very oblique inclination of the radial fibres.

The radial fibres are from 30 to 70μ (rarely more) in stoutness, and, speaking generally, consist almost entirely of megascleres regularly arranged in close parallelism,—the spongin cementing the spicules seldom forming a very well defined sheath, and more usually being so small in quantit as to be barely discernible unless stained. The main fibres of the axial skeleton are mostly coarser—up to 90 or 100μ in stoutness—and much more sponginous, and the spicules composing them are less compactly arranged; they form by interunion among themselves, and with the aid of numerous short connecting fibres, a dense, lattice-like meshwork, in which the course of the individual fibres is rather difficult to trace. The extra-axial connecting fibres occur at irregular intervals, and are either single (spongin-ensheathed) spicules or, more usually, are composed of several (seldom more than five or six) disorderly-arranged spicules interunited by spongin.

Megascleres.—The megascleres are oxea and relatively few styli, the number of the latter being approximately somewhere between one-fifteenth and one-thirtieth that of the former; among them, an occasional strongyle is also to be met with. They are almost invariably curved,—as a rule a little angulately; are (with the exception of the very stoutest) of uniform, or nearly uniform diameter throughout their length to within 25μ or less of their extremities; and usually taper thence, either regularly or with the intermediacy of one or two more or less abrupt contractions, to a sharp or only slightly rounded-off point. Spicules with much blunted extremities, however, are, in some specimens, by no means uncommon. A certain proportion of the irregularly-ended spicules terminate mucronately. Among the megascleres of the stalk—rarely, if ever, in other parts of the sponge—occasional (yet constantly occurring) ones are met with which taper almost (or, if stylote, quite) from end to end in one direction, *i.e.*, are markedly anisoactinal. In the stalk, also, the megascleres attain to a much greater maximum size than elsewhere, and are often slightly more fusiform in shape. In three of the examined specimens (including among them the one with rare microstrongyla) the megascleres are of approximately the same dimensions—ranging from about 160 (but rarely below 200) to 300μ in length, and up to 9μ in stoutness, in the branches, and attaining a maximum size of 440 x 15μ in the stalk: in the fourth specimen—in which, also, the megascleres are much more frequently blunt-pointed—they are notably larger, 180 to 370μ long and (at most) 11μ stout in the branches, and occasionally attaining to 510 × 17·5μ in the stalk.

Microscleres.—(i.) The spirulæ (Text-fig.3) are mostly of less than 2 turns, rarely of more than 2½. Rod-shaped derivatives of them, of all lengths between 4 and 23μ, and from 2 to 3·5μ in diameter are fairly common—numbering, say, one to every forty or fifty of the coiled spicules; the latter rarely exceed 2·5μ in diameter.



Text-fig.3.*

(ii.) The microstrongyla are imperfectly differentiated into two kinds: (1) slenderer, invariably centrotylote forms ranging in length from 12 to 27μ and in diameter from less than 1μ up to 3 or 3·5μ, and (2) stouter, rarely centrotylote ones, occasionally as much as 5μ in diameter, and seldom more than 20μ in length. The former are present in great abundance in three of the examined specimens, but are almost, or entirely absent from the fourth; the latter are scarce in all four specimens.

Text-fig.4.†

*Spirulæ and microstrongyla of *Trachycladus digitatus.*

† *Trachycladus digitatus.* Megascleres: *a*, from the stalk; *b*, from the branches.

Abnormal forms among the microstrongyla (of the kind shown in the Text-fig.) are of more frequent occurrence in the present, than in any other of the species excepting *T. pustulosus*, their proportionate number being not less than one in thirty.

TRACHYCLADUS DIGITATUS var. GRACILIS, var.nov.

(Pl. xxii., fig.3; Pl. xxiii., fig.2; Pl. xxvii., fig.2.)

Diagnosis.—Branches slender (2 to 3·5 mm. in diameter); of uniform diameter throughout their length. Oscula scattered irregularly. Dermal layer with closely packed spirulæ throughout its entire thickness. Radial fibres of lesser length than the diameter of the axial fune. Megascleres almost exclusively sharp-pointed oxea; stylote modifications much more frequent in occurrence than strongylote; maximum size, 530 × 23μ in the stalk, rarely as much as 430 × 15μ in the branches.

Loc.—Port Jackson.

Occurring in the collection is a single specimen (labelled as from Port Jackson, and well-preserved in alcohol) which, while presenting the more essential features displayed by the typical form of the species, yet differs in many respects so appreciably from the above-described specimens that it seems advisable, provisionally at least, to regard it as constituting a separate variety. The differences which distinguish it externally (Pl. xxii., fig.3) are chiefly these: the cylindrical, untapered branches are comparatively slender, measuring only from 2 to 3·5 mm. in diameter (the specimen itself being 115 mm. in total height); the consistency is very firm, the branches being stiffly flexible and but slightly compressible; and the colour superficially is a subtranslucent slaty-grey. The size and distribution of the pores and of the oscula are much the same as in the typical variety, except that the pores are smaller (not exceeding 65μ in diameter), and their linear reticulate arrangement (Pl. xxvii., fig.2) is more pronounced. As in the typical variety also, the main exhalant canals leading to the oscula are visible through the dermal membrane, presenting an appearance as of veins; but they are here very much more distinct, and are traceable for a much greater distance from the oscula The dermal membrane varies from 50 to over 100 (rarely to 130μ) in thickness, and is closely packed throughout with spirulæ.

The distinctive internal features are the very much greater relative development of the axial fune as compared with the extra axial skeleton, the slightly stouter and more sponginous fibres, and the greater dimensions of the megascleres. In the first-mentioned respect, as may be seen from the figure (Pl. xxv., fig. 2), the skeleton (which is of a pale brownish-grey tint) approaches rather closely to that of *T. scabrosus*—inasmuch as, throughout the greater part of the length of the branches, the axial condensation occupies not less than three-fourths of their diameter; only towards the extremities of the branches do the radial fibres become distinctly apparent, and even there their length never much exceeds 1 mm. The diameter of the radial fibres varies from 30 to over 80μ, and their spicules are always surrounded by a well-defined, though usually very thin layer of spongin. The spongin does not extend to the very extremities of the fibres, but terminates quite abruptly a short distance therefrom, leaving the endmost spicules free.

In correspondence with their greater stoutness, the megascleres (*cf.* Text-figs. 4 and 5) are slightly more fusiform than in the typical variety; and their apices

Text-fig. 5.—*Trachycladus digitatus* var. *gracilis*. Megascleres: *a*, from the stalk; *b*, from the branches.

are nearly always sharply and regularly pointed. Styli are of rather frequent occurrence, their proportionate number being approximately one in ten: anisoxea are met with in the stalk and very rarely also in the branches. They range in length from about 280 to 420 or 430μ (with a maximum stoutness of 14 or 15μ) in the branches, and up to 530μ in length by 23μ in stoutness in the stalk.

The spirulæ and their derivatives are without distinctive features, either as regards size or relative numbers.

The microstrongyla appear to be exclusively of the *stouter* kind occurring in the typical variety, and never centrotylote: they are moderately scarce, and attain a size of 20 by 5μ.

TRACHYCLADUS DIGITATUS var. CLAVATUS, var.nov.
(Pl. xxii., fig.4; Pl. xxiii., fig.3; Pl. xxv., fig.2; Pl. xxvii. fig.3; Pl. xxviii., fig.5; Pl. xxix., fig.1.)

Diagnosis.—Branches gradually increasing in diameter distally, thus becoming elongately club-shaped and attaining to fair stoutness. Oscula in part scattered irregularly, and in part (or sometimes almost without exception) arranged more or less distinctly in two longitudinal series on opposite sides of the branches. Radial fibres generally nearly twice the diameter of the axial fune. Megascleres chiefly sharp-pointed oxea, but intermediate forms between these and strongyla are more or less frequent; stylote modifications comparatively rare; maximum size varying (in different specimens) from 400 × 14μ to 480 × 17μ in the stalk, rarely exceeding 300 × 9μ in the branches.

Loc.—Port Phillip.

This variety is based upon three specimens markedly distinguished from all the remaining available examples of the species by the shape of the branches, which gradually increase in diameter upwards from their base, attaining their maximal stoutness at no great distance from their extremities. Two of the specimens are comprised amongst those recorded by Dendy(**7**) as examples of *Trachycladus lævispirulifer* Carter,—being, namely, the two (with the reg. nos. 415 and 1046) referred to by him as distinguished from the others by their more robust and stouter branched habit and the more evident microspination of their spirulæ; the third, which I select as the type-specimen, is in the collection of the Australian Museum.

External characters.—Of the three specimens, two (which are excellently preserved in alcohol)—viz., the Australian Museum specimen and R.N. 1046—are exceedingly alike in all but size; the former (Pl. xxii., fig.4) measures 145 mm. in total height, the latter 100 mm. Their branches are, without exception, circular or nearly so in cross-section, attain a maximal stoutness distally of from 10 to 12 mm., and are seldom more than 5 mm. in diameter at the base: the extremities of the branches are never in the least degree pointed. The surface is perfectly even and glabrous, without the faintest trace of granulation. The oscula are minute, seldom as much as 0·4 mm. in diameter, and for the most part are scattered irregularly; in places, however, they exhibit a tendency towards a longitudinal serial arrangement. Excurrent canals leading to the oscula are not visible through the dermal membrane. The colour in alcohol, both superficially and for some distance interiorly, is an opaque pale creamy-white; proceeding towards the axis, it gradually becomes more yellowish, owing to the closer approximation of the spongin-ensheathed skeletal fibres. The consistency, in the more expanded, distal parts of the branches, is soft and resilient; the branches are flexible and elastic.

The other specimen (R.N. 415), measuring 108 mm. in total height, exhibits the following differences (Pl. xxix., fig.1): (i.) The branches (which vary from 10 to 14 mm. in stoutness) are mostly pointed at the extremities, and rendered irregular by occasional swellings and protuberances (incipient secondary branches); (ii.) the oscula, almost without exception, are arranged along the branches in irregular opposite rows, and the largest are nearly 1 mm. in diameter; (iii.) the surface is minutely wrinkled, and in parts slightly granular; and (iv.) the consistency is comparatively firm and hard, and the branches are brittle rather than flexible. Otherwise, however, with the exception of the single difference mentioned in the next paragraph, the specimen agrees in all essential respects with the preceding; and, furthermore, the differences (iii.) and (iv.) are, almost undoubtedly, due merely to the fact of the specimen's having been allowed to become partially dried before being placed in alcohol.

Text-fig. 6.*

The pores are notably larger in size than in the two preceding varieties, varying in diameter from 40 to 120 μ, and are more uniformly distributed (Pl. xxvii., fig. 3). The dermal layer is from 40 to 90 μ in thickness, and, in the case of the two similar specimens, is closely packed throughout with spirulæ. But in R.N. 115, only a superficial layer of the dermis—usually less than 25 μ in thickness—is packed with spirulæ, the remaining portion being occupied by numerous parasitic algal cells.

The skeleton presents no appreciable point of difference from that of the typical variety excepting that the radial fibres are generally much longer—their length, in the expanded portions of the branches, being about twice the diameter of the axial fune (Pl. xxv., fig. 3). The fibres attain, at most, a stoutness of 70 to 80 μ, but are usually much slenderer, and are always provided with a distinct, though thin sheath of pale-coloured spongin. The skeleton, seen in its entirety, is pale golden-yellowish.

The megascleres of the stalk are scarcely different from those of

* *Trachycladus digitatus* var. *clavatus*. Megascleres: *a*, from the stalk; *b*, from the branches.

the typical variety, while those of the branches are different only in the fact that their extremities are most frequently more or less blunt-pointed, and strongylote forms are common. The branch-spicules are of the same dimensions in all three specimens, ranging in length from about 170 to slightly above 300 μ and attaining to about 9 μ in stoutness: the stalk-spicules have a maximum size, in the type-specimen, of (rarely) 480 × 15 μ; in R.N. 1046, of 450 × 17 μ; and in R.N. 415, of 400 × 14 μ.

The spirulæ are not distinguishable from those of the typical variety. Microstrongyla are rather scarce in R.N. 415, and in the other two specimens are extremely rare or absent; apparently they are never centrotylote, and are at most 15 × 3 μ in size. Abnormal forms of the microstrongyla, such as occur in the typical variety, were not observed.

TRACHYCLADUS DIGITATUS var. STRONGYLATUS, var.nov.

(Pl. xxii., fig.5; Pl. xxiii., fig.4; Pl. xxvi., figs.5, 6; Pl. xxvii. fig.4.)

Diagnosis.—Branches cylindrical, untapered, moderately slender. Oscula irregularly scattered. Dermal membrane with closely packed spirulæ confined to a superficial layer seldom as much as 25 μ in thickness. Radial fibres of lesser length than the diameter of the axial fune. Megascleres chiefly strongyla and very blunt-pointed oxea,—those in the branches rarely exceeding 290 by 7 μ in size.

Loc.—Port Phillip.

This variety is represented by a single incomplete (but excellently preserved) example (Pl. xxii., fig.5)—consisting only of a pair of united branches—the appearance (of the proximal part) of which suggests its having grown from a small broken-off piece of another specimen. As compared with the representatives of the preceding varieties, the specimen is distinguished chiefly by the more or less strongylote character of the majority of its megascleres—in which respect it rather resembles an example of *T. reteporosus*; this statement, however, is possibly true only as regards the megascleres of the branches, since a stalk is lacking. The branches are cylindrical and slender, 3·5 to 5 mm. in diameter.

The surface is minutely granular. The oscula are scattered irregularly, and vary in diameter from 0·3 to 0·75 mm. The colour superficially is pale brownish-grey. The dermal pores (Pl. xxvi., figs.3, 6; Pl. xxvii., fig.4) are for the most part scattered singly and irregularly, as in the variety *clavatus*, but here and there, especially on some parts of the surface, they exhibit also a tendency to become arranged several together in incipiently sieve-like groups; they range from 40 to 110μ in diameter. The dermal membrane is rarely, if ever, more than 50 or 60μ in thickness; and the dermal spirulæ are confined to a superficial layer which is at most 25μ in thickness.

Text-fig.7.*

Examined in its entirety, the prepared skeleton (Pl. xxiii., fig.4) is of a pale golden-yellow colour, fine textured, and of soft feel, and of denser appearance extra-axially than that of any other of the varieties or species owing to the greater number and closer arrangement of the radial and connecting fibres, which quite conceal the axial core from view; the core itself is less dense than that of the other varieties. The radial fibres, which are of slightly lesser length than the diameter of the core, are mostly between 30 and 50μ—rarely as much as 60μ—in stoutness, and are seldom provided with spongin sufficient in quantity to form a distinct ensheathing layer.

The megascleres in the uppermost part of the branches consist almost entirely of strongyla and blunt-pointed oxea (the former somewhat the more numerous), and rarely if ever exceed 300 by 7·5μ in size: the length of the shortest spicules is less than 150μ, and individuals below 200μ in length are common. At the

*?*Trachycladus digitatus* var. *strongylatus*. Megascleres.

lowermost extremity of the (incomplete) specimen, the megascleres are still chiefly strongyla, but they comprise also a quite appreciable number of more or less sharp-pointed oxea, and range in size up to 350 by 10μ. The spinispirulæ and their more or less rod-shaped derivatives (the latter of which are rather rare) are very seldom, if ever, more than 2μ in stoutness. Microstrongyla were not observed.

TRACHYCLADUS RETEPOROSUS, sp.nov. (et varr. ?).

General diagnosis.—Branches elongated and tapering. Surface smooth to slightly granular. Oscula entirely, or for the most part, disposed in longitudinal series. Dermal membrane at most 50μ in thickness; with closely packed spirulæ occurring only in a thin superficial layer. Dermal pores arranged wholly or in part in subcircular sieve-like groups; in any case, the distance separating adjoining pores is generally very much less than their own diameter. Skeleton with a relatively very dense axial fune of diameter equal to or less than the radial fibres. Radial fibres directed at an angle varying from (rarely less than) 45° to nearly 90° to the skeletal axis; never more than about 50μ in stoutness; generally with a well-defined, though thin spongin-sheath. Megascleres chiefly strongyla and very blunt-pointed oxea, the former somewhat the more numerous; only occasionally slightly larger in the stalk than elsewhere; varying in maximum size (in different specimens) from 290 × 7 to rarely (in the stalk) 330 × 10μ.

Loc.—Port Phillip.

The specimens which I ascribe to this species exhibit in certain respects considerable variability, so that it is impossible to be certain whether they are representative of several genetically distinct forms or owe their differences merely to individual variation. A second difficulty in connection with the species arises from the fact that, in certain of the specimens, the mode of disposition of the dermal pores approaches somewhat closely to that characteristic of *T. digitatus*, and in others again, owing to their shrunken condition, the pores are not discernible; in the case of these specimens, accordingly,—since no appreciable difference exists in spiculation between the present species and *T. digitatus* var. *strongylatus*,—the only definitely definable character justifying their inclusion in the present species, rather than in *T. digitatus*, is the elongate tapering habit of their branches. Among the remaining specimens, however, there is one which in various respects stands considerably apart from all the rest, and in these respects also is by far the most divergent from *T. digitatus*. I therefore select this specimen to represent the typical form of the species, and the remainder I refer provisionally to an undesignated variety, leaving the problem of their correct allocation to be determined in the future.

T. RETEPOROSUS, typical form.

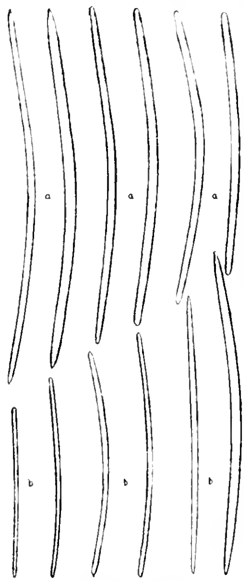
(Pl. xxi., fig.2; Pl. xxiii., fig.5; Pl. xxiv., fig.3; Pl. xxvi., figs.1, 4, 7; Pl. xxvii., fig.5.

The single, excellently preserved specimen (Pl. xxi., fig.2),—which measures 340 mm. in total height—consists of a half-score of long, lax, straight, gradually tapered, main branches (160 to 250 mm. in length), arising dichotomously and sub-dichotomously within a comparatively short distance of the short stalk, and of about the same number of shorter (10 to 120 mm. long), but otherwise similar, sporadically occurring secondary branches. But for overlapping and occasional slight torsion, the branches would be disposed in a single plane, and the habit of the sponge flabellate. The branches, in addition to tapering distally, are also more or less narrowed proximally (attaining their maximum stoutness usually at some considerable distance above their base), and, with the exception of a few of the shorter ones, are generally more or less compressed in the plane of branching: the stoutest measure at most 12 or 13 mm. in the major diameter of their cross-section, and 9 to 10 mm. in the direction at right angles thereto. Anastomosis between the branches does not occur. The oscula, which measure up to 0·75 mm. in diameter, are arranged almost exclusively, though not always very regularly, in two longitudinal series situated on opposite sides of the branches, or occasionally in a single longitudinal series. The surface is smooth and even, without the faintest trace of granulation; on close inspection, it presents a minutely reticulate appearance due to the dermal pores (Pl. xxvi., fig.4). The dermal membrane is thin and (owing to the multitude and close apposition of the minute pores) of gauzy appearance,— permitting to be perceived through it, more or less distinctly, the subdermal pinhole-like openings which are the entrances of the incurrent canals. The consistency is rather fleshy, soft, and resilient, and the branches are flexible and lax. The colour in alcohol is pale orange-yellow.

The dermal pores are arranged in closely approximated, oval to circular groups or "pore-sieves" (Pl. xxvi., figs.4, 7; Pl. xxvii., fig 5) containing each from 3 to 8 pores, and measuring up to 350μ in diameter; the pores themselves measure from 50 to about 100μ in diameter. Very commonly, the boundaries between the sieves are scarcely more pronounced or wider than those separating the pores, so that, in places, the lines of demarcation between the sieves become obscure and the pores appear almost to be uniformly distributed. Within the pore-sieves, the dermal membrane is extremely thin, and contains but very few spirulæ sparsely scattered.

Skeleton. The skeletal axis or core is much more sharply defined and delimited than in any other of the species, and is equalled in density only by that of *T. fastigatus*; in comparison with the stoutness of the branches, it is rather slender, measuring in diameter generally not more than two-thirds of the length of the radial fibres. The radial fibres proceed outwards from the axis in a direction inclined to it at an angle of 60° and upwards, and arrive at the surface almost perpendicularly thereto. Connecting fibres between the radial fibres are extremely few; consequently, in the prepared or macerated skeleton (Pl xxiii. fig.5), the radial fibres are easily disarranged and thus usually present a somewhat dishevelled appearance. The colour of the skeleton is pearl-grey except axially, where it is brownish-grey. The radial fibres are rarely as much as 50μ in stoutness, and are usually provided with a distinct layer of spongin external to the spicules. The connecting fibres consist frequently of only a single spicule, and seldom of more than two.

Megascleres.—Contrary to what is the case in the other herein-described species, *T. fastigatus* excepted, the megascleres are but very rarely, and then only very slightly, of larger size in the stalk than in the branches. They are chiefly strongyla and blunt-pointed oxea approximating more or less in form to strongyla; quite sharp-pointed oxea are comparatively scarce. The strongyla are usually cylindrical or nearly so throughout their whole length, the oxea to within a short distance of their extremities. They attain a maximum size of 300 by 8·5μ. Individuals above 280 by 7μ are rare, and these for the most part are slightly fusiform oxea with more or less sharp-pointed extremities. The shortest spicules are less than 130μ in length, and almost invariably strongyla.



Text-fig.8.*

Microscleres.—The spirulæ are usually of less than 2 complete turns, rarely, if ever, of as much as $2\frac{1}{2}$; they are somewhat slenderer than those of other species, their diameter very seldom slightly exceeding 1·5μ. Rod-shaped derivatives of the spirulæ, attaining a maximum size of about 17 by 1·7μ, are very scarce.

Microstrongyla are apparently absent.

T. RETEPOROSUS, var. (aut varr.?).

(Pl. xxi., fig.3; Pl. xxiii., figs.6-8; Pl.xxiv., figs.1, 2; Pl. xxv., fig.1; Pl. xxviii., figs.1-4; Pl. xxix., fig.2.)

The remaining specimens referable, or seemingly referable, to the present species (but distinguished in various respects from the above-described typical example) are eleven in number,—comprising ten of those recorded by Dendy(7) as *T. lævispirulifer*

* *Trachycladus reteporosus.* Megascleres: *a*, from the stalk; *b*, from the branches.

Carter, together with an incomplete specimen occurring in the collection of the Australian Museum: the register-numbers of the former are 297, 366, 426, 470 (two spms.), 983, 984, 1000 (two spms.), and 1061. So far as skeletal features are concerned, the specimens exhibit no marked differences (either among themselves or from the typical example), except in certain details of their microspiculation; but the extra-axial skeleton is somewhat less sparse than in the type-specimen,—as may be observed from a comparison of the figures illustrating the appearance of the entire skeleton,—and the colour of the skeleton (in the denser portions thereof) is not brownish-grey, but varies from pale straw-yellow to light golden-yellow. The megascleres are, in all of them, of approximately the same forms and dimensions as in the typical specimen, the greatest deviation by far occurring in in the case of R.N. 426, in which the megascleres of the stalk attain a maximum size of 325 by 9·5μ, while those of the branches rarely exceed 290 by 7·5μ. All likewise agree with the type-specimen in possessing long and relatively rather slender branches, which attain their maximum stoutness at some distance above their base; and, with rare exceptions, the branches taper more or less distally. On the other hand, in a number of other external features, and especially in the distribution of the dermal pores, considerable variability is displayed. Non-anastomosis between the branches is the rule. The colour, except in one instance, is some shade of pale yellowish-grey.

Exact resemblance to the typical specimen, as regards the mode of disposition of the dermal pores, is shown only by the incomplete specimen which is in the collection of the Australian Museum. In this specimen, the surface is somewhat ruggedly uneven (Pl. xxi., fig.3), the branches (with a maximum stoutness of only 8mm.) are not at all flattened, and the colour is a slightly salmon-pinkish stone-grey. Microstrongyla are absent. (A photograph of the macerated skeleton is shown in Pl. xxiii., fig.6).

R.N. 1061 approaches the typical specimen in general habit (Pl. xxiv., fig.1), but the branches are much less tapered (occasionally of nearly uniform diameter throughout their length), the surface is faintly granular and somewhat uneven, and the oscula are almost as frequently scattered as arranged serially; the consistency, also, is comparatively firm. The branches vary from (rarely) cylindrical to much compressed, and are usually somewhat lenticular in cross-section. The pores are almost or quite as closely situated and numerous as in the typical specimen, but for the most part they are not arranged distinctly in groups. The spirulæ are peculiar in the fact that they are much less closely coiled than in any other example of the genus, the shape of most of them approaching more or less to that of a contort S: more or less C- or (-shaped forms are also common, but straight or nearly straight rods are extremely rare. Scarce (though by no means rare) microstrongyla are present, varying from 9 to 16μ in length and from 2 to 4μ in stoutness, and almost invariably centrotylote. (A photograph of the macerated skeleton is reproduced in Pl. xxiii., fig.8).

The two specimens R.N. 1000 are much alike in general habit, —which probably accounts for their being registered under the same number,—and differ from all the other specimens, with the exception of R.N. 362, 983, and 984, by the occasional coalescence of their branches: the branches are slender (5 to 8 mm. in diameter), gradually tapered, and not at all compressed: and the surface is somewhat uneven and slightly granular. Nevertheless, in one of the specimens the pores are arranged (Pl. xxviii., fig.2) very nearly as in the typical specimen, while in the other they are distributed singly (Pl. xxviii, fig.1) almost in the same manner as in *T. digitatus*. In both, microstrongyla are exceedingly rare.

In R.N. 983 and 984 the arrangement of the pores (Pl. xxviii., figs.3, 4) is intermediate between that obtaining in R.N. 1061 and that characteristic of *T. digitatus* var. *strongylatus*. The former specimen consists solely of two long branches (one simple, the other with a partially coalescent secondary branch towards its upper extremity), measuring respectively 200 and 300 mm. in length, and both arising almost independently from a small common disc of attachment without the intervention of a stalk. The branches are only 4 mm. in diameter proximally and increase in stoutness upwards very gradually, the larger one attaining a maximum diameter of 12 mm. at a distance of about 50 mm. from its apex, and thence gradually tapering to a point, the smaller one 8 mm. in greatest stoutness and distally untapered. The other specimen, R.N. 984, consists only of a broken-off pair of fused branches somewhat similar to those just described.

R.N. 426 is in one respect unique: the surface is finely hispid, being rendered so by the extremities of the radial skeletal fibres, which everywhere project ½ to 1 mm. beyond it, presenting the appearance of delicate hairs. Furthermore, although the specimen appears to be excellently preserved, the dermal pores have entirely disappeared, and even the oscula are completely closed. Since the skeletal fibres are altogether too slender and weak to be considered capable of withstanding the bending strain which a shrinkage of the sponge due to the action of the preservative fluid would exert, the peculiar condition of the specimen must almost certainly be the result of contraction while in the living condition. In general outward habit, as is evident from the figure (Pl. xxiv., fig.2), this specimen rather resembles the typical specimen. Scarce strongyla are present, similar to those of R.N. 1061.

The two specimens R.N. 470 consist each of only a few detached branches, which, apart from being non-hispid, are exactly similar in every way to those of the preceding specimen. In one of these specimens, no microstrongyla were observed; in the other (and in this alone of all the specimens) they are fairly abundant, resembling in form and size those of R.N. 1061. (A photograph of the macerated skeleton is shown in Pl. xxiii., fig.7).

In R.N. 297 and 366,—both of which are in a dried, much shrunken condition, and consequently afford no information regarding the pores,—the spirulæ are distinguished by being mostly of less than one complete turn and hence more or less C-shaped; straight rods of all lengths from 3 to upwards of 15μ are also common, especially the shorter ones. R.N. 366 consists of a main stem or branch, about 200 mm. in length, attached by its base (which spreads to form a thin incrusting disc about 4 mm. in area) to the surface of a shell, and sending off on one side, at the distances of 50, 60, and 80 mm. respectively from its base, three secondary branches which become coalescent with one another. R.N. 297 is unique in consisting solely of a long slender unbranched stem, 250 mm. in length. In both specimens the extremities are tapered. In neither were microstrongyla observed.

TRACHYCLADUS PUSTULOSUS, sp.nov.

(Pl. xxi., fig.5; Pl. xxvi., figs.5, 8; Pl. xxvii. fig.6; Pl. xxxix., figs.6, 7.)

1887. (?)*Spirophora bacterium* Lendenfeld(**26**), p.795.

Diagnosis.—Branches quite short and distally expanded; sometimes so abbreviated as to be little more than mammiform lobes. Surface closely studded with small pimple-like elevations, and exhibiting, on close inspection, a minute reticulate pattern due to the mode of arrangement of the dermal pores. Oscula situated only on the more distal parts of the branches. Dermal pores arranged in close-set, subcircular, sieve-like groups, usually with from 3 to 7 pores in each group. Dermal layer loosely packed with spirulæ usually throughout its entire thickness—which varies from 40 to 80μ. Skeleton in the upper, more expanded, parts of the branches not forming an axial fune. Fibres stout, and provided with much spongin. Megascleres in the upper parts of the branches consisting almost exclusively of strongyla and oxea in about equal numbers, and rarely attaining to $320 \times 9\mu$ in size; peduncular megascleres chiefly oxea (together with occasional styli and only rare strongyla), attaining a maximum size of $460 \times 15\mu$. Microstrongyla extremely abundant, frequently assuming various abnormal shapes, and in part reduced to spheres.

Loc. Port Phillip.

This species,—of which two well-preserved specimens are at hand, one incomplete, consisting only of a few branches,—is characterised especially by its short stunted branches and very noticeably pimpled surface, and by the fact that the skeleton, except in the stalk and the lowermost part of the longer branches, is only slightly or not at all condensed axially (Pl. xxxix., fig.6). Whilst these features sharply mark it off from all the other known species, it is still further distinguished by having the pores arranged in sieve-like groups (Pl. xxvi., fig.5)—in which respect it is approached only by *T. reteporosus*—and by the reduction of the microstrongyla in part to spheres. An adequate idea of the external habit will be obtained by reference to the figure (Pl. xxi., fig.5) of the single complete example, which measures 60 mm. in total height: in the case of the other specimen, the branches are somewhat longer, several of them attaining a length of 25 mm. The colour in alcohol is a minutely mottled, slightly brownish pale grey, and the consistency is firm, fairly tough, compressible and resilient.

The surface-pimples,—which coincide in position with, and to some extent are the expression of, the points of impingement of the skeletal fibres upon the dermal membrane,—are fairly uniformly distributed over the whole surface at a distance apart approximating to their own breadth, which on the average is about 0·4 mm.; they are rounded or flattened above, not conule-like, and are conspicuous not so much by the amount of their projection—which at the most is but slight—as by their whitish colour and more opaque appearance compared with the intervening portions of the surface. At the locations of the small areas formed by these elevations, the dermal membrane is closely adherent and non-porous; but between them it overlies subdermal spaces, and is so perforated by numerous small pore-sieves as to appear minutely reticulate. The pore-sieves (Pl. xxvi., fig.7; Pl. xxvii., fig.6), are oval to circular in outline and generally between 40 and 120μ in distance apart, range from less than 100 up to about 200μ in diameter, and contain each, according to their size, from 2 to 8 pores of diameter varying from 20 to 60μ.

Skeleton.—Except in the stalk and the lower portions of some of the lower branches, the skeleton exhibits no well-marked axial condensation or core, but is rather of the dendritic type (Pl. xxxix., fig.7) consisting chiefly of longitudinally-running and of gradually outward-trending, continually branching main fibres, which are not distinguishable as axial and radial respectively; transverse or connecting fibres are numerous between the main fibres in the central region of the branches, but comparatively scarce and somewhat irregular in occurrence towards their surface The main fibres attain a stoutness occasionally of nearly 200μ in the axial region of the skeleton, but diminish in diameter peripherally to between 60 and 100μ; they are composed of somewhat loosely and irregularly packed spicules united by abundant spongin-cement. The connecting fibres are usually less than 50μ in stoutness and are composed almost entirely of spongin. The spongin shrinks considerably on drying, so that in the dried skeleton the stoutness of the fibres is much less than stated above. The skeleton seen in its entirety (Pl. xxxix., fig 6) is of a golden-yellow colour.

Text-fig. 9.—*Trachycladus pustulosus.* Megascleres: *a*, from the stalk; *b*, from the branches.

Megascleres.—The differences between the megascleres of the stalk and of the branches are more marked than in any other of the species herein described, the former consisting almost entirely of sharp-pointed oxea, ranging from seldom less than 250 up to 460μ in length and up to 16μ in stoutness, and very similar in form and size to those of *T. digitatus* var. *strongylatus*, while the latter are strongyla and more or less blunt-pointed oxea—the strongyla being if anything somewhat the more numerous—ranging in length from occasionally less than 150μ up to about 320 or 330μ, and seldom exceeding 8·5 or 9μ in stoutness. Occasional styli are met with, which are most frequent among the peduncular megascleres; among the latter also anisoxea are not uncommon.

Microscleres.—The spirulæ are of all forms between corkscrew-spirals of a little more than 2 turns and straight rods, the latter fairly common and mostly between 12 and 25μ in length and from 2 to 3·5μ in diameter. The spirulæ are less closely coiled than in any other of the species, and are also slightly larger (occasionally attaining to 18μ in length).

The microstrongyla are rarely less than 2 or more than 3·5μ in diameter, and of all lengths up to 18μ; a notable proportion are reduced to spherulæ. They are mostly not centrotylote. Abnormal forms of various shapes are rather common.

EXPLANATION OF PLATES XXI.-XXIX., figs.1-2; XXXIX., figs.6-7.

Plate xxi.

Fig.1.—*Trachycladus fastigatus*, sp.nov.: from the (partially dried) type-specimen; ($\times \frac{3}{8}$).

Fig.2.—*T. reteporosus*, sp.nov.; from the type-specimen; ($\times \frac{1}{3}$).

Fig.3.—*T. reteporosus*, sp.nov. (var. ?); from an incomplete specimen with slightly rugose surface; ($\times \frac{1}{2}$). *Cf.* also Pl. xxiv., figs.1-2.

Fig.4.—*T. scabrosus*, sp.nov.; from the type-specimen; ($\times \frac{2}{3}$).

Fig 5.—*T. pustulosus*, sp.nov.; from the type-specimen; ($\times \frac{4}{5}$ nearly).

Plate xxii.

Figs.1-2.—*Trachycladus digitatus* Lendenfeld, typical form; ($\times \frac{5}{8}$ approx.).

Fig.3.—*T. digitatus* var. *gracilis*, var.nov.; from the type-specimen; ($\times \frac{5}{6}$).

Fig.4.—*T. digitatus* var. *clavatus*, var.nov.: from the type-specimen; ($\times \frac{3}{4}$ nearly).

Fig.5.—*T. digitatus* var. *strongylatus*, var.nov.; from the (incomplete ?) type-specimen; ($\times \frac{9}{10}$).

Plate xxiii.

Fig.1.—*Trachycladus digitatus* Lendenfeld, typical form; skeleton; (nat. size).

Fig.2.—*T. digitatus* var. *gracilis*, var.nov.; skeleton; (nat. size).

Fig.3.—*T. digitatus* var. *clavatus*, var.nov.; skeleton; (nat. size).

Fig.4.—*T. digitatus* var. *strongylatus*, var.nov.: skeleton; (nat. size).

Figs.5-6.—*T. reteporosus*, sp.nov.: skeleton (of the type-specimen and of the specimen illustrated in Pl. xxi., fig.3, respectively); (nat. size).

Figs.7-8.—*T. reteporosus*, sp.nov., (var. ?); skeleton (of the specimens figured in Pl. xxiv., figs.1-2); (nat. size).

Fig.9.—*T. scabrosus*, sp.nov.; skeleton; (nat. size).

Fig.10.—*T. fastigatus*, sp.nov.; skeleton; (nat. size).

Plate xxiv.

Fig.1.—*Trachycladus reteporosus*, sp.nov., (var. ?); R.N.1061; (× ½).

Fig.2.—*T. reteporosus*, sp.nov., (var. ?); R.N.426 (a specimen in which the dermal pores could not be seen); (× ½).

Fig.3.—*T. reteporosus*, sp.nov., typical form; one-half of a (desilicified) longitudinal median section of a branch of the type-specimen, showing the dermal layer (in part torn away), subdermal spaces, excurrent and incurrent canals, flagellated chambers, and (on the left) portion of the axial skeleton; (× 18).

Plate xxv.

Fig.1.—*Trachycladus reteporosus*, sp.nov., (var. ?); longitudinal median section of the skeleton; (× 10).

Fig.2.—*T. digitatus* Lendenfeld, var. *clavatus*, var.nov.; portion (slightly less than one-half) of a transverse section of a branch, showing the arrangement of the flagellated chambers, etc.; (× 18).

Plate xxvi.

Fig.1.—*Trachycladus reteporosus*, sp.nov., (typical form); longitudinal median section of the skeleton, showing the pattern of the axial fune; (× 10).

Fig.2.—*T. digitatus* Lendenfeld, (typical form); portion of the surface (from part of which the dermal membrane has been pared off) showing the disposition of the dermal pores, and also of the main incurrent canals; (× 6).

Fig.3.—*T. digitatus* var. *strongylatus*, var.nov.; portion of the surface, showing the arrangement of the dermal pores and the character of the oscula; (× 6).

Fig.4.—*T. reteporosus*, sp.nov.; portion of the surface, showing the arrangement of the dermal pores; (× 6).

Fig.5.—*T. pustulosus*, sp.nov.; portion of the surface, showing the arrangement of the dermal pores; (× 6).

Fig.6.—*T. digitatus* var. *strongylatus*, var.nov.; portion of the surface, showing the arrangement of the dermal pores; (× 20). (From a drawing).

Fig.7.—*T. reteporosus*, sp.nov., (typical form): portion of the surface, showing the arrangement of the dermal pores; (× 30). (From a drawing).

Fig.8.—*T. pustulosus*, sp.nov.; portion of the surface, showing the arrangement of the dermal pores; (× 30). (From a drawing).

Fig.9.—*T. digitatus* Lendenfeld, var. *gracilis*, var.nov.; moderately thick, transverse section of a branch; (× 18).

Plate xxvii.

Fig. 1.—*Trachycladus digitatus* Lendenfeld, (typical form); surface-section, showing the arrangement of the dermal pores; (× 40).

Fig. 2.—*T. digitatus* var. *gracilis*, var. nov.; surface-section, showing the arrangement of the dermal pores; (× 40).

Fig. 3.—*T. digitatus* var. *clavatus*, var. nov.; surface-section, showing the arrangement of the dermal pores; (× 40).

Fig. 4.—*T. digitatus* var. *strongylatus*, var. nov.; surface-section, showing the arrangement of the dermal pores; (× 40).

Fig. 5.—*T. reteporosus*, sp. nov., (typical form); surface-section, showing the arrangement of the dermal pores; (× 40).

Fig. 6.—*T. pustulosus*, sp. nov.; surface-section, showing the arrangement of the dermal pores; (× 40).

Plate xxviii.

Fig. 1.—*Trachycladus reteporosus*, sp. nov., (var. ?); portion of the surface (of one of the specimens R.N. 1000) showing the arrangement of the dermal pores; (× 40).

Fig. 2.—*T. reteporosus*, sp. nov., (var. ?); surface-section (of R.N. 1061), showing the arrangement of the dermal pores; (× 40).

Figs. 3, 4.—*T. reteporosus*, sp. nov., (var. ?); surface-sections (of the specimens R.N. 983, 984), showing the arrangement of the dermal pores; (× 40).

Fig. 5. *T. digitatus* Lendenfeld, var. *clavatus*, var. nov.: rather thin (undesilicified) transverse section of a branch; (× 15).

Fig. 6.—*T. scabrosus*, sp. nov.; rather thin (desilicified) transverse section of a branch; (× 20).

Plate xxix., figs. 1-2.

Fig. 1.—*Trachycladus digitatus* Lendenfeld, var. *clavatus*(?), var. nov.; specimen R.N. 415; (× ½).

Fig. 2.—*T. reteporosus*, sp. nov., (var. ?); thin, transverse section of a branch (of specimen R.N. 1000); (× 15).

Plate xxxix, figs. 6-7.

Fig. 6.—*Trachycladus pustulosus*, sp. nov.; skeleton photographed by transmitted light; (nat. size).

Fig. 7.—*T. pustulosus*, sp. nov.; showing pattern of the skeleton as seen in thin longitudinal section (passing through three branches and the upper part of their common stem); (× 5).

NOTES AND EXHIBITS.

Mr. Fred Turner exhibited a number of fruits of *Fusanus acuminatus* R.Br., var. *chrysocarpus* Turner, the "Yellow Quandong," forwarded to him by the Venerable Archdeacon F. E. Haviland, of Cobar, who collected them from a tree in an isolated locality on Kergunyah Station, about 35 miles north-east of Cobar, N.S.W., a new record for this remarkable tree.

Mr. Baker exhibited sections of the trunk of the Grey Mangrove (*Avicennia officinalis* Linn.), and explained the peculiar structure of the wood of this tree. Sections of leaves were also shown.

Mr. E. Cheel exhibited fresh specimens of Azalea, with "Rhododendron Galls," *Exobasidium* sp., probably *E. rhododendri* Cram., affecting a plant cultivated in the Botanic Gardens. Conidia only were present, which measured 7-12 × 1 μ; spores were not found. Examples had previously been collected by the late Mr. A. Grant in October, 1898, and by Mr. J. H. Camfield in August, 1913.

Mr. A. A. Hamilton exhibited, from the National Herbarium, examples of (1) *Rubus moluccanus* Linn., showing irregular, foliar fission, and a varicoloured tomentum. A gradual reduction from a compound (trifoliate) leaf to a simple one may be found. Examples collected at Douglas Park (A. A. Hamilton; December, 1915) range from trifoliate to tripartite; and a series from Gosford (A. A. Hamilton; January, 1916), continues the irregular dissection, from a simple but deeply lobed leaf to one slightly constricted. The tomentum of the specimens from Douglas Park is pale grey, while that of the Gosford series is ferruginous.—(2) *Sprengelia incarnata* Sm., from National Park (A. A. Hamilton; December, 1915), showing leaf-variation. The leaves exhibit a gradual increase in size from 10 to 15 mm. in length, with a basal width of 4-6 mm., to 5 cm. long and 15 mm. wide at the base.—(3) *Darwinia taxifolia* A. Cunn., two examples showing variation in foliage and habit due to environment. A specimen from Cowan (A. A. Hamilton; May, 1915), from a sandstone-hillside, has comparatively luxuriant foliage, and is a much more robust plant (3-5 feet) than that from the Centennial Park (W. Forsyth; October, 1896), which grew in a swampy environment and has the crowded, narrow leaves clustered at the top of the otherwise bare branches, typical of the swamp-xerophyte.

Mr. North, by sanction of the Curator of the Australian Museum, exhibited a specimen of an adult male of the Superb Fruit Pigeon, *Ptilopus superbus* Temm., received from Mr. Percy K. Gorrick, of Wickham, through Mr. Julian Windeyer, of Newcastle. It was obtained at Wollomombi, 394 miles north of Sydney. Mr. North stated that although this species was fairly common in the coastal districts of North-eastern Queensland, it is extremely rare in New South Wales, only three specimens in the flesh, procured in this State, having come officially under his notice during the last thirty years. The bird was a beautiful specimen, being plump and in fine condition, the mouth and crop being absolutely crammed with the berries of a Lily-pilly. Two other specimens of this pigeon, procured at North Shore, in 1876, are in the Museum.

Mr. A. G. Hamilton exhibited a coloured drawing of an undetermined orchid, now flowering in the bush-house of a friend at North Sydney, allied to *Dendrobium tetragonum* A. Cunn., but with the thickened portion of the stem longer and larger and the flowers somewhat differently marked.

Mr. Allan R. McCulloch showed an attractive series of lantern-slides illustrative of the fauna associated with Australian Mangroves. Mr. R. T. Baker followed with a complementary set illustrating the characteristic botanical features of the Mangrove-association.

ORDINARY MONTHLY MEETING.

SEPTEMBER 27th, 1916.

Mr. A. G. Hamilton, President, in the Chair.

The President offered a very cordial welcome to Mr. C. F. Laseron, a Member who had served and been wounded at Gallipoli. He also made sympathetic reference to Mr. M. Aurousseau, another Member, recently reported as having been wounded in France.

The Donations and Exchanges received since the previous Monthly Meeting (30th August, 1916), amounting to 8 Vols., 55 Parts or Nos., 4 Bulletins, one Report, and 4 Pamphlets, received from 38 Societies, etc., and two private donors, were laid upon the table.

NOTES AND EXHIBITS.

Mr. J. L. Froggatt showed specimens of a third, at present undescribed, species of Chalcid wasp, parasitic upon the Sheep maggot-fly, from Hay, N.S.W.

Mr. W. W. Froggatt exhibited a series of specimens illustrating the life-history of the Ribbed Case-Moth (*Thyridopteryx herichii*), recently damaging the foliage of the Sugar-Gums (*Eucalyptus corynocalyx*) at Yanco, at the Irrigation Area at Leeton, and elsewhere.

Mr. Fred Turner exhibited an example of prolification of an apple given to him by Mr. J. H. Beatson, Managing Director, Messrs. Anderson & Co., Seedsmen and Plant Merchants, Sydney, who had received it from a client of his firm. There were no true carpels produced in the abnormal fruit, but a whorl of leaves (probably enlarged sepals) were developed at its summit, a very curious and interesting form of vegetable teratology.

A REVISION OF THE GENERA WITH MICROSCLERES INCLUDED, OR PROVISIONALLY INCLUDED, IN THE FAMILY *AXINELLIDÆ*; WITH DESCRIPTIONS OF SOME AUSTRALIAN SPECIES. Part ii.

[PORIFERA.]

By E. F. HALLMANN, B.Sc., LINNEAN MACLEAY FELLOW OF THE SOCIETY IN ZOOLOGY.

(Plates xxix., fig.4; xxx.-xxxii.; xxxiii., figs.1-5; xxxiv.-xxxvii.: xxxviii., figs.1-3: and Text-figs.10-16.)

Genus BIEMNA Gray (sens. lat.).

Definition.—Axinellidæ typically of massive or encrusting habit, occasionally tending to become lamellar or calicular, almost invariably provided with conuli or other surface-elevations of less regular form, or with digitate processes either solid or tubular; or, finally, consisting almost entirely of tubular processes. The skeleton varying, sometimes conforming more or less to a halichondroid type, but more frequently consisting of definite fibres, which sometimes are arranged reticulately. The spicules composing the fibres are sometimes (in the less typical species) arranged more or less plumosely, or even in part echinatingly. The megascleres are typically of a single order,—either styli alone, or styli together with oxea of similar dimensions; special dermal megascleres are absent. The microscleres are invariably sigmata and trichites (or microxea), the latter usually or perhaps always occurring (partly at least) in dragmata; and to these may be added commata, microstrongyla, or spherulæ.

Type-species, *B. peachi* Bowerbank.

The species for which the genus *Allantophora* was proposed by Whitelegge(**58**) differs in the combination of its characters so notably from any species known previously to it, and, in one important respect at least, so considerably also from any which has since been described, that its true affinities were until recently(**13**) unsuspected, while the propriety of maintaining a separate genus for its reception has not hitherto been called into question. Whitelegge, disregarding the evidence afforded by the microscleres present, and attaching overmuch importance to the echinate arrangement of some of the spicules composing the skeletal fibres, arrived at the conclusion that *Allantophora* is intermediate between *Echinoclathria* and *Ophlitaspongia*; whereas I, in my earlier remarks in reference to the genus(**12**), expressed the opinion that, provisionally at least, it should be placed in the Mycalinæ, and suggested the possibility of its relationship with *Crambe*(= *Tetranthella*). Since then, as I more recently have found occasion to remark(**13**), a second species possessing microstrongyla as microscleres in addition to sigmata and trichodragmata, has been described by Hentschel(**15**) under the name *Tylodesma microstrongyla*, which in spiculation accords so closely with *Allantophora plicata* as to leave no room for doubting the close genetic affinity of the two, yet the skeleton of which conforms, or at any rate closely approximates, to a halichondroid type. Hence it seems to follow that the essential feature to be taken into account in deciding as to the proper systematic position of these species is not, in either case, the precise configuration of the skeleton, but rather the constitution thereof from the point of view of the spicular elements composing it, both megascleric and microscleric: and accordingly one is led to suspect the probability of their relationship with such species as *Biemna megalosigma* Hentschel(**15**), and *Biemna chilensis* Thiele(**42**), the spiculation of which is essentially the same as theirs except only in this respect, namely, that instead of microstrongyla the microscleres include spherulæ, —and in which, furthermore, the skeletal arrangement is of a somewhat intermediate type. In support of this, there now comes to light a third species with microstrongyla (and, significantly, with spherulæ also), - described below as *Allantophora victoriana*,—which forms a definite and absolute connecting-link between *A. plicata* and *Sigmaxinella ciocalyptoides* Dendy, it being even questionable, indeed, whether both it and the last-named should not be looked upon merely as varieties of *A. plicata*: and *Sigmaxinella ciocalyptoides*, in turn, is found to provide no feature definitely justifying its separation generically from the majority at least of the species at present included in *Biemna*. Accordingly it becomes necessary to decide upon what grounds, if any, the genera *Tylodesma*, *Allantophora*, and *Sigmaxinella* admit of being retained.

The distinction between *Tylodesma* (olim *Biemna*) and *Biemna* (olim *Desmacella*) deemed essential by Topsent(**46**),—to whom the separation of the species of Ridley and Dendy's group Desmacellinæ into these two genera is due,—was with respect to the mode of conformation of the skeleton, a halichondroid type of skeleton being regarded by him as characteristic of the former genus, a disposition of the megascleres in definite fibres as characteristic of the latter: whether the megascleres were styli or tylostyli was looked upon as of minor importance The same distinction was emphasised by Lundbeck(**30**) in defining these genera, though at the same time he attached equal value to certain differences in their microscleric spiculation; other authors, however,—as Thiele(**41**), Dendy(**8**), and Hentschel(**15**),—seem disposed, like Topsent, to regard it as fundamental. Nevertheless, a critical survey of the species concerned renders it evident that the distinction is an arbitrary one, and incapable of being maintained; in proof of which one need only refer to the fact that in certain instances, as, for example, in the case of *Biemna microxa* Hentschel(**14**), and of the so-called *Biemna humilis* Thiele(**41**), the authors themselves show uncertainty as to the genus to which the species ought rather to be assigned. If, however, the species with tylostyli or subtylostyli as megascleres (typical of *Tylodesma*) be compared with those in which tylostylote megascleres are absent (typical of *Biemna*), it is found in the case of the former that the microscleres present frequently comprise toxa in addition to sigmata, but never trichites or microxea, whereas in the case of the latter, with one highly questionable exception—viz., *Desmacella fragilis* Kieschnick(**24**),—trichites or microxea are invariably present, but never toxa. Accordingly there is excellent ground for the retention of the genus *Tylodesma*, but its definition requires amendment.

The three species, for the reception of which Dendy(**7**) proposed the genus *Sigmaxinella*, agree in having both monactinal and diactinal megascleres and, as microscleres, sigmata and trichodragmata, but in a number of other important respects they differ very considerably; and, as already indicated, one at least of them equally admits of inclusion in *Allantophora* or in *Biemna* as hitherto defined. However, the first-described of the three, *S. australiana*, as well as several of the species which Kirkpatrick(**20**) and Whitelegge(**60**) have ascribed to *Sigmaxinella*, differ from all other known species possessing similar microscleres, firstly in being of ramose habit, and secondly in having an axially condensed skeleton. Consequently, with an amended diagnosis, the genus *Sigmaxinella* also admits of being retained.

The third species assigned by Dendy to *Sigmaxinella*—*S. flabellata*—is (among the species having sigmata and trichodragmata as microscleres) quite unique, not only as regards skeletal structure, but also in the fact that the megascleres are of two distinct kinds, viz., styli composing the fibres, and elongated flexuous strongyla (and tornota) occurring interstitially,—the latter of which are strikingly analogous to the spicules of similar form characteristic of many species of *Axinella*, *Phakellia*, *Acanthella*, and *Tragosia*. Were it not for the presence of sigmata, there would be no adequate reason, apart from the flexuous character of the interstitial megascleres, for excluding the species from the genus *Dragmacidon* (g.n.), which in turn comprises species hitherto assigned to *Thrinacophora*; whilst, if both kinds of microscleres were absent, it would almost certainly have to be included in the genus *Phakellia* as defined by Dendy(**8**). Being such as it is, however, the species undoubtedly deserves a new genus for its accommodation, and for this I propose the name *Sigmaxia*.

The question whether *Allantophora* admits of separation from *Biemna* is a much more difficult one, and at present cannot be satisfactorily decided; for although there exists with respect to skeletal structure a profound difference between the typical species of the two genera,—as is very obvious from a comparison of Topsent's figure of *B. peachi*(**54**; Pl. iv., fig.3) with mine of

A. victoriana (Pl. xxxi., figs.1, 2),—yet the descriptions of other species seem to indicate that intermediate (as well as additional) types of skeleton occur, while in not a few instances, furthermore, the requisite information relating to the skeleton is lacking. At the outset, a satisfactory line of division between the two genera seemed to me possibly securable by taking into account the fact that in most if not all of the indubitable species of *Biemna* the microscleres include commata, but never microstrongyla, whereas in the remaining species commata are absent; but the serviceableness of this as a means of distinction appears to be ruled out of court by the circumstance, recently announced by Topsent(**54**), that in *B. peachi* commata are apparently sometimes missing. A further difficulty is created by Topsent's discovery (*loc. cit.*) that "commata" are present in his *Biemna fistulosa*, which have not the form of curved microstyli but "s'y montrent flexueux avec un bout renflé et l'autre un peu aminci," so that their form "rapelle un peu celle de sigmaspires deroulées"; and it is possible that these microscleres are a connecting-link between the styliform commata of *B. peachi*, etc., and the microstrongyla of typical *Allantophora*-species. Consequently, since one is unable so to define the genera as to render them mutually exclusive, there is no alternative for the time being but to combine them, and I have therefore formulated the diagnosis of *Biemna* accordingly. Inasmuch, however, as I am confident that the necessity for this is only temporary, and that a fuller knowledge of the species concerned will furnish occasion for the rehabilitation of the genus *Allantophora*, I have refrained for the present from discarding the name in the designation of the species described below, to which it must necessarily apply if the genus be ultimately readopted.

The amendment which I introduce in regard to the distinction to be drawn between the genera *Biemna* and *Tylodesma* affects the position only of five species, namely, of *Tylodesma microstrongyla* Hentschel, and *T. microxa* Hentschel, which (as their spiculation consists of styli, sigmata, trichites, and, in the former, also of microstrongyla) must be included in *Biemna*; and of *Biemna humilis* Thiele(**41**), *B. vulgaris* Topsent(**45**), and

B. truncata Hentschel(**15**), which (having a spiculation composed, in the case of the first, of subtylostyli, sigmata, and toxa, and in the others, of tylostyli and sigmata) must be transferred to *Tylodesma*. In order to frame a satisfactory definition of *Biemna*, which will serve effectually to distinguish it from *Dragmacidon* and *Rhaphoxya* (gg.nn.), it is necessary to insist upon the presence of sigmata as an essential character of the genus: for this reason, if for no other, Topsent's *Desmacella aberrans* (with trichodragmata alone as microscleres), which Lundbeck has referred to *Biemna*, must be removed therefrom: and for its reception I propose a new genus, *Dragmatella*, which I provisionally regard as occupying a position between *Dragmacidon* and *Rhaphoxya*. Lundbeck is inclined to refer also Schmidt's imperfectly known *Desmacella vagabunda* and *D. pumilio* to *Biemna*. Of these two species I have not seen the descriptions; but judging from Schmidt's original diagnosis of *Desmacella*, quoted by Ridley and Dendy(**53**), the microscleres present are sigmata and (or) toxa, in which case the species cannot in my estimation be assigned to *Biemna*, but belong most probably to *Tylodesma*. As regards Kieschnick's *Desmacella fragilis*, referred to above, it is impossible, owing to the unreliability of its description, to express any definite opinion. If it be true that its microscleres are sigmata, trichodragmata, and *toxa*, as stated, I think that this would render necessary the erection for it of a new genus; until rediscovered, however, the species must be regarded as *incertæ sedis*. The only other species about which there can be said to exist any occasion for doubt is *Desmacella cavernula* Bowerbank(**1**), in which the microscleric spiculation is described as consisting solely of sigmata: but as the megascleres are styli (and *not* tylostyli), and, furthermore, as there is ground to suspect, owing to the dried condition of Bowerbank's single specimen, that the occurrence of trichodragmata therein was overlooked, the probability is that the species is correctly to be assigned to *Biemna*. Nevertheless, the species is peculiar, regarded as a member of this genus, in the fact that the megascleres are distinguishable into two groups, the one kind composing the fibres, the other occurring interstitially and also forming a dermal skeleton; and this peculiarity may possibly prove to be associated with other distinctive features of a character that would justify its exclusion from the genus. According to Thiele(**40**), a partial differentiation of the megascleres into several groups is exhibited in the case of *B. korenii* also, but apparently this occurs without relation to the particular position which the spicules occupy, since he makes no mention of the fact; and Lundbeck(**30**) further notes that in *B. capillifera* there are present, in addition to the skeletal spicules proper, smaller styli which are found only in the part of the sponge nearest to the substratum, where they form a thin layer. In all the remaining species of *Biemna*, so far as I am aware, the megascleres are definitely of a single order (though occasionally comprising both monactinal and diactinal forms).

Hentschel(**15**) has recently referred to *Biemna* (under the name *B. aruensis*) a species possessing neither sigmata nor trichodragmata, but having as flesh-spicules small slender curved tylostyli, which he terms "kommaformige Rhaphiden" and apparently regards as homologous with the commata of species like *B. peachi*. Inasmuch, however, as the remaining spiculation consists of megascleres (of two distinct kinds) in the form of (longer) subtylostyli and (very much shorter) tylostyli respectively, and as, furthermore, the sponge is regularly dome-shaped and prolongs itself upwards into a tubular process, it seems to me practically certain that the species is one requiring to be included in the family Polymastiidæ. Unfortunately Hentschel has neglected to investigate the structure of the skeleton, and one therefore lacks the information necessary to decide whether the species requires a new genus for its reception, or permits of inclusion in the genus *Polymastia* itself. But, for the present, I would recommend that the species be known as *Polymastia*(?) *aruensis*.

Of species referable to *Biemna* which have been assigned to genera other than *Biemna*, *Desmacella*, *Tylodesma*, or *Allantophora*, there is apparently only one, viz., *Sigmaxinella incrustans* Kirkpatrick(**20**).

A few fragments of a sponge have been recorded from Christmas Island by Kirkpatrick(**21**) as *Desmacella* sp., in which the megascleres are oxea, fewer styli, and rare strongyla, all of approximately the same dimensions (viz, 180 × 7μ, 150 × 9μ, and 126 × 6μ respectively), and the microscleres are very rare sigmata, rare toxa, and rare trichites; but in which the skeleton is a unispicular renieroid meshwork, with triangular and quadrangular meshes. Obviously, if the microscleres are really proper to it, this species should be assigned, provisionally at least, to the genus *Gellius*.

The genus *Biemna*, as now defined, accordingly comprises the following species:—

i. With commata – typical species of the genus.

B. peachi Bowerbank(**1**; **30**).	English Channel; Scotland; off Norway; off Iceland.
B. capillifera Levinsen(**28**; **30**).	E. Canada; Iceland; Kara Sea.
B. hamifera Lundbeck(**30**).	Off Iceland.
B. grœnlandica Fristedt(**10**; **30**).	E. Coast of Greenland.
B. stellifera Fristedt(**9**). (With asters?).	Sweden.
B. fistulosa Topsent(**48**; **54**).	Amboina.
B. sp. Thiele(**41**).	Ternate.

ii. Without commata (so far as known), and without microstrongyla; but apparently otherwise conforming rather to the species with commata.

B. korenii Schmidt(**35**; **40**).	Off Norway.
B. variantia Bowerbank(**1**).	Bristol Channel.
(?)*B.* (?)*cavernula* Bowerbank(**1**).	Shetland Islands.
B. trirhaphis Topsent(**48**; **41**).	Amboina; Ternate.
(?)*B. fortis* Topsent(**48**).	Amboina.

iii. Without commata (so far as known), and without microstrongyla; but apparently otherwise conforming rather to the species with microstrongyla.

B. incrustans Kirkpatrick(**20**).	Cape Colony.
B. tubulata Dendy(**8**).	Ceylon.
B. macrorhaphis Hentschel(**16**).	Antarctic Ocean.

B. microxa Hentschel(**14**).	Sharks Bay, W. Australia.
B. sp. Hentschel(**15**).	Arafura Sea.
B. chilensis Thiele(**42**). (With spherulæ).	Chili.
B. megalosigma Hentschel(**15**). (With spherulæ).	Arafura Sea.
B. megalosigma var. *liposphæra* Hentschel(**15**).	Arafura Sea.
B (*Allantophora*) *ciocalyptoides* Dendy.	Port Phillip, Victoria.

iv. With microstrongyla.

B. (*Allantophora*) *plicata* Whitelegge.	New South Wales.
B. (*Allantophora*) *victoriana*, sp.n.	Port Phillip, Victoria.
B. (?*Allantophora*) *microstrongyla* Hentschel(**15**).	Arafura Sea.

Allantophora plicata Whitelegge.

(Pl. xxix., fig.4; Pl. xxx., figs.1, 2, 3.)

1907.*Allantophora plicata* Whitelegge(**60**),p.505, Pl. xlv., fig.28.

Diagnosis.—Sponge consisting of a cluster of erect, proliferous lamellæ, sometimes interunited more or less by anastomosis, and frequently tending to become more or less pointed above or to divide distally into digitate processes. Surface irregular, and provided with many slender tapering conuli. Dermal membrane moderately thick, without contained megascleres, and without pores visible to the naked eye. Skeleton an irregular reticulation, of fairly uniform density throughout, consisting of ascending multispicular main fibres (mostly between 100 and 200μ in stoutness) and numerous slenderer, for the most part paucispicular, connecting fibres. Spicules of the main fibres rather loosely (and often somewhat plumosely) arranged. Both main and connecting fibres provided with moderately numerous, more or less nearly perpendicularly-directed, echinating spicules similar in kind to the coring spicules. Spongin present only in moderate quantity. Megascleres: styli and (relatively few) oxea, ranging from less than 300 to upwards of 500μ (occasionally to upwards of 600μ) in length, and (in different specimens) varying from 16 to 22μ in maximum stoutness. Microscleres: (i.) numerous sigmata of two sizes, respectively 11 and 21μ in maximum length; (ii.) trichodragmata typically of two sizes, together with scattered trichites of similar length (viz., up to about 60μ) to those composing the larger dragmata; and (iii.) numerous microstrongyla, the largest measuring 20 by 8μ.

Loc.—Off Crookhaven River, N.S.W. ("Thetis").

Introductory.—In addition to the single example originally described, there are now available three other complete specimens of the species, and a fragment of a fourth. Of these, only the last-mentioned is preserved in alcohol, the remainder (with the exception of the type-specimen, which has been dried—probably after having been some time in alcohol—without complete removal of the sarcode) being washed-out and otherwise more or less damaged beach-specimens.

External features.—In all four specimens, the general habit is the same. The sponge consists of an often more or less intricate cluster of erect lamellæ, which are joined each to another along one lateral edge,—the other edge either remaining free or (less frequently) becoming connected by anastomosis with some portion of another lamella,—and which tend most frequently to become narrowed and more or less pointed above, or sometimes to partially resolve distally into several pointed digitiform processes. The lamellæ vary from 2 to 12 mm. in thickness; and the largest specimen measures 130 mm. in height. Usually, a main or primary lamella is to be distinguished, and from this secondary lamellæ proceed, which in turn give rise in a similar way to others of higher order. The lamellæ are not always directed perpendicularly to those from which they arise, but often more or less obliquely; and occasionally some of the larger ones may be vertically curved or folded. The sponge is sessile, and is sometimes attached only by a limited portion of the base of the primary lamella; but more usually the area of attachment is much more extensive, and is formed partly by the bases of other lamellæ as well. The surface is rendered more or less uneven by irregular, longitudinally disposed ridges and furrows, and by numerous acuminate conuli. The former inequalities are much more marked in dried and washed-out specimens (Pl. xxx., fig.2) than in the perfect sponge (Pl. xxx., fig.1), since in the case of the latter the depressions are largely filled up with fleshy tissue and covered over by dermal membrane. In the washed-out condition of the sponge, numerous lesser inequalities also are in evidence, causing the surface to present a somewhat cellular or roughly pitted appearance, and giving rise here and there—more especially in the case of thinner lamellæ—to actual perforations: it is the depressions producing this appearance that are somewhat misleadingly referred to in the original description as "pores." The conuli are conspicuous in the well-preserved sponge, but may be entirely missing in the case of beach-specimens owing to their fragility and the ease with which they become broken off when dry; they are narrow at the base and thread-like at the apex, are traversed axially by a single skeletal fibre, and vary in length from 2 to 5 mm. Oscula were not observed.

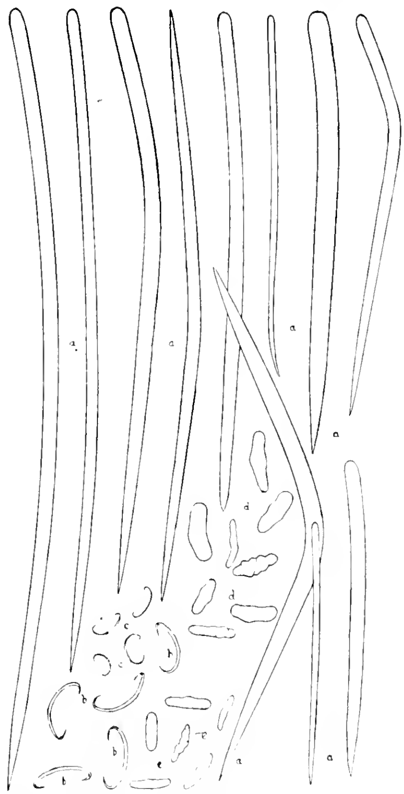
The consistency of the sponge in alcohol is firm, fairly tough, compressible, and resilient; and the colour is yellowish-brown. Dry specimens vary considerably in their consistency and textural appearance according to the extent to which the sarcode has been removed. When thoroughly washed-out, the sponge is tough and elastic, and its texture (as compared with that, say, of an ordinary washing sponge) is loosely and coarsely fibrous: the fibres that terminate at the surface run towards it in an obliquely ascending direction, and being free from one another (*i.e.*, unconnected by transverse fibres) for some distance from their extremities, give to the surface a slightly shaggy appearance (Pl. xxx., fig.3). On the other hand, if dried without (or with only partial) removal of the sarcode, the sponge (as in the case of the type-specimen) is inelastic and rather brittle, and of a texture that might be described roughly as pumiceous (Pl.xxx., fig.2). In this latter condition of the sponge, the interstices of the skeleton are frequently tympanised by delicate parchment-like membranes (erroneously referred to in the original description as being portions of the dermal membrane). The colour of dry specimens varies from light to brownish-grey.

The dermal membrane is very distinct and fairly tough, and overlies numerous, usually not very extensive, subdermal spaces: it is not (to the naked eye) visibly porous. The dermal pores, over limited areas of the surface, are similar in their arrangement to those of *A. victoriana* (*cf.* Pl. xxxviii., figs.1-4), except that the circular groups they form (which, in rare instances, attain a diameter of 130 to 150μ) are relatively less closely apposed; but generally they occur only several together in much smaller groups—or, in rare cases, even singly—and the groups are separated by distances sometimes exceeding their own diameter.

Skeleton.—Whilst in regard to spiculation no definite distinction can be drawn between the present species and *A. victoriana*, the arrangement of the skeleton in the two differs very considerably This will be evident from a comparison of the figures of the skeleton (prepared by treatment with caustic potash) in the two cases, as seen in section,—especially Pl. xxix., fig.4, and Pl. xxxi., fig.1,—the former of which is from a lamella (varying in thickness from less than 1 mm. at one edge to 8 mm. at the other) of the present species, and the latter from a thick vertical slice (from 6 to 10 mm. in thickness) of a massive specimen of *A. victoriana*. The chief points of difference are two. Firstly, there is an entire absence, in the present species, of any observable differentiation in the structure of the skeleton relative to a number of separate axes, and the pattern is accordingly everywhere (including even the incipient processes into which the lamellæ sometimes tend to resolve) much the same; and secondly—in necessary correlation with this—the main fibres are never transversely directed, but always run in a more or less ascending direction, with gradual trend surfacewards, branching (not very frequently) as they go. As in *A. victoriana*, the connecting fibres are numerous, and interunite with one another to form (along with the main fibres) a rather small-meshed reticulation; but the reticulation is here very irregular, and there is no marked tendency on the part of the connecting fibres to be confined (as in *A. victoriana*) to vertical planes; in some parts, however,—more especially in the processes—a slight tendency towards such an arrangement is occasionally exhibited. A further notable point of difference is the frequency of occurrence, in the present species, of megascleres disposed more or less perpendicularly to the fibres,—with their bases implanted therein,—in the manner of echinating spicules. The main fibres are composed chiefly or (not seldom) almost entirely of spicules, arranged usually in a loose, often in a more or less dishevelled or somewhat plumose fashion, and are usually between 100 and 200μ in stoutness; in the oldest portions of the sponge, however, they occasionally attain a diameter of from 300 to 400μ. The amount of spongin cementing their spicules is rather variable, but is seldom sufficient to form a well-defined sheath; as seen in cross-section, the outline of the fibres is very irregular. The connecting fibres are uniserial to multiserial in spiculation, and are relatively more sponginous than the main fibres. But very few megascleres are scattered between the fibres. Sigmata (of two sizes) and microstrongyla occur in great abundance throughout all parts of the interior, together with moderately numerous trichodragmata and singly scattered trichites; the last-mentioned, however, are not very evident owing to their extreme tenuity. In the dermal membrane, sigmata are again very abundant, and single trichites almost equally so, but trichodragmata and microstrongyla are extremely rare, and megascleres are altogether absent.

Spicules.—(i.) The megascleres are styli and relatively few oxea—the proportionate number of the latter variable, ranging from less than 1 in 100 (in the type-specimen), occasionally to as many as 1 in 10. Though somewhat scarce as echinating spicules, the oxea occur in all the same situations in the skeleton as the styli, and are undoubtedly only variants of them; nevertheless, transitional forms between the two are extremely rare. The styli are slightly curved, with the curvature most pronounced in, and usually confined to their basal moiety; are evenly rounded at the base, and of uniform or nearly uniform diameter thence to beyond the middle of their length; and taper gradually to a sharp point. The oxea—apart from their being diactinal—

differ from the styli only in being curved symmetrically and more strongly, and also somewhat angulately. In different specimens, the megascleres vary from 520 to 670μ in maximum length and from 16 to 22μ in maximum stoutness; and the shortest spicules in any specimen are between 200 and 300μ in length. The longest spicules are seldom much more than one-half (very rarely, if ever, as much as two-thirds) the maximum stoutness, the greatest diameter being attained by those of intermediate and lesser lengths.



Text-fig. 10.

Allantophora plicata. *a*, megascleres; *b*, *c*, larger and smaller sigmata; *d*, *e*, microstrongyla from each of two different specimens.

(ii.) The sigmata are, almost without exception, more or less contort, but seldom to such an extent as to appear S-shaped when viewed from the side. They are of two sizes, the larger 15 to 21μ, the smaller 7 to 11μ, in length, and measure respectively 1·5 and about 0·75μ in maximum stoutness. The latter are by far the less numerous, but are nevertheless by no means scarce.

(iii.) The trichites are typically of two sizes; the longer ones immeasurably thin, 50 to 65μ in length in some specimens, only 35 to 50μ in others, and occurring both in dragmata and scattered singly; the shorter ones relatively stouter and slightly fusiform in shape, 15 to (rarely) 30μ in length, and apparently occurring only in dragmata. In two (dry) specimens, however, the shorter trichites were not observed. The dragmata frequently take the form of dense roundish masses of trichites, sometimes exceeding 300μ in breadth, which refract the light in such a way as to appear blackish and opaque.

(iv.) The microstrongyla are seldom less than 10μ in length and 2μ in diameter, but are usually much stouter, and have a maximum size of 20 by 8μ. They are nearly always slightly curved and more or less distinctly centrotylote. Abnormal forms occur, in which the annular swelling is irregular in shape, excentric in position, or several times repeated, but they are not very numerous and seldom depart from the normal shape to any considerable extent.

ALLANTOPHORA VICTORIANA, n.sp.

(Pl.xxx.,figs.4,5; Pl.xxxi.,figs.1-4; Pl.xxxii.,figs.1-5; Pl.xxxviii., figs.1-4; Pl. xl., figs.5, 6.)

Diagnosis.—Sponge erect, either entirely massive or subdividing superiorly into separate tapering digitations. Surface slightly irregular, and provided with numerous, fairly uniformly distributed, more or less acuminate conuli. Dermal membrane very distinct; without contained megascleres: usually showing to the naked eye a minutely reticulate pattern due to the mode of arrangement of the dermal pores. Skeleton (in the body of the sponge) consisting of a congeries of similar components, each constructed on the same plan as the entire skeleton of a single digitation. In each component, the main fibres (excepting, usually, one or a few longitudinally-directed primary fibres occupying its axis) are disposed more or less perpendicularly to the axial direction of the component, *i.e.*, in a radial or pinnate fashion; and these are joined together by connecting fibres which are almost exclusively confined to vertical planes. The main fibres are relatively very stout (up to over 300μ in diameter), and are composed chiefly of spicules arranged more or less compactly; the connecting fibres are slender, mostly paucispicular, and composed chiefly of spongin. A few echinatingly-disposed spicules occur on the main fibres, but are rare or absent on the connecting fibres. The spiculation is almost identically the same as that of *A. plicata*, the chief point of difference being that the microstrongyla are much more various in form and size, and frequently pass into spherulæ.

Loc.—Port Phillip.

Introductory.—The species is represented in the Australian Museum by two half-specimens from Port Phillip, and a complete specimen (of somewhat different habit) the locality of which is uncertain; in addition, a third half-specimen is included among the original specimens described, by Dendy, as *Sigmaxinella ciocalyptoides*,—viz., the one referred to by him as R.N.338. The last-mentioned, however, does not constitute a fourth example of the species, but is plainly only the other half of one of the Australian Museum specimens. All the specimens are well preserved in alcohol.

External features.—The two Port Phillip examples are massive sponges, of erect, somewhat quadrangulately prismatic shape, slightly narrowed below to form a broad base of attachment, and with a very rugged, monticulate upper surface (Pl. xxx., figs.4, 5): the slightly larger is 115 mm. in height, and would measure, if complete, about 60 or 70 mm. in breadth and in thickness. The third specimen (Pl. xxxi., fig.3), which is very much smaller,—measuring only 55 mm. in height,—is similarly massive in its lowermost portion, but divides above into many separate (or more or less incompletely separate) tapering digitations of various size, the largest measuring 25 mm. in length and 5 or 6 mm. in diameter at the base. The difference in habit in the two cases, however, is probably to be regarded only as one of degree, since the rugged character of the distal surface of the more massive specimens is such as might be due to incipient digitation.

The whole surface, including that of the processes, is covered with conuli formed in the same manner as in *A. plicata*; they are sometimes low and sharp, sometimes acuminate or even filiform, up to 2 or 3 mm. in length, and situated at an average distance apart varying from one to several millimetres. The surface is rendered uneven by low, irregular undulations and indistinct, longitudinal furrows. On the upper surface only of the more massive specimens, between the monticular elevations, there are many oscula-like openings, the appearance of which (although they are plainly seen to be the orifices of main exhalant canals) suggests that they have been caused by laceration of the dermal membrane; and it is possible, therefore, that in the perfect sponge the dermal membrane is continuous across the debouchures of the exhalant canals, thus producing a condition of lipostomy. This may account for the fact that, in the smaller, digitate specimen, oscula were not observable.

The main exhalant canals run longitudinally upwards through the sponge, increasing in diameter as they ascend; they attain a maximum diameter, in the largest specimen, of about 3 mm., but in the smallest specimen, only of about 1 mm. Many of the canals, especially in the upper part of their course, run for a considerable distance immediately below the surface, their outer wall consisting of scarcely more than the dermal membrane Immediately underlying the dermal membrane, also, there are, elsewhere, numerous and fairly extensive incurrent spaces.

The consistency of the sponge in alcohol is firm, fairly tough, compressible, and resilient ; and the colour varies from pale cream to light yellowish-brown. The colour in life, as recorded in the case of a single specimen by Dendy, is "cinnamon, [with] the projections deep chrome." The skeletonised sponge is very loose-textured, and not of uniform density (Pl. xxxi., fig.1): the coarseness of the fibres is about the same as in *A. plicata*, but, in the present species, the skeleton is of considerably smaller bulk relatively to the bulk of the entire sponge.

The dermal membrane—owing partly to the many spaces immediately underlying it, and partly to its being of considerable thickness—is very distinct, and, except on the upper surface of the sponge (*i.e.*, in the region of the oscula-like openings) presents a minutely reticulate appearance due to the mode of arrangement of the dermal pores (Pl. xxxviii., figs.1-4). The reticulate pattern is conspicuous, even to the naked eye, in the two massive specimens, but requires a lens for its detection in the case of the digitate example. Where the reticulation is apparent, the dermal pores are arranged in closely situated, oval or rounded groups, or "pore-areas" (Pl. xl., figs. 5, 6) measuring up to 0·5 mm. in diameter, the pores themselves varying in diameter from less than 20 to upwards of 80μ; within the pore-areas, the dermal membrane is reduced, owing to the presence of the pores, to a fine, lace like network. Where the dermal membrane is apparently non-reticulate, this is due to the fact that the pore-areas are much smaller and much more widely separated.

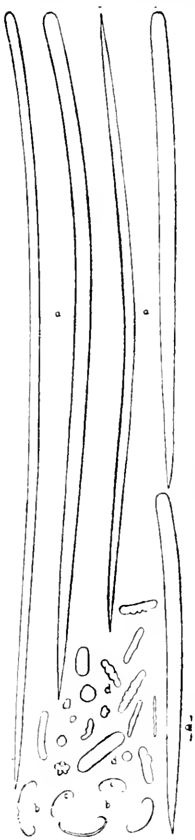
Skeleton.—The structure of the skeleton is such as would result if the sponge had consisted, in the first place, of a number of independent, simple or branched, digitiform upgrowths, each with its own separate skeleton, and if subsequently these individual upgrowths, by lateral expansion and coalescence, had grown together into a single mass,* and their skeletons become more or less interunited: or, in other words, the skeleton is resolvable into similarly constituted, simpler components, the arrangement of which conforms to that of a system of ascending, branched axes. In order to convey an idea of the general conformation of the skeleton, therefore, it will be sufficient to describe the structure and mode of arrangement of the skeleton in a single such component (as shown to best advantage in a digitate process of the semi-massive specimen), and to explain the manner in which interunion is effected between the skeletal fibres of different components.

In each simple digitation, the skeleton consists (Pl. xxxi., fig. 4; Pl. xxxii., fig. 1): (i.) of stout multispicular main fibres radiating outwards, almost invariably without branching, from the axis of the process in a direction perpendicular or nearly perpendicular thereto, and at a considerable distance (usually not less than 1 mm.) apart from one another; and (ii.) of very much slenderer connecting fibres, most abundant towards the axial region of the

* The occurrence of pebbles and small patches of coarse sand here and there in the interior of all these specimens, more especially towards their base, lends colour to the view that the massive body of the sponge actually has been formed by the coalescence of originally separate digitations.

digitation, which reticulate among themselves to form a narrow-meshed network between the main fibres (*cf.* Pl. xxxii., figs. 3, 4, 5). The first-mentioned, or radially directed fibres appear usually to arise by the branching of one or a few axially situated fibres running lengthwise: but, in some instances, no such primary main fibres are observable, the radially-directed fibres each arising independently. In addition to the paucity or absence of longitudinal main fibres, the skeleton also presents two other characteristic and distinctive features: the radial fibres are arranged for the most part in a more or less orthostichous manner, and, almost without exception, the connecting fibres between them occur only between those belonging to the same orthostichies. Hence it follows that the connecting fibres are confined almost exclusively to vertical (or, as one might almost say, to meridional) planes; and thus, in a transverse section of a digitation (Pl. xxxii., fig.2), the main fibres appear to be without connections. The pattern of the reticulation formed by the connecting fibres is also characteristic, the meshes usually being elongated and narrow, with their long axis in the direction perpendicular to the main fibres. The main fibres vary in stoutness from 120 to 350μ; the spicules composing them are fairly closely and regularly packed, seldom slightly plumose in their arrangement, and are cemented by a relatively small amount of spongin, seldom sufficient in quantity to form a distinct sheath. The connecting fibres are peculiar in being thin and ribbon-shaped, and are mostly paucispicular and composed chiefly of spongin. Echinating spicules occur similarly as in *A. plicata*; but they are here very rare upon the connecting fibres, and are scarce even upon the main fibres. Interstitially scattered megascleres are relatively very few. The microscleres have the same distribution, and are equally as abundant as in *A. plicata*.

In the massive body of the sponge, as already stated, the skeleton consists of interunited components each constructed on the same plan as the above-described skeleton of a single digitation. The interconnection between the components is effected simply by the prolongation of the radial (main) fibres of one component, and their ultimate union with connecting fibres of another; as a rule, the fibres only of one of any two connected components are thus prolonged. A feature not observed in the skeleton of a separate digitation is provided by the fact that the fibres proceeding surfacewards from some of the more peripheral components (more especially from such as are situated not very close to the surface) run in a more or less upward direction (instead of perpendicularly outwards), and may thus attain a considerable length, and may also several times branch (Pl. xxxi., fig. 2).



Text-fig. 11.*

Spicules.—The spiculation is almost identically similar to that of *A. plicata*, not only as regards the forms, but also the sizes, both of the megascleres and microscleres,—the only noteworthy point of difference in the case of the present species being the much greater irregularity in the forms of the microstrongyla and the frequency of occurrence among them of spherulæ. In all three specimens, the megascleres are of about the same dimensions, ranging in length from about 230 or 240μ (rarely, however, less than about 300μ) up to 680μ, and having a maximum stoutness of 16 or 17μ; the sigmata, which appear not to be separable into two groups as regards size, vary in length from 8 to 20μ, and up to 1·5μ in stoutness; the longer trichites attain a maximum length of 70μ, while the shorter ones are rarely longer than 30μ: and the microstrongyla vary in diameter from less than 1 up to 5 or 6μ, and in length up to 17 or 18μ.

ALLANTOPHORA CIOCALYPTOIDES Dendy, (et var.).

1896. *Sigmaxinella ciocalyptoides* Dendy(7), p. 243.

Diagnosis.—Sponge in the typical form of the species incrust-

* *Allantophora victoriana.* *a*, megascleres; *b*, *c*, sigmata; *d*, microstrongyla.

ing to lowly-massive, rising above into short, slender, digitiform processes; in the varietal form (so far as known) consisting of a compressed, plate-like, sessile basal portion soon completely dividing above into a single series of long, slender, tapering digitations. Surface acutely conulose, the conuli usually not very distinct except on the processes, where they are slender and acuminate. Surface minutely reticulate, though not always visibly so to the naked eye. Skeleton in the typical form of the species approaching in structure to that of *A. victoriana*; in the variety similar to that of *A. plicata*. Spiculation differing from that of the foregoing two species only in the absence of microstrongyla.

Loc.—Port Phillip (typical form). Off Botany Bay (variety).

It is very probable that the two forms which I associate under this species,—one of which I distinguish as a variety, *reducta*,—have separately originated from, and should be regarded as no more than varieties of, *A. plicata* and *A. victoriana* respectively. In the absence of more conclusive evidence than is furnished by the specimens available, however, it has seemed to me advisable to regard them as constituting a species distinct.

Allantophora ciocalyptoides (typical form).

(Pl. xxx., figs.6, 7.)

Of this, there are four examples,—the three originally recorded by Dendy,* and an additional one in the collection of the Australian Museum Two of these (the last-mentioned and one of the originals) are almost identically similar (Pl. xxx., fig.7), each having the form of a comparatively thin crust which spreads extensively over the surface of a flattened water-worn stone, and from which arise, short, tapering, digitiform processes—in part occurring singly at wide and irregular intervals, and in part disposed closely in clusters (usually with some amount of coalescence). The digitations are from 5 to 15 mm. in length and seldom more than 2 or 3 mm. in stoutness except near their base, and are provided with moderately numerous, filosely acuminate

* In the original description, four specimens are referred to; but, as already mentioned, one of them (R.N. 338) is an example of *A. victoriana*.

conuli, 1 to 2 mm. in length, which give to them a somewhat spinose aspect. The encrusting base of the sponge attains a maximum thickness of about 10 mm. centrally, and thins out peripherally almost to a film; its upper surface is slightly irregular and uneven, and provided with usually inconspicuous conuli. The thin and semitransparent dermal membrane is underlain, between the conuli, by extensive subdermal spaces, and is not of reticulate appearance. The other specimens (one of which is shown in Pl. xxx., fig.6) are much less extended horizontally, and are relatively more elevated than the preceding two, and might be described as intermediate in form between them and the specimen of *A. victoriana* illustrated in Pl. xxxi., fig.3. Otherwise, they exhibit no noteworthy point of difference, excepting that the dermal membrane is, for the most part, minutely reticulate. The colour in life has been described as "cinnamon, with the projections deep chrome." The consistency, especially of the encrusting specimens, is rather soft and lacking in toughness.

The skeleton in the digitate processes is similarly constructed as in the processes of *A. victoriana*. In the encrusting base of the sponge, it consists, in the thinnest portions thereof, simply of single, vertically-running, stout main fibres connected in a somewhat irregular fashion by inter-reticulating slender transverse fibres; but, in the thicker portions of the base, the main fibres, as they ascend, become irregularly branched and also interunite with one another by anastomosis. On approaching the surface, the main fibres (which vary from 150 to 300μ in stoutness) usually become slightly plumose. The spiculation differs in no way, except in the complete absence of microstrongyla (and of spherulæ), from that of the preceding species.

ALLANTOPHORA CIOCALYPTOIDES(?), var. REDUCTA.

(Pl. xxx., fig.8.)

The single specimen (Pl. xxx., fig.8) consists of a sessile erect plate,—5 to 10 mm. in thickness, 110 mm. in length, and 35 to 45 mm. in height,—prolonged above, in a pectinate fashion, into a series of very gradually tapered, almost subuliform, digitate processes varying in length from 35 to 70 mm. The specimen is in a much macerated condition, the dermal membrane and most of the superficial fleshy substance having disappeared, leaving exposed the surface of the skeleton. The texture is coarsely fibrous and fairly dense, and the consistency is flexible and moderately tough. The exposed surface, both of the basal plate and of the processes, is irregularly and closely furrowed in the vertical direction. From the surface, at distances of from 1 to 2 mm. apart, there project single bristle-like fibres, which are most conspicuous on the processes, where they frequently attain a length of 1·5 to 2 mm.; these fibres no doubt represent the remnants of conuli.

The skeleton is of the same structure as in *A. plicata*. In the processes (in which it is but very slightly condensed axially) it consists of numerous more or less longitudinally-running, stout, multispicular main fibres, frequently branching and interuniting with one another, and connected by numerous, inter-reticulating, slender transverse fibres. The bristle-like fibres, which project from the surface, arise as branches from longitudinal fibres situated towards the axis, and run surfacewards in a direction obliquely upward and outward; at first they are comparatively slender and paucispicular, but increase in stoutness and become more densely spicular as they proceed, finally attaining a diameter of between 150 and 200μ. Without removal of the sarcode, the pattern of the skeleton is rather difficult to determine owing to very faint outlines of the almost colourless spongin, and to the numerous, mostly longitudinally-directed megascleres lying scattered between the fibres.

Tylodesma Thiele.

Diagnosis.—Axinellidæ(?) typically of massive (or rarely incrusting) habit, the outward form irregular or somewhat compressed, occasionally more or less leaf-shaped. Skeleton consisting of a more or less irregular network of spicules, or of fibres that are most frequently not very well-marked and reach no great length, or finally, of well-developed spicular fibres. Spongin present only in relatively small amount, or altogether wanting.

Megascleres of a single order: tylostyli, subtylostyli, or tylostrongyla, occasionally in part reduced to styli. Microscleres: sigmata and (or) toxa, the latter sometimes in dragmata.

Type-species.—*T. inornata* Bowerbank.

In proposing the name *Tylodesma*, in lieu of *Desmacella*, for the genus wrongly designated *Biemna* (misspelt *Biemma*) by Topsent(**46**), Thiele(**41**) omitted to indicate which species was to be considered the type: since, however, two species only (other than those described by him as new) were enumerated by Topsent as belonging to *Biemna*,—viz., *B. inornata* Bowerbank, and *B. corrugata* Bowerbank,—it is one of those, no doubt, which should be preferred, and I select the former, both because it is that which was named first in order by Topsent and is the better known. The name *Tylodesma* is adopted here in preference to *Desmacella*, not so much from conviction of the correctness of Thiele's contention accepted by Wilson(**61**) and some other authors, but not by Dendy(**8**)—that the latter name is properly a synonym of *Hamacantha*, as owing to the fact that the original species of *Desmacella* described by Schmidt—viz., *D vagabunda* and *D. pumilio* are imperfectly known, and may possibly prove not to belong to the present genus

For reasons already stated above in my remarks on *Biemna*, a slightly amended definition of *Tylodesma* is here proposed, necessitating the removal therefrom, to the former genus, of Hentschel's *Tylodesma microstrongyla* and *T. microxa*, and the addition thereto of *Biemna humilis* Thiele, *B. truncata* Hentschel, and *B. vulgaris* Topsent.

Leaving out of account Topsent's *Biemna dautzenbergi* and *B. chevreuxi*, the former of which is stated by Lundbeck(**30**) to be identical with *T. rosea* Fristedt, and the latter by Topsent(**53**) himself to be identical with *T. annexa* Schmidt, the species which I regard (provisionally) as belonging to *Tylode ma* are as follows:—

T. inornata Bowerbank(**1**); (**46**); (**53**).	Shetland Is.; Azores.
T. corrugata Bowerbank(**1**); (**46**).	British Is.; Azores.
T. annexa Schmidt(**36**); (**30**).	North Atlantic: widely distributed.

T.(?) *pumilio* Schmidt(**35**).	Florida.
T.(?) *vagabunda* Schmidt(**35**).	Florida.
T. infundibuliformis Vosmaer(**56**);(**30**)	Arctic Ocean.
T. rosea Fristedt(**9**); (**30**); (**53**).	E. Greenland; Azores
T. vulgaris Topsent(**38**).	Banyuls.
T. grimaldii Topsent(**44**); (**46**); (**53**).	Azores.
T. humilis Thiele(**41**).	Ternate.
T. jania Verrill(**55**).	Bermudas.
T. alba Wilson(**61**).	E. of Galapagos Is.
T. vestibularis Wilson(**61**).	E. of Galapagos Is.
T. truncata Hentschel(**15**).	Arafura Sea.
T. informis Stephens.*	W. Coast of Ireland.

Under the name *Desmacella arenifibrosa*, Hentschel(**14**) has described, from Western Australia, a species which evidently cannot be referred with propriety either to *Tylodesma* or to *Biemna*: for although the megascleres are styli and subtylostyli, and the microscleres toxa (of two sizes, the longer measuring 303 to 340μ in length and much resembling rhaphides), the main skeleton consists of stout fibres formed chiefly of sand grains, without visible spongin-cement. The constitution of the skeleton and the rhaphide-like character of the longer toxa suggested to me that the species might belong to Dendy's *Stylotrichophora*(**6**), established for a single species—*S. rubra* from Port Phillip, and defined thus: "The main skeleton is a network of horny fibre cored with foreign bodies. In addition to this, there are smooth monactinal megascleres (styli) and hair-like microscleres (rhaphides)." Examination of the type-specimens of *S. rubra*, which were kindly forwarded to me by the Curator of the Melbourne National Museum, has shown that such really is the case: for in this species also, small toxa are present, and the long rhaphide-like megascleres are frequently curved more or less in the manner of toxa. The chief points of difference between the two species are their somewhat different external habit, and the fact that in *S. rubra* the megascleres are styli only, the fibres are provided with a well-defined spongin-sheath, and the

* Stephens, J.—"Preliminary Notice of some Irish Sponges." Ann. Mag. Nat. Hist. (8), xvii., 1916, p.234.

foreign skeletal elements are broken spicules. *Stylotrichophora* was placed by Dendy in the family Haplosceridæ (Heterorrhaphidæ), in vicinity to *Phoriospongia* Marshall, and *Chondropsis* Carter, but for reasons which I intend to publish in a subsequent paper, it appears to me rather that these genera are degraded Desmacidonidæ, requiring at present to be included in the subfamily Mycalinæ.

SIGMAXINELLA Dendy (emend.).

Definition.—Axinellidæ of ramose habit, with cylindrical or compressed branches, and without conuli or other kind of surface-processes. Skeleton symmetrically arranged, consisting axially of a more or less condensed or core-like region formed by a reticulation of spongin-ensheathed spicule-fibres: extra-axial skeleton consisting of paucispicular main fibres radiating outwards to the surface, sometimes (when of considerable length) connected by frequent, typically aspiculous, transverse fibres, but more usually with relatively few, or altogether without, transverse connections. Megascleres typically of a single order: styli, sometimes in part transformed into oxea or strongyla. Microscleres: sigmata and trichites (or microxea), the latter either in dragmata or scattered singly.

Type, *S. australiana* Dendy.

As amended, the genus will include only three of the species which have formerly been assigned to it. Of the remaining four, *S. ciocalyptoides* Dendy, and *S. incrustans* Kirkpatrick, are transferred to *Biemna*; *S. flabellata* (Carter), redescribed below, is made the type of a new genus, *Sigmaxia*, while *S. mammillata* Whitelegge(**60**), with its rhabdostylote megascleres (which are found to show traces of spination, and are accompanied by sigmata only), possesses a type of spiculation very similar to that of Carter's *Microciona intexta*,—a species referred with hesitation by Topsent(**53**) to his genus *Rhabderemia*,—and requires for its reception a new genus, to be included in the Myxillinæ, for which I propose the name *Rhabdosigma*. On the other hand, two species are now added to the genus,—one new, the other long since described by Carter under the name *Phakellia ramosa*.

Sigmaxinella accordingly comprises at present five species, as follows: –

S. australiana Dendy. *S. arborea* Kirkpatrick(**20**),
S. dendroides Whitelegge. *S. viminalis*, sp.n.
S. ramosa Carter(**4**).

Whether *S. arborea* strictly belongs to the genus as above defined is not quite certain, inasmuch as its megascleres are stated by Kirkpatrick to be of three kinds, (i.) basally attenuated styli, 800-1150 × 25-37μ; (ii.) strongyla, 700-800 × 25-30μ; and (iii.) "rhaphide-like" oxea (very rare), 700-870 × 12·5μ. The probability is, however, that the strongyla are merely variants of the styli and connected with them by intermediate forms; while very possibly the oxea are of foreign origin.

SIGMAXINELLA AUSTRALIANA Dendy.
(Pl. xxxiii., figs.1-3; Pl. xxxiv., fig.1.)

1896. *Sigmaxinella australiana* Dendy(**7**), p.240.

Diagnosis.– Ramose, erect, stipitate: with cylindrical or slightly compressed, moderately slender, dichotomously dividing branches, usually of medium length and more or less arborescently outspread, but occasionally remaining much abbreviated and partially coherent together proximally. In outward appearance much resembling a Chalinine sponge. Surface even; non-hispid. Oscula in the form of shallow stelliform depressions, scattered or serial along the branches. Dermal membrane thin and delicate, aspiculous. Skeleton fairly regularly reticulate, more or less condensed axially: formed of spicule-cored, non-plumose main fibres, and wholly sponginous connecting fibres. Megascleres: subcylindrical styli and oxea and forms intermediate between, often irregularly pointed, and rather variable in size in the same specimen; with a maximal size, in different specimens, of from 360 to 450μ by 7 to 17μ. Microscleres: slender sigmata of two sizes, respectively 16 to 20μ and 45 to 50μ in maximal length; and trichites, almost exclusively in dragmata, 20 to 45μ in length.

Loc.—Port Phillip; Maroubra Bay, near Port Jackson.

Introductory.—Of this species, there have been examined, for the purpose of the present description, six specimens, four of which, well preserved in alcohol, are from the original locality, while the other two are washed-out beach-specimens obtained in the vicinity of Port Jackson; examination was also made of a mounted section of one of the type-specimens. As the possibility of a mistake regarding the identity of the species was out of the question, and, moreover, as the available specimens presented a greater range of variation than that recorded in the case of the original specimens, the latter were not sent for to be consulted. The two specimens from the northern locality differ slightly from the Port Phillip ones (more especially in certain details of spiculation), but not sufficiently, I think, to warrant their being regarded as constituting a distinct variety. In order briefly to distinguish the specimens, the former are referred to in the description as the P.J. specimens, the latter as the P.P. or typical specimens.

External features.—The typical habit of the species, so far at least as regards the shape and mode of disposition of the branches, is that displayed by the specimen illustrated in Pl. xxxiii., fig. 1—the largest and most profusely branched of those before me, measuring 180 mm. in total height—which may be very satisfactorily described, in the precise terms of the original description, as "consisting of a bushy bunch of rather slender, short, subcylindrical or somewhat compressed branches, sometimes anastomosing, and supported on a short stalk." But in two respects this specimen is perhaps exceptional: namely, in the great multitude and closely crowded arrangement of the branches (the number of which exceeds two hundred), and, secondly, in possessing oscula which in comparison with those of other specimens are conspicuously noticeable. In the four P.P. specimens available, the branches vary from 5 to 8 mm. in stoutness, and, except when somewhat compressed, are usually nearer to the latter figure than the former; but in the P.J. specimens, in the case of which also the stalk is comparatively long and narrow, they are slenderer, 3 to 5 mm. in diameter, and much more uniformly cylindrical (Pl. xxxiii., fig. 3). Branching takes place chiefly, if not entirely, by dichotomy, and successive dichotomies, as a rule, are in the same plane, the consequence being a well-marked tendency, most clearly expressed in sparsely-branched specimens, towards a flabellate disposition of the branches; but with their multiplication in number and consequent displacement due to mutual interference, the branches gradually come to assume a more or less regularly arborescent arrangement. The maximum length attained by the branches rarely exceeds 80 mm., but is usually greater than 40 mm; occasionally, however, as in the single case of one of the P.P. specimens (Pl. xxxiii., fig.2), they remain quite short (even the longest not exceeding 25 mm.) and more or less coherent with one another proximally, thus forming, or tending to form, a cluster or "head" of (somewhat palmately) lobed or digitate lamellæ.

The oscula are characteristic, having the form of shallow stelliform depressions, 1 to 2 mm. in diameter, at the centre of each of which is a group of several (usually 3 or 4) minute exhalant orifices; their stellate shape is frequently enhanced by short, shallow grooves radiating from them. Most frequently, they are arranged along the branches more or less distinctly in two rows, but sometimes only one such row is apparent, and sometimes they are in part disposed in a scattered fashion; their arrangement appears generally to be the more irregular in proportion as the branches are the more compressed. In most cases, the oscula are not conspicuous, and they are less evident in the desarcodised than in the perfect condition of the sponge; indeed, in the case of the two washed-out P J. specimens, they were altogether unobservable.

In general appearance and in texture, the sponge is nearly similar to an ordinary Chalinine sponge. The consistency is fairly tough and elastic; moderately soft, but not fleshy; compressible and resilient. The colour in life is recorded in the original description as brownish-red or orange-rufous; in alcohol, it varies from pale greyish-yellow to light brown.

The dermal membrane is extremely thin and delicate, and without spicules; it appears to be very easily destroyed, since, even in the specimens which otherwise are excellently preserved, only portions of it remain. The dermal pores are arranged in small oval or circular groups, averaging about 150μ in diameter but somewhat variable in size, scattered over the entire surface, and containing usually less than 10 pores each. Where the dermal membrane has disappeared, the surface is closely perforated with minute pinhole-like apertures, which are the openings of the inhalant canals : the presence of these is discernible also where the dermal membrane is intact, but, as a rule, only faintly and indistinctly.

Skeleton.—The skeleton which remains, after complete maceration of a specimen by means of caustic potash, preserves exactly the external form of the perfect sponge; it is composed of pale-coloured, highly sponginous fibres, and is fine-textured and of sufficient density to render it difficult for one to perceive from external inspection whether a condensed axial region is present or not. In section, under the microscope, the pattern is seen to be fairly regularly reticulate, the reticulation being formed by longitudinal and obliquely outward-trending main fibres pauci-serially cored with spicules, and by numerous short connecting fibres containing no spicules (Pl. xxxiv., fig.1). The reticulation is condensed axially, though not in any very marked degree except in the older, more basal parts of the branches, the condensation being the result merely of a progressive increase of stoutness of the fibres,—most rapid in connection with the axially situated ones, and scarcely at all affecting those situated near the periphery,—with increasing age. Within the axial region of the oldest part of the branches, the fibres may attain a stoutness of over 100μ: but throughout the greater part of the skeleton, they are comparatively slender, even the main fibres seldom exceeding 40μ, while the connecting fibres are of all degrees of lesser stoutness down to below 5μ. Irregularity in the pattern of the skeleton is due to the fact that the connecting fibres rarely pass singly and directly between the main fibres (in such manner as to produce a rectangular or scalariform reticulation), but to a greater or less extent,—depending on the distance apart of the main fibres,—interunite among themselves, thus giving rise to an irregularly-meshed, somewhat plexiform reticulation. The average width of the meshes is less than 100μ, while the average distance apart of the main fibres is not less than 200μ. As the main fibres trend surfacewards,—with gradually increasing deflection from the longitudinal direction as they proceed, they increase in number, mainly by branching, but partly also (at least in proximity to the surface) through the formation of additional ones which take origin from connecting fibres; and they arrive at the surface almost at right angles. The spicules of the main fibres are seldom more than 4- or 5-serial in their arrangement, very rarely as many as 9- or 10-serial; as a rule they lie fairly closely together, forming a moderately compact core. The most superficially situated fibres of the skeleton, including the outermost of the connecting fibres, give support to relatively numerous outwardly-directed spicules, for the most part collected, or tending to be collected, into loose divergent tufts surrounding the extremities of the main fibres.

In balsam-mounted sections of the perfect sponge (*i.e.*, with the soft tissues intact), the above-described features of the skeleton are to a very considerable extent obscured or disguised. This is due partly to the very pale colouration of the spongin,—in consequence of which the outlines of the fibres are usually almost or quite indiscernible,—and partly to the fact that the bulk of the megascleres are located externally to the fibres. These extra-fibral megascleres for the most part are not scattered irregularly through the mesogloea, but are situated chiefly in proximity to the main fibres, lying in approximate parallelism therewith. As a consequence, it is often difficult, or even impossible, to distinguish between spicules lying immediately adjacent to the fibres and others enclosed within them; and the skeleton may thus appear as if composed solely of spicules, for the most part directed parallelly to the directions of growth of the sponge, and more or less collected loosely into ill-defined strands. Irregularly scattered megascleres also are present, as well as relatively few transversely-directed ones, the latter of which always occur singly. Sigmata and trichodragmata are present in moderate number, but the former are not readily perceived owing to their slenderness; rare singly-scattered trichites also occur.

Spicules.—The megascleres are slightly curved, subcylindrical to subconical styli, fewer oxea, and scarce strongyla, the three forms differing in general only with respect to the character of their extremities, and connected with one another by numerous intermediates. They are often irregularly ended and more or less blunt-pointed, and many of the oxea are markedly anisoactinate. Their size is very variable both as regards length and stoutness. In the P.P. specimens, they range in length from 120 or 130 to 360μ in some cases, up to over 400μ (rarely to 450μ) in others, and vary in diameter, irrespective of length, from 2 to 7 or (rarely) to 10μ. In the P.J. specimens, they are generally much stouter, attaining a maximum diameter of from 15 to 17μ, and range in length from about 150 to 420μ. The styli are, on the average, stouter than the oxea, and the stoutest spicules are mostly those of intermediate and lesser lengths. In the case of the P.P. specimens, the shortest spicules,—those of lesser length than, say, 200μ,—are chiefly oxea, generally with abruptly, often mucronately pointed ends; but, in the P.J. specimens, the shortest spicules are nearly always styli.

Text-fig. 12.*

(ii.) The sigmata are extremely slender,—invariably less than 1μ in diameter,—and of two kinds, the smaller (and less numerous) varying in length from 9 to 16μ, the larger from 25 to 45μ, measured from bend to bend. Both kinds are mostly more or less contort,—the smaller, however, usually only slightly so, the larger often to such an extent as to appear S-shaped; both kinds

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* *Sigmaxinella australiana.* *a*, megascleres; *b*, *c*, larger and smaller sigmata.

occur in dragmata, as well as scattered singly, but the shorter dragmata are rare.

(iii.) The trichites, both forming the dragmata and scattered singly, are exceedingly slender microxea, varying in length from 20 to 45μ.

SIGMAXINELLA DENDROIDES Whitelegge.

(Pl. xxxiv., fig.2.)

1907. *Sigmaxinella dendroides* Whitelegge(**60**), p.513, Pl. xlvi., fig.42.

Diagnosis.—Ramose, erect, stipitate; with cylindrical, tapered, dichotomously dividing, slender branches of moderate length. Surface even. Oscula presumably either very small or very shallow, at any rate not apparent in the skeletonised specimen. Dermal features unknown. Skeleton consisting (i.) of a condensed axial reticulation, the fibres forming which are moderately rich in spongin, and (ii.) of fibres radiating therefrom which are poor in spongin, are united only sparingly by (entirely sponginous) transverse fibres and by single spicules, and run (with occasional branching) in nearly parallel courses to the surface, becoming multispicular and somewhat plumose on nearing it, and terminating each in a subpenicillate tuft. The spicules of the radial fibres are of greater average length than those of the axial reticulation. Megascleres: subcylindrical styli, usually tapering gradually to a sharp or slightly rounded point at the apex, and usually slightly curved, sometimes bent; frequently tending to become abruptly blunt-pointed at the base; occasionally passing into strongyla, very rarely into oxea; 300 to 640μ long by 10 to 26μ in diameter. Microscleres: slender sigmata of two sizes, respectively 20 to 40μ in maximal length; and scarce trichites (microxea), 25 to 35μ long, scattered singly.

Loc. South of Port Hacking, N.S.W. ("Thetis").

External features.—The only known specimen—a figure of which has been furnished by Whitelegge—is a stipitate arborescent sponge, 180mm. in total height, with moderately elongated, cylindrical, distally tapered branches, 4 to 6 mm. in diameter, rising erectly from an equally slender stem, and occasionally anastomosing. The mode of branching is dichotomous, and successive dichotomies are usually in the some plane, but owing to irregularities, partly resulting through mutual interference, the branches come to be disposed in various planes: it is very probable, however, that specimens occur in which the branching is confined entirely to the one plane. The division of the stem to form the first two branches takes place 25 mm. above the base, each of those again dichotomising at about the same distance above their origin, and each of the resultant four branches also at about the same distance above theirs; the subsequent divisions for the most part occur at increasingly longer intervals, some of the terminal branches having an uninterrupted length of 70 mm.

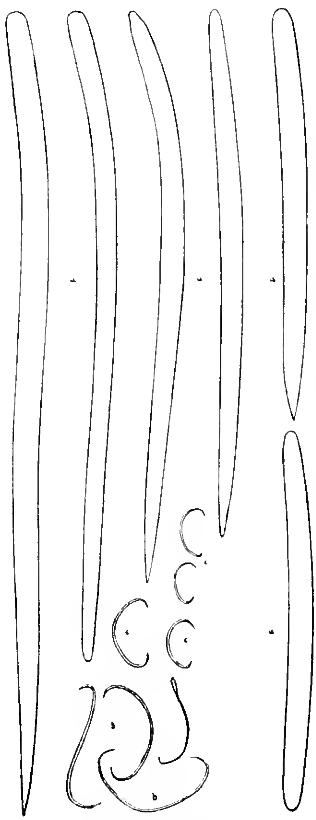
The specimen is imperfect, consisting only of the dried skeleton,—in which condition it appears to have been also when first described. Nothing can be said, therefore, in regard to the dermal features; but evidently the outer surface was even, without conuli or elevations of any kind. Oscula are not indicated. The skeletonised sponge being held between the eye and the light, the skeleton is plainly perceived to consist, in each branch, (i.) of a sharply circumscribed cylindrical core, of diameter generally less than one-fourth and (except in the lowermost parts of the sponge, up to about as far as the third dichotomy) not greater than one-half the diameter of the branch, and (ii.) of an outer region formed of slender radiating fibres, which are inclined to the longitudinal direction of the branch at an angle varying from 60° to nearly 90°, and present collectively an appearance somewhat resembling that of fur. The colour is a faintly creamy-tinted pale grey or dirty white, its paleness being due to the extremely small amount of spongin entering into the composition of the radial fibres. In the original description, the consistency is described as "tough, resilient, and compressible," but this is not strictly correct: the axial region is fairly tough and slightly compressible (and the branches consequently are flexible), but the extra-axial layer is soft, and on compression remains partially crushed.

Details of skeletal structure (Pl. xxxiv., fig.2).—Except towards the extreme apices of the branches, the demarcation between the axial region of the skeleton and the extra-axial, as seen in longitudinal section, is very pronounced (more especially if the spongin has been stained) notwithstanding there is no discontinuity between the main fibres of the two regions (*i.e.*, between the longitudinal fibres of the former and the "radial" fibres of the latter), such as might be inferred from the terms "primary" and "secondary" used in the original description to distinguish them. The contrast is partly due to the much greater density of the axial skeleton, and also partly (i.) to the rapidity with which the fibres change in direction from longitudinal to almost perpendicularly transverse, and (ii.) to the sudden and very considerable diminution in the amount of their constituent spongin,— as they pass from the one region to the other; but there are other differences also.

In the axial region, the main or longitudinal fibres, which have a maximal stoutness of 80 or 90μ, usually contain multiserial spicules, for the most part not very compactly or regularly arranged; are rather closely juxtaposed, and frequently coalesce with each other for short distances; and are connected at close intervals by short, aspiculous, transverse fibres. Participating in the formation of the axial skeleton also are many spicules whose relation to the fibres is more or less indefinite, as well as many transversely and obliquely directed ones occurring singly. In the older portions of the skeleton, the meshes of the reticulation become much reduced in size, often to the point of obliteration, through the continued growth in stoutness of the fibres. The more peripherally situated of the main fibres run, not longitudinally, but with a slight, and gradually increasing, trend outwards; ultimately they pass into the extra-axial region, and, curving surfacewards, immediately subdivide each several times in rapid succession to form the radial fibres.

The radial fibres, throughout the greater part of their length, are only two or three spicules broad; the spongin cementing their spicules is usually so small in quantity as scarcely to be discernible unless stained; and the connecting fibres between them occur only at comparatively wide and irregular intervals.

They run with slight divergence (gradually becoming more nearly parallel to each other as they proceed), and with occasional branching, generally at a distance of from 200 to over 300μ apart, to meet the surface almost at right angles. As the surface is approached, their spicules increase in number and become disposed for the most part in a somewhat plumose manner, the fibre undergoing a gradual change in character culminating in the formation, at its extremity, of a corymbiform, slightly divergent tuft consisting frequently of as many as 10 or 12 spicules. Elsewhere in the radial fibres the spicules lie mostly with their long axis in, or only very slightly inclined to, the direction of the fibre; but obliquely directed spicules, disposed more or less in an echinating fashion, are by no means uncommon. Some of the latter become united at their apices, by means of spongin, with adjoining fibres, and thus assist in the task performed by the connecting fibres; occasionally such spicules are ensheathed with spongin. The connecting fibres proper, of which mention has been made above, are formed entirely of spongin, like those of the axial region; they are very slender, varying in stoutness from less than 5μ to at most 20 or 25μ, and occur at distances apart usually exceeding, say, 300μ; where occurring closely together, they generally interunite among themselves.



Text-fig. 13.
Sigmaxinella dendroides.
a, megascleres; *b*, *c*, larger and smaller sigmata.

The megascleres forming the radial fibres are notably longer, on the average, than those of the axial skeleton; while the longest spicules of all are found in the surface-tufts. Sigmata are present in great number, and occur for the most part arranged uniserially along lines which probably coincide with the courses of the main canals; they are of two sizes, the larger being much the more numerous. Short, slender microxea (unmentioned in the original description) are also present, but appear to be rare; apparently also, they occur only singly scattered, never in dragmata.

Spicules.—(i.) The megascleres are almost exclusively styli, usually of slightly lesser diameter at the base than at some distance therefrom, and tapering towards the apex; frequently more or less blunt-pointed apically, and occasionally passing into strongyla, those of the latter form being almost invariably of less than the average length; often abruptly somewhat blunt-pointed at the basal end, but very rarely becoming oxea; ranging in length from about 300 to 640μ, and in stoutness from rarely less than 10 to about 26μ. The shorter spicules are generally straight or nearly so, the longer are nearly always slightly curved, or sometimes bent, the flexure as a rule being mainly in the basal moiety of the spicule.

(ii.) The two kinds of sigmata are scarcely different except with respect to size. The smaller vary in length from 12 to (rarely) 20μ, the larger from 25 to 40μ, measured from bend to bend; the maximal stoutness is in each case about 2μ. They are, without exception, more or less contort,—often (especially in the case of the larger ones) to such an extent as to appear S-shaped.

(iii.) The microxea (trichites) are fusiform, 25 to 35μ in length, and at most 1·5μ in diameter.

SIGMAXINELLA VIMINALIS, sp.nov.

(Pl. xxxiii., fig.4; Pl. xxxv., figs.1, 2; Pl. xxxvi., fig.1.)

Diagnosis.—Ramose, erect, stipitate; with elongated, slender, cylindrical, tapered branches, disposed irregularly. Surface hispid. Oscula, if present, small and inconspicuous. Dermal membrane thin, without contained megascleres. Skeleton with a central axis, in which the megascleres for the most part are so disposed as to produce a lattice-like pattern, and in which (except in the older portions of the sponge) spongin is only scantily developed. Extra-axial skeleton consisting of numerous, short, pauciserial lines of (relatively very long) spicules, radiating from the central axis to the surface,—the spicules composing which are more or less divergently directed, and are not united by visible spongin. Megascleres: slightly curved styli, 320 to 1525μ in length by 18μ in maximal stoutness. Microscleres: sigmata of two sizes, respectively 18μ and 50μ in maximal length, the larger ones in part occurring in dragmata; and fusiform trichites, 22 to 48μ in length, occurring both in dragmata and scattered singly.

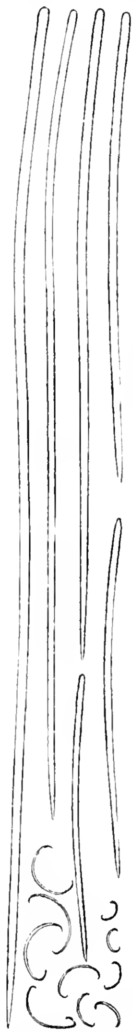
Loc.—Great Australian Bight (exact locality unknown).

External characters.—The single specimen (Pl. xxxiii., fig.4)—280 mm. in total height—consists of about half-a-dozen more elongated or main branches, 130 to nearly 200 mm. in length,—one of which is a direct continuation upwards of the stalk and gives off the others at different levels,—and of a score or so shorter branches, ranging from 5 to over 100 mm in length, which arise from the former at distant intervals, and nearly always proceed off from them at very wide angles, often almost or quite perpendicularly. The mode of branching, therefore, is not dichotomous (as it usually is in the case of ramose sponges) but irregular. The branches are at most 5·5 mm. in diameter proximally, and diminish in stoutness to slightly less than 2·5mm. at their extremities. The stalk has a length of 55 mm. measured from its base to the origin of the first branch, and terminates below in a tuft of branched rootlets. The species is very similar, in general habit, to *Raspailia tenuis* Ridley and Dendy(**33**).

The specimen, although in alcohol, is not in a very good state of preservation, the superficial layer being much damaged and the dermal membrane almost completely destroyed through maceration. Whether there are oscula or not, is accordingly not evident; but, if present, they must be rather small and inconspicuous. The surface is everywhere hispid with far projecting spicules. The branches are flexible and tough, with an outer layer of softer consistence: this layer has disappeared from the stalk, which is dense and tough throughout, and has a smooth and even surface. The colour in spirits is greyish-yellow.

Skeleton.—The formation of the skeleton differs from that of *S. dendroides*, described above, mainly in two respects; and these differences are to some extent consequent upon the much greater length (up to 1·5 mm.) of the megascleres in the present species, and upon the relative narrowness of the external layer intervening between the central axis and the surface. In the central axis, there are not to be distinguished, as in *S. dendroides*, definite longitudinal fibres joined by transverse ones in more or less ladder-like fashion, but the megascleres are disposed rather loosely in ill-defined tracts which cross one another at acute angles, thus giving rise to a somewhat lattice-like arrangement. And, secondly, the extra-axial skeleton (Pl. xxxv., fig.2) is entirely without transverse fibres, and consists simply of numerous, short, pauciserial lines of spicules running outwards to the surface in a direction nearly perpendicular thereto,—these spicules being arranged more or less penicillately and united by, at most, an infinitesimal amount of spongin, and the terminal ones projecting far beyond the surface.

The axial skeleton changes considerably in character with age, owing to gradual increase in the amount of spongin developed in connection therewith, and presents a very different appearance in the older and more basal parts from that which it exhibits in the uppermost portions of the branches. In the latter region, for a considerable distance (several centimetres at least) from the extremities of the branches, the amount of spongin present is so slight that its existence is apparent only in sections from which the fleshy tissue has been removed by maceration (Pl. xxxv., fig 1). In this portion of the skeleton also, the spongin appears diffused, and is without definite outlines. Proceeding towards the base of the sponge, the spongin gradually becomes more and more concentrated upon the sides of the lattice-like meshwork formed by the megascleres, which is thus converted into a reticulation of spiculo-spongin fibre. The elongated, narrow meshes of this reticulation ultimately (in the stalk of the sponge) become reduced in size almost to the point of obliteration.



Text-fig. 14.*

In addition to a gradual increase of density, the central axis also undergoes with age a gradual increase in diameter. This is effected by the continued formation, and addition to it externally, of fresh tracts of megascleres, which later similarly become ensheathed in spongin. In this way, the axial skeleton eventually comes to include within it the lines of spicules which previously constituted the extra-axial skeleton (Pl. xxxvi., fig. 1). The extra-axial layer, however, maintains about the same width—viz., about 1 to 1·5 mm.—throughout the whole length of the branches.

Sigmata of two sizes are scattered throughout all parts, the smaller in extreme abundance, more especially in the extra-axial layer; the larger ones, which are only moderately abundant, occur also in dragmata. Trichodragmata and singly scattered trichites are also moderately abundant, except in the axial region, where they are rare.

Megascleres.—These are slightly curved, occasionally slightly flexuous styli, almost without exception evenly rounded at the base, and of uniform diameter therefrom to beyond the middle of their length, whence they taper gradually to a sharp point; in very rare cases only, the basal extremity also is more or less pointed, and the spicule may become an anisoxea. They range from 320 to 1525μ in length and up to 18μ in stoutness. Spicules much below 700μ in length are relatively scarce.

Microscleres.—(i.) The larger sigmata are always more or less contort, though rarely to such a degree as to appear S-shaped when seen from the side; the smaller are usually C-shaped or but very slightly

* *Sigmaxinella viminalis.* Megascleres and sigmata.

contort. The former vary in length from 27 to 50μ, the latter from 12 to 18μ, measured from bend to bend; and their maximal stoutness is respectively 1·5μ and 1μ.

(ii.) The trichites or microxea, whether in dragmata or scattered singly, are all of the same kind. They are slightly fusiform, from 22 to 48μ in length, and from 0·5 to 0·75μ in stoutness.

SIGMAXIA, gen.nov.

Definition.—Axinellidæ typically of erect habit, stipitate, without conuli or other kind of surface-processes. Skeleton a reticulation of spiculo-spongin fibre; the main fibres more or less plumose, the connecting fibres typically few. Megascleres of two distinct kinds,—styli forming the fibres, and flexuous strongyla occurring interstitially. Microscleres: sigmata and trichites (or microxea), the latter in dragmata and scattered singly.

Type, *S. flabellata* Carter; the only species.

SIGMAXIA FLABELLATA Carter.

(Pl. xxxiii., fig.5; Pl. xxxvi., figs.2, 3.)

1885. *Axinella flabellata* Carter(**3**), p.361.

1896. *Sigmaxinella flabellata* Dendy(**2**), p.241.

Diagnosis.—Sponge composed of one or several proliferous, thick lamellæ, or of a single more or less flabelliform lamella, springing from a short stalk. Surface coarsely granular. Oscula minute, marginal (or scattered ?). Dermal membrane very thin; no dermal skeleton. Skeleton chiefly formed of loosely constituted, semi-plumose, stout main fibres, comparatively poor in spongin, running longitudinally side by side in moderately close apposition, and gradually curving towards the surface; connecting fibres few, arranged irregularly, mostly paucispicular, sometimes without contained spicules. Megascleres: styli, curved or slightly bent, and gradually sharp-pointed, occasionally passing into oxea, from 300 to 350μ in maximal length and up to 18μ in stoutness; and slender, flexuous strongyla and (fewer) tornota, 200 to (rarely) 580μ in length, and at most 7μ in diameter. Microscleres: slender sigmata 15 to 20μ long; and trichites of two sizes, respectively about 30 to 60μ in maximal length, the former occurring only in dragmata, the latter in part also scattered singly.

Loc.—Port Phillip.

The species is known now from six specimens, one of which forms the subject of the original description, while four in addition have been taken account of in the summary of specific characters furnished by Dendy. The present description, so far as it relates to the structure of the skeleton, is based almost entirely upon the sixth, the identity of which with the preceding has been established by comparison of it with a mounted preparation of one of Dendy's specimens.

External characters.—The sponge may be simply flabelliform, consisting of a single, erect, stout lamella narrowed below and prolonged into a stalk, as, for example, in the case of the single immediately accessible specimen (Pl. xxxiii., fig.5),—in which, however, the lamina is not of uniform thickness, but is rendered irregular by a number of rounded hummocks and several low, compressed ridges, the latter evidently of the nature of incipient secondary lamellæ; this specimen, 65 mm. in total height, has an orbicular lamina about 50 mm both in height and breadth and from 8 to over 20 mm. in thickness, and a cylindrical stalk, 7 mm. in diameter, expanded proximally into a broad disc of attachment. Of somewhat similar, but of less regular form,—and of larger size, measuring 88 mm. high by 112 by 37 mm. horizontally,—was also the original example, described by Carter thus: "compressed, expanded, thickish, lobate; margin irregular: stem short, angular, and thick." But more usually, it seems, the form assumed is one of less simplicity owing to the development of additional lamellæ, perhaps both primary and secondary: for the specimens upon which Dendy's account is based are described as composed of "proliferous lamellæ about a quarter of an inch thick, springing from a short thick stalk."

Oscula, unobserved by Carter, are stated to be present by Dendy, who describes them as minute, marginal or scattered; in the present specimen they are certainly absent from the lateral surfaces, and are not distinguishable on the margin,—but the latter circumstance may be owing to the slightly damaged condition of the surface there. The dermal membrane is thin and delicate, and easily destroyed. The undamaged surface has a finely to coarsely granular appearance, due to minute pimple-like elevations of the dermal membrane produced by the impingement upon it of the outer ends of the main skeletal fibres; where the membrane has disappeared, the projecting ends of the fibres render the surface slightly shaggy. The texture is tough, fibrous, resilient. The colour in spirit is pale brownish or yellowish-grey.

The dermal pores are distributed singly, though often in rather close apposition; they are variable in size, 20 to 50μ in diameter.

Three of the four specimens recorded by Dendy are noted by him as being beset with parasitic Anthozoa. The present specimen is likewise infested, no doubt with the same organism: it is a small, solitary anthozoan, only 1 to 2 mm. in height and diameter, occurring almost completely imbedded in the sponge.

Skeleton.—The structure of the skeleton, as revealed in sections of the completely desarcodised sponge, in which nothing remains but the spongin-cemented elements (or skeletal framework), is very definite and uniform in character, and at first sight, more especially under the lowest powers of the microscope, appears as if more correctly to be described as dendritic than as reticulate (Pl. xxxvi., figs.2, 3). It consists almost entirely of ascending, frequently branching, stout main fibres, running moderately closely side by side in subparallelism (at an average distance apart, say, of from 300 to 400μ), gradually curving outwards, as they ascend, towards the surface. Connecting fibres, however, are by no means rare, but for the most part they are comparatively inconspicuous. The main fibres, which are seldom less than 100μ, and occasionally surpass 200μ in stoutness, are formed chiefly of spicules, for the most part rather loosely and confusedly arranged, a variable proportion (generally a small minority) of which are disposed with their points directed more or less obliquely outwards. As the surface of the sponge is approached, however, the spicules composing the fibres become gradually more and more divergingly disposed, as well as more loosely compacted, and the fibres finally assume, in consequence, a typically plumose aspect. The spongin cementing the spicules, —though necessarily fairly considerable in amount owing to their loose arrangement,—is, except in the stalk and oldest portions of the skeleton, usually of scarcely more than the minimal quantity required to hold them together, and seldom or never forms a distinct sheath: where the spicules lie more widely apart, it often becomes reduced to a mere film between them, and here and there even leaves small open spaces or fenestræ. Running upwards from the stalk, and continuing for some distance into the body of the sponge, gradually dissolving as they proceed, are a number of relatively stout strands of spicules, or funes, evidently formed each by the fusion of several originally separate fibres (Pl. xxxvi., fig.2). Connection between the main fibres, apart from occasional anastomosis or direct union between them by inosculation, is partly by means of relatively few, obliquely-running multispicular fibres, similar in character to the main fibres except in being usually of lesser stoutness, and partly by means of connecting fibres proper. The latter are mostly very slender, and usually contain few spicules or are composed of spongin alone; they occur at irregular intervals, sometimes singly, sometimes several together, and in the latter case usually interunite also among themselves

In sections of the sponge with the soft tissues intact, the appearance of the skeleton is somewhat different. The presence of spongin is scarcely apparent; the main fibres have a much looser and more plumose aspect; and the connecting fibres are seldom definitely recognisable as such, owing to the difficulty of distinguishing between the megascleres actually constituting them and others that are merely scattered between the fibres. The more diffuse and plumose appearance of the main fibres is probably due to the fact that some proportion of the more exteriorly situated (and likewise more obliquely directed) spicules entering into their formation are not attached by spongin, and consequently are absent from the skeleton that remains after maceration. In the more peripheral parts of the skeleton, the megascleres scattered between the fibres are relatively few, and consist of styli only, similar to those composing the fibres. But at some distance from the surface,—usually a somewhat considerable distance, megascleres of a second kind make their appearance,—flexuous strongyla and tornota,—which increase in number towards the deeper portions of the sponge and eventually become very abundant; indeed, it is almost as much to the increased multitude of the latter, as to augmentation in the quantity of the spongin, that the greater density of the skeleton in the stalk and other older portions of the sponge is due. A considerable proportion of the latter spicules are developed in close contiguity to the fibres, and ultimately, owing to the subsequent formation of additional spongin, become completely united to them. The presence of these flexuous megascleres, owing to their extreme rarity in, or total absence from, those portions of the sponge usually selected for examination, hitherto has escaped notice.

Through all parts of the sponge there are scattered small sigmata singly in moderate abundance, trichodragmata of three kinds, and single trichites of similar size to those composing the larger trichodragmata. The trichodragmata of two kinds are in the form of neat sheaves of extremely slender trichites, and differ from each other only in length; the shorter of these are almost as numerous as the sigmata, while the longer are relatively scarce. The dragmata of the third kind are composed of trichites equal in length to those of the just-mentioned longer dragmata, but stouter and more fusiform, and occur for the most part in dense masses of irregular shape and size, which refract the light in such a way as to appear blackish and opaque, and are, therefore, very noticeable although comparatively scarce; some of the largest of these aggregations exceed 200μ in breadth. The singly scattered trichites, or microxea, are moderately scarce in the interior, but more plentiful near the surface.

Megascleres.—(i.) The styli are invariably more or less curved, are usually evenly rounded at the base and of uniform or nearly uniform diameter therefrom to beyond the middle of their length, and almost invariably taper throughout the remainder of their length gradually (except frequently for slight irregularities near the apex) to a sharp point; a gradual slight narrowing of the spicule towards the basal end, however, is not uncommon. The curvature as a rule is restricted to the basal moiety of the spicule, and is usually well-pronounced, but varies much both in form and degree: frequently it is more or less angulate, the spicule appearing slightly bent; and occasional spicules are bi-angulate. In odd cases of extreme curvature, the form of the spicule makes some approach to that of a rhabdostyle. Variability exists also in the shape of the spicule at its basal extremity, which frequently shows a tendency to become abruptly more or less sharp-pointed, either hastately or mucronately so; but sometimes the attenuation is more gradual, and the form assumed is that of an oxea. The proportion of oxeote forms is greatest amongst the slenderer, presumably immature spicules, which only occur scattered between the fibres, and are relatively few in number. The maximal size of the spicules in the case of Dendy's specimens is given as $290 \times 16{\cdot}6\mu$: in the present specimen, the size attained is $350 \times 15\mu$, but individuals much exceeding 320μ in length are scarce; those composing the fibres are seldom less in stoutness than 10μ. Developmental forms of all sizes down to less than $140 \times 1\mu$ are to be met with. (In the

Text-fig. 15.—*Sigmaxia flabellata.* *a*, megascleres of the fibres; *b*, interstitial megascleres; *c*, sigmata.

original description, the size of the spicules is given as 70 by 2-6000ths of an inch—*i.e.*, $296 \times 8{\cdot}4\mu$, but this, I think, must be due either to an error of measurement or to a misprint).

(ii.) The variously curved, usually more or less flexuous megascleres are mostly strongyla, but individuals with sharp-pointed ends are also numerous. They range from about 200 to 580μ in length and from 1·5 to 7μ in diameter. The acutely-ended spicules, as a rule, are more or less abruptly-pointed, *i.e.*, are tornota; but more or less oxea-like forms are not rare. Some of the shortest among the latter spicules are hardly to be distinguished from the oxea that derive from the stylote megascleres.

Microscleres.—(i.) The sigmata are invariably more or less contort, though seldom to such a degree as to appear S-shaped when seen from the side; they are 15 to 20μ in length measured from bend to bend, and about 1μ in stoutness.

(ii.) The trichites are of two sizes as regards length, the shorter measuring from 15 to 28μ, the longer from 37 to about 60μ. As already mentioned, the former occur only in dragmata, the latter both in dragmata and scattered singly.

Ceratopsis Thiele.

Definition.—Axinellidæ of erect, lamellar or ramose habit; typically with an axially condensed skeleton deficient in spongin. Megascleres either of two distinct kinds—styli (sometimes in part secondarily diactinal) and elongated flexuous strongyla,—or the latter spicules are absent. Microscleres: smooth microxea only, typically occurring most abundantly in the dermal layer.

Type, *C. expansa* Thiele.

The genus was instituted by Thiele(**38**) for four species from Japan, differing from all previously known Axinellidæ by the presence of microscleres of a single kind in the form of smooth microxea, and further characterised according to the generic diagnosis—(i.) by the presence of smooth stylote megascleres "die ein festes Axenskelett bilden, von dem nach Peripherie radiäre Style ausgehen", (ii.) by the very small amount of spongin present, and (iii.) by the almost complete restriction of the microscleres to the ectosome, where they constitute a dermal skeleton. The only additional information provided regarding the skeleton is to the effect that the "feste Axe" is similar in character to that of the genus *Acanthella*: whether the radially-directed styli are collected into fibres or not, or in what respects, if any, the several species differ in skeletal structure, is not stated. Three of the species,—viz., *C. expansa*, *C. erecta*, and *C. ramosa*,—agree in their described characters very closely, and are undoubtedly congeneric; but the fourth, *C. clavata*, is distinguished not only by its non-lamellar (cauliform) habit and conulose surface, but also by the fact that the megascleres are of two distinct kinds,- styli composing the main skeleton, and relatively few long flexuous strongyla (presumably occurring interstitially). Since it is not unlikely that *C. clavata* will be found to differ from the remaining three species in other important respects also, its inclusion in the present genus must be looked upon as provisional.

More recently Kirkpatrick(**20**) has described from Cape Colony, under the name *Phakellia microxephora*, a fifth species with microxea, which it seems necessary also to include provisionally in the genus *Ceratopsis*. This species agrees with *C. clavata* in the possession of elongated flexuous strongyla, but the accompanying megascleres are relatively few, and chiefly oxeote, and the external habit of the sponge is lamellar as in the case of the typical species of the genus. Concerning the structural characters of the skeleton in this species, no information is available.

By Thiele and Kirkpatrick, the oxeote microscleres were regarded as indicative of affinity with the genus *Higginsia*. The evidence afforded by the spiculation of *C. clavata* and *C. microxephora*, however, much more strongly justifies the view that *Ceratopsis* is related to *Sigmaxia*, and that it constitutes a connecting-link between the latter and such genera as *Axinella*, *Phakellia*, and *Acanthella*.

It is necessary to refer here to the species designated *Axinella frondula* by Whitelegge(**60**), the spiculation of which has been described as consisting of smooth styli of two sizes and of scarce small oxea 110 by 3·5μ in size, occurring "chiefly in or near the dermal portion of the sponge",—and which consequently might be thought to be related to *Ceratopsis*. I have re-examined this species, and find that the oxea are merely variants of the smaller styli (differing from them neither in size nor in situation), and that the latter are differentiated into two kinds, one of which is distinguished by having the distal moiety vestigially spined, and by being very slightly stouter and of more conical shape than the other. The species belongs, in fact, to the Myxillinæ, and requires a new genus for its reception, for which I propose the name *Echinaxia*. The sponge is thinly lamellar, flabelliform; and the skeleton consists (i.) of a condensed axial region formed mainly of an irregular reticulation of the smaller smooth styli (which vary from 90 to 150μ in length and up to 5μ in stoutness) and partly of fairly numerous, longitudinally directed, singly-occurring, long slender styli (varying in size from less than 200 by 2μ to upwards of 700 by 12μ), and (ii.) of short, fairly stout, echinated fibres radiating from the axial region towards the surface, composed both of smooth and spined short styli, and terminating in a compact bundle or tuft of long stout styli (apparently similar to the longer of those occurring in the axial region) the extremities of which project somewhat beyond the surface. I am inclined to think that the genus *Echinaxia* should be so defined as to include also the two species described by Thiele(**38**) as *Raspailia folium* and *Raspailia hirsuta*.

DRAGMAXIA, gen.nov.

Definition.—Axinellidæ of lamellar habit, typically flabellate or cup-shaped. Skeleton composed of dense spicule-axes ramifying in the midplane of the lamina, and of plumose spicule-columns radiating therefrom, between which interconnection by means of transverse fibres is rare. Megascleres: styli only; either of a single sort, or more or less completely differentiated into two sorts,—one (of shorter length) forming the fibres, the other occurring interstitially. Microscleres: trichodragmata accompanied or not by singly scattered trichites.

Type, *D. variabilis* Whitelegge.

The species for which I propose the genus was referred by its author to the genus *Spongosorites*, under the erroneous impression that the microscleres present—which are exceptionally slender trichite-sheaves, peculiar in being often more or less fusiform in shape—were microxea. Even had the microscleres been as stated, however, it is not to *Spongosorites* that the species would have required to be assigned, but probably to *Ceratopsis*. Hitherto, all species with a plumose or with an axially-condensed type of skeleton, and with trichodragmata only as microscleres, have been included in the single genus *Thrinacophora*, but I now propose to regard them as representative of several distinct genera.

DRAGMAXIA VARIABILIS Whitelegge.

(Pl. xxxviii., figs.1, 2, 3.)

1907. *Spongosorites variabilis* Whitelegge(**60**), p.513, Pl. xlvi., fig.45.

Diagnosis.—Thinly lamellar, varying from flabelliform to caliculate. The lamina alternately denser and less dense along lines running towards the margin, and thus presenting an appearance as of venation, with corresponding faint ridges and grooves on the surface. The surface otherwise even. Dermal membrane distinct, aspiculous. Oscula inconspicuous. Skeleton consisting of dense spicule-axes corresponding in position with the "veins," and of stout plumose fibres running outwards therefrom to the surface. Spongin rather scanty. Megascleres: styli only, not quite perfectly differentiated into two kinds; those forming the fibres are shorter, stouter, and more curved, attaining a maximum size of about 900 by 33μ; the others, which are relatively few and occur only interstitially, occasionally surpass 1300 or 1400μ in length and are not more than 18μ in diameter. The trichodragmata vary from about 100 to 200μ in length and up to 5μ in stoutness; singly scattered trichites, similar to those forming the dragmata, also occur.

Loc.—Off Crookhaven River, N.S.W. ("Thetis.").

External features.—The original specimen was rudely cup-shaped or, rather, compressed funnel-shaped, with a few laterally arising secondary lamellæ disposed in vertical planes; and measured, when complete, approximately 130 mm. in height by 120 and by 80 mm. respectively in the greatest and least diameters of the cup-orifice, and from 2 mm. (at the margin) to about 5 mm. in the thickness of the lamina or cup-wall: it exists now in two pieces, one of which—figured by Whitelegge—is in a dried but otherwise undamaged condition, while the other is well-preserved in alcohol. According to the original description, the lateral lamellæ occur on both the inner and the outer surfaces of the cup, but this is really not the case; they are confined entirely to the interior side.

A second specimen (also obtained by the "Thetis" Expedition, but from an unknown locality) is now known, which is simply flabelliform without secondary outgrowths. This measures 90 mm. in height by only 2 to 3 mm. in thickness, and is in a dried, completely washed-out condition.

An exceedingly characteristic feature,—very clearly evident when the sponge is examined by transmitted light,—is the structural peculiarity of the lamina, which is alternately denser and less dense along slightly diverging, ever multiplying lines, or rather strips, running in a direction from stalk to margin: along the denser strips, the lamina is usually slightly thicker than it is between them, and the surface is accordingly marked with radiating faint grooves and slight ridges. With respect to this structure, however, the two specimens exhibit a very appreciable difference, which may prove to be varietally distinctive. In the smaller specimen, the strips (of greater density) are all directed radially, increasing in number upwards by repeated branching, and are all similar in character; they diminish in individual width from somewhat less than 2 mm. in proximity to the stalk to less than 0·5 mm. at the sponge-margin, and the width of the intervening strips of lesser density is about the same. In some portions of the type-specimen, the structure is very similar to this, except that the lines of greater density are generally much broader; but elsewhere there also occur a few relatively very powerful, dense, nervure-like thickenings of the lamina, ramifying through it, upwards from the stalk, in the manner of the palmate leaf, and from these the lesser lines of density, in part, branch off (at small angles of divergence) in pinnate fashion (Pl. xxxvii., fig.3).

As a result of maceration, the less dense portions of the lamina largely disappear, and the sponge becomes abundantly perforated by rounded holes arranged serially along radiating lines.

The surface is somewhat uneven, owing to inequalities in the thickness of the lamina; it is also slightly granular, but not hispid. The dermal membrane is thin and translucent, but not very delicate; situated beneath it, more especially along the grooves marking the less dense portions of the lamina, are numerous small subdermal spaces. Dermal pores occur on both surfaces, but are relatively few and for the most part are scattered singly and irregularly on the one surface (viz., the inner one, when the sponge is cup-shaped), very numerous, and generally so closely arranged as to produce a net-like appearance of the dermal membrane, on the other. In most places where the pores are numerous, the dermal layer appears as if consisting of two incompletely separated membranes, the outer one of which is provided with many, smaller pores, the inner with fewer and much larger ones. On the surface which has the fewer pores, there are also many circular openings, from 0·2 to 0·5 mm. or slightly more in diameter, situated only along the surface-grooves and principally in the positions where the lamina becomes perforated when the sponge is macerated; these openings appear to be oscula.

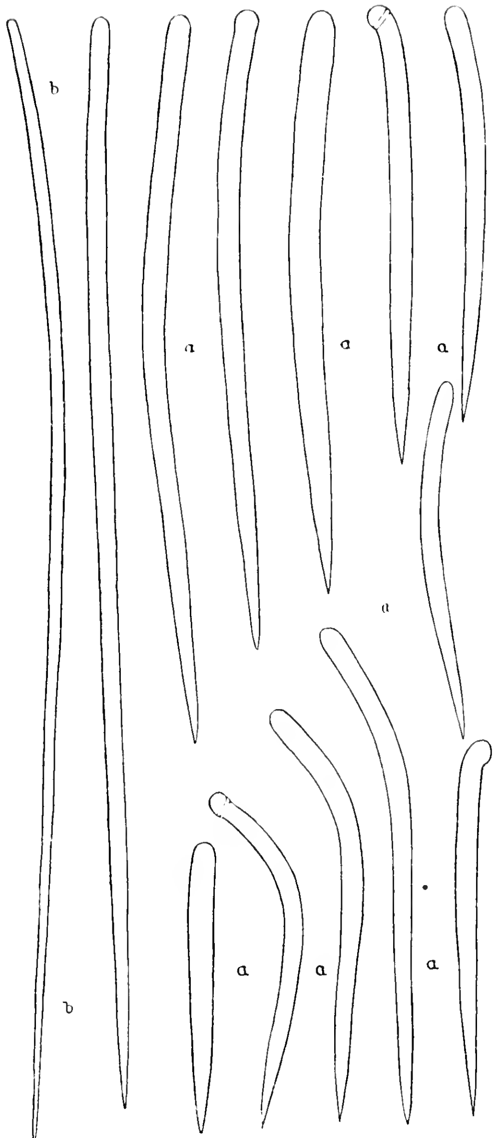
The consistency of the sponge, when well-preserved in alcohol, is firm and tough, only slightly compressible, and resilient; and the colour is a pale yellowish-brown. Dried specimens are light in weight and rather brittle, and of a pale greyish colour.

Skeleton.—The skeleton is resolvable into (i.) a system of condensed, multifibrous axes or "funes," which ramify dendritically in the midplane of the sponge-lamina, progressively decreasing in stoutness as they ascend,—and which form the midribs, as it were, of the denser strips of the lamina above referred to; and (ii.) of numerous, highly plumose, usually branched, short secondary fibres, which proceed off from the former, apparently from all sides thereof, and run upwards and gradually outwards to the surface. Towards the margin of the sponge, the funes dissolve ultimately into similar plumose fibres (Pl. xxxvii., fig.3), and the skeleton in this region accordingly is composed entirely of such (Pl. xxxvii., figs.1, 2): these fibres are composed of a compact stout core (seldom less than 200μ and frequently surpassing 400μ in diameter) of longitudinally disposed spicules, cemented together by a relatively somewhat small amount of spongin, and of rather numerous, usually very obliquely (often nearly or quite perpendicularly) directed, outwardly-projecting or "echinating" spicules of similar kind, the number of which is greatest towards the outer extremities of the fibres. The echinating spicules of immediately adjoining fibres usually intercross with one another, and very often, where two fibres lie sufficiently close together, the points of some of the spicules of each of them become embedded in the spongin of the other; occasionally, one or a few together of these connecting spicules become invested with a sheath of spongin, and a connecting fibre is thus formed, but such connections are comparatively rare. Megascleres scattered between the fibres are relatively few, and in part are much longer and slenderer than those forming the fibres. The funes are composed each of a dense, irregular plexus of stout, mostly non-plumose fibres with closely compacted spicules arranged usually in a more or less disorderly fashion, and cemented by a relatively small amount of spongin, which does not form an external sheath; the outermost-lying spicules of the fibres, indeed, are usually almost or quite free from spongin. Towards the older parts of the sponge, the meshes of the plexus tend to become obliterated, and the skeleton has the appearance of consisting of a confused mass of spicules. The formation of the plexus appears to be brought about by the continued addition of spicules to, and also in between, the plumose fibres of the original skeleton.

Trichodragmata are scattered fairly plentifully through all parts of the sponge, including the dermal membrane, but are nowhere extremely abundant: within the funes they are rather scarce. Singly scattered trichites in moderate number also occur, but are difficult to perceive owing to their extreme tenuity. The dragmata are unusually slender, and are often notably longer than the individual trichites composing them.

Megascleres.—(i.) The styli composing the fibres are almost invariably more or less curved, and are, without exception, evenly rounded at the base and of uniform or nearly uniform diameter therefrom to beyond the middle of their length, whence they taper gradually to a sharp point. Their curvature, as a rule, is slight to moderate, and most frequently is confined to the basal moiety of the spicule, but it varies in degree very considerably, and when most pronounced is usually somewhat angulate. Quite commonly in the case of the smaller specimen, much less frequently in the larger, the basal part of the shaft, at a variable distance from the extremity, is more or less sharply curved or bent to one side; occasionally such spicules have the form of rhabdostyli. In the latter, or typical specimen, a notable proportion (numbering between 25 and 50 per cent. of the spicules) exhibit a faint annular swelling close to the basal end, at a distance therefrom varying from 15 to about 50μ,—the distance usually being greatest, and the annulation less distinct, in the case of the longest spicules; in some of the shorter spicules, the annular swelling is replaced by a slight basal inflation, the spicule becoming a subtylostyle. In the case of the smaller specimen, this peculiarity is exceedingly rare. In the typical specimen, also, the spicules increase in stoutness towards the base of the sponge, attaining in proximity to the stalk a maximum diameter of 45μ; whereas in the uppermost regions thereof, and throughout all parts of the other specimen, their diameter is at most 33 or 34μ. Their length is about the same in both specimens,—ranging from about 350μ (but seldom less than 400 or 450μ) to somewhat above 900μ.

(ii.) The longer and slenderer styli, occurring only between the fibres, and relatively few, are generally straight or (in comparison



Text-fig. 16.—*Dragmaxia variabilis.* *a*, megascleres of the fibres; *b*, interstitial megascleres.

with their length) but slightly curved, often somewhat flexuously; and with extremely rare exceptions are unprovided with a subbasal annular inflation: otherwise, in shape, they are similar to the preceding, with which they form a continuous series. In the typical specimen, they range from somewhat less than 1000 to upwards of 1500μ (rarely to nearly 1600μ) in length, and up to 18μ in diameter, spicules between 900 and 1000μ in length being comparatively rare; in the other specimen, they are of equal stoutness, but seldom surpass 1250μ, and very rarely if ever attain to more than 1400μ in length, while individuals between 900 and 1000μ long are comparatively frequent.

Microscleres.—The trichites, both composing the dragmata and scattered singly, are very slender, always less than 0·5μ in diameter, and vary in length from 75 to 110μ; they are very frequently curved or flexuous. The dragmata are seldom as much as 5μ in diameter, and as a rule they are very compactly composed and somewhat fusiform in shape; they are often much longer than the trichites, occasionally attaining a length of 200μ.

EXPLANATION OF PLATES.

Plate xxix., fig.4.

Fig.4.—*Allantophora plicata* Whitelegge; showing the skeleton (photographed by transmitted light) of portion of a lamella of the type-specimen, the lamella varying in thickness from 1-8 mm.; (nat size).

Plate xxx.

Fig.1. *Allantophora plicata* Whitelegge; portion of a spirit-specimen; (× $\frac{5}{6}$).

Fig.2.—*A. plicata* Whitelegge; portion of a lamella of the partially macerated, dried type-specimen; (nat. size).

Fig.3. *A. plicata* Whitelegge; an entire lamella of a dry, washed-out specimen, showing the texture of the skeleton; (nat. size).

Figs.4, 5.—*A. victoriana*, sp.nov.; specimens of massive form (*cf.* Pl. xxxi., fig.3); (× $\frac{5}{12}$).

Fig.6.—*A. ciocalyptoides* Dendy; a submassive, digitate specimen, attached to a stone; (× $\frac{5}{12}$).

Fig.7.—*A. ciocalyptoides* Dendy; a semi-encrusting specimen, growing upon a stone; ($\frac{5}{12}$).

Fig.8.—*A. ciocalyptoides*, var. *reducta*, var.nov.; (× $\frac{5}{12}$).

Plate xxxi.

Allantophora victoriana, sp.nov.

Fig.1.—Skeleton (photographed by transmitted light) as it appears in a thick vertical slice of an entire massive specimen; (nat. size).

Fig.2.—Skeleton of a moderately thick vertical slice of the type-specimen; (nat. size).

Fig.3.—Skeleton (photographed by transmitted light) of portion of a digitate specimen, extending from the base upwards into two digitiform processes; ($\times 1\frac{1}{3}$).

Fig.4.—Digitate specimen; (nat. size).

Plate xxxii.

Allantophora victoriana, sp.nov.

Fig.1.—Portion of a longitudinal mesial section of the skeleton of a digitiform process, showing the axial region, the radiating main fibres, and the connecting fibres; ($\times 9$).

Fig.2.—Portion of a transverse section of the skeleton of a digitation, showing the paucity of the connecting fibres in the transverse plane; ($\times 9$)

Figs.3, 4, 5.—Portions of the skeleton (of the two massive specimens), showing the pattern of the reticulation formed by the connecting fibres.

Plate xxxiii., figs.1-5.

Figs.1, 2.—*Sigmaxinella australiana* Dendy; ($\times \frac{5}{12}$).

Fig.3.—*S. australiana* Dendy, (? var.); ($\times \frac{5}{12}$).

Fig.4.—*S. viminalis*, sp.nov.; ($\times \frac{5}{12}$).

Fig.5.—*Sigmaxia flabellata* Carter; ($\times \frac{5}{12}$). [The oscula-like pits on the surface are due to an epizoic Zoantharian.]

Plate xxxiv.

Fig.1.—*Sigmaxinella australiana* Dendy; longitudinal mesial section of the skeleton of portion of a branch; ($\times 13$).

Fig.2.—*S. dendroides* Whitelegge; longitudinal mesial section of the skeleton of portion of a branch; ($\times 13$).

Plate xxxv.

Sigmaxinella viminalis, sp.nov.

Fig.1.—Longitudinal mesial section of the skeleton of the terminal portion of a branch; ($\times 14$).

Fig.2.—Longitudinal mesial section of a branch; ($\times 14$).

Plate xxxvi.

Fig.1.—*Sigmaxinella viminalis*, sp.nov.; longitudinal median section of the skeleton of the stalk; ($\times 14$).

Fig.2.—*Sigmaxia flabellata* Carter: (portion of a) longitudinal section of the skeleton perpendicular to the plane of the sponge-lamina; (× 3).

Fig.3.—*Sigmaxia flabellata* Carter: portion of the section shown in the preceding figure, more highly magnified; (× 13).

Plate xxxvii.

Dragmaxia variabilis Whitelegge.

Fig.1.—Skeleton as shown in a thin section parallel to and in the midplane of the sponge-lamina at its upper margin; from a typical specimen; (× 15).

Fig.2.—Skeleton as shown in a thin longituninal section perpendicular to the sponge-lamina at its upper margin; from a typical specimen; (× 15).

Fig.3.—Skeleton (of an entire piece of the sponge-lamina) showing the arrangement of the dense multi-fibrous axes or "funes" and their ultimate resolution into single fibres; (× $1\frac{1}{3}$).

Plate xxxviii., figs.1-4.

Figs.1, 2, 3, 4.—*Allantophora victoriana*, sp.nov.; photograph of portions of the surface of different specimens, showing the mode of disposition of the dermal pores.

THE GAMETOPHYTE OF PSILOTUM: PRELIMINARY NOTES.

By Thomas Whitelegge, Medalist of the Royal Society of New South Wales, 1899.

(*Communicated by the Rev. W. W. Watts.*)

(Plate xlv.)

These Notes are an attempt to elucidate the mystery of the sexual reproduction of *Psilotum*, which has hitherto eluded all the researches of investigators.

As far back as 1899, at the request of Dr. J. P. Hill, late of Sydney, now Professor of Zoology in University College, London, I sowed spores of *Psilotum triquetrum*, and these spores were subjected, by Dr. Hill and myself, to continuous observation for some time. The spores germinated, but as we failed to get any light upon the method of germination, the observations were discontinued. The spores, in this case, were sown on the dead, barren fronds of *Platycerium alcicorne*, and the aim of the experiment was to discover a visible prothallus. This search for a prothallus was evidently the reason of our failure, as it has probably been the reason of the failure of other investigators.

After a lapse of 15 years, I decided, in 1915, to try growing the spores upon a living plant, and, for this purpose, selected the aërial rhizomes of *Davallia pyxidata* Cav., seeing that the two plants were often found growing in proximity to one another.

Spores were sown thickly, on prepared rhizomes, on November 20th, 1915; and the method adopted was as follows. A 5″ pot was filled with soil to within an inch of the brim, the soil having been sterilised by dry heat, and by soaking it in several changes of boiling water. When cool, the surface was covered with pieces of the rhizomes of *D. pyxidata*. While the surface was fairly wet, Psilotum-spores were dusted over it, after which a sheet of glass was placed on the top of the pot, the inequalities of the rim providing sufficient ventilation for the spores. The pot was placed on the window-sill in my room, and exposed to bright sunlight in the afternoon. Water was supplied by means of a saucer and by an occasional bath up to the soil-level, water on the top being, of course, avoided. It should be said that the rhizomes used were soaked in water for a day or two, to get rid of spores, dirt, or insect-pests, which were removed with a soft brush. Decayed scales were also removed, and only healthy ones left.

In this experiment, instead of waiting for the appearance of prothalli, I made a thorough examination of some of the spores as often as possible, both day and night. The examination was continued until nearly all the spores were exhausted.

On December 20th, additional spores, freshly gathered, were sown on the same rhizomes, and these were continuously examined up to the end of the year, but without any definite results.

On New Year's Day, 1916, however, I was rewarded by seeing the male gametophyte *attached to the spore*. There were at least four, or more, antheridia visible, some of them already discharging antherozoids, and others almost ready to do so.

This discovery cleared up what had been, to me, a mystery for many weeks. I had frequently seen, and increasingly so towards the end of December, bodies that now proved to have been the antheridia of *Psilotum* discharging antherozoids. I had not dreamt, at the time, that these bodies were the sperm-cells of a vascular cryptogam: they seemed, to me, a phase of the life-history of some organism quite unknown to me: a surmise all the more probable seeing that every fresh collection of spores placed under the microscope was associated with many forms of life, including Infusoria, Protozoa of various kinds, Tardigrades, Mites, and Worms.

The difficulty experienced in recognising these antheridia will be understood when it is stated that the first examples seen were solitary spherical cells of various sizes, some of them equal in diameter to the smaller diameter of the spore, and others of them about equal to its nucleus. These cells were floating freely in water, and seemed to have the power of movement. These antheridial cells I will now try to describe. The cell-wall is thin, transparent, and devoid of structure, with the exception of a bracket-like mark, which later becomes a slit, on some part of the wall. The contents of the cell consist of a large number of extremely minute oval, or round, bodies; but a one-sixth objective reveals nothing definite, except semi-transparent dots and, when sharply focussed, a thin, dark line. When one of these cells is placed in water, osmosis begins, and finally the cell-wall is ruptured at the bracket-like mark, enabling a small cloud of active bodies to escape, and swim rapidly away. When the rupture takes place, the force is such that there is a kind of backward thrust, which causes either rotation or change of position. The exit-slit appears now to close again, leaving the bulk of these bodies within the cell, where they continue to swim about, vigorously endeavouring to escape. Some of them have so difficult an exit that their efforts often cause the cell to move. It takes an hour, and sometimes two hours, for all these bodies to emerge from the cell. There is no rest: they are active all the time; and, after escaping, they scatter rapidly.

After these bodies had been identified as antherozoids, search was made for some spore in a suitable condition to attract them, but without success. Further observation, however, showed that the ripe spores, taken from an open synangium and placed in water, underwent, in the course of a few hours, a series of changes, by way of cell-division, which revealed the existence of two well-marked kinds of spores, differing from one another, in shape slightly, and greatly in the density of their cellular contents: the first indication that the spores were *diœcious.* And it may be said here, though I shall be anticipating a later part of my statement, that the male-producing spores are subreniform in shape, a little wider, or deeper, than the female-bearing spores, with the ends more rounded. Moreover, cell-division in the male spore is definite, and in the female indefinite; in the male, also, the spore-contents assume the form of a large bubble-cell, which fills up the whole of the spore.

This bubble-cell splits into two cells, which again subdivide, until finally eight, or more, cells are formed. The whole of the protoplasm appears to be used up in the formation of these cells, which are unequal in size, free, and without a trace of any other cellular structure. When nearing maturity, some of these cells may be seen outside the spore-case, while others remain inside, the relative inequality in size being unaltered. All these cells produce antherozoids in abundance. There appears to be a thin deposit of gum binding the spore-case and the cells to the substratum on which the spore grows. These cells are usually spherical, easily separated, and often floating freely without any trace of their having been attached.

So far as concerns the male gametophyte of Psilotum, therefore, I may claim to have got positive results. The numerous specimens I have had under observation warrant the conclusion that there is one kind of spore that produces the male gametophyte; that this gametophyte consists of a series of free antheridia, and that each antheridial cell, irrespective of size, forms mother-cells and antherozoids.

The search for the female gametophyte has been a much more difficult matter, and very disappointing. A careful look-out was kept for signs of the female throughout my investigations, and I have already indicated how I was enabled to conclude that the spores were diœcious. Curiously enough, the females were present all the time, and quite as plentifully as the males. The size, shape, and colour of the peculiar structure, which I have come to regard as the female gametophyte, required at least a one-sixth objective to distinguish it from small, malformed spores of the normal kind, and immature spores of various shapes and sizes. The presence of three or four testaceous amœbæ, which resembled the gametophyte in shape and colour, two species of Arcella, one Assulina, and one Euglypha, added to the confusion.

Even after I had seen the female *in situ*, both in its early stages and in what I regard as the adult form, it required prolonged examination to be certain of its identity. Its minuteness and the fact that it was often so deeply stained that nothing in the way of structure could be seen, rendered the search extremely difficult. That I have found at least a stage of the female gametophyte, however, I have no doubt; and the following tentative description of its structure is submitted as being the nearest possible without a resort to sections.

The spore producing the female gametophyte is, as already intimated, narrower, with the ends less rounded than in the male. The spore-contents consist of numerous small cells. Usually, one thick-walled body is seen as an outgrowth from the spore, as development proceeds, and a number of irregularly-shaped cells appear, some of which project from the surface; the appearance presented being as if the cells were imbedded in gum. The structure, when complete, is dome-shaped, with at least two small clusters of projecting cells near the summit on opposite sides; these projecting cells I regard as possibly, and even probably, the archegonia. The base presents structural features which render the identification of the female gametophyte certain in all stages. At the point of union with the spore, there is a very distinct ring, consisting of a series of cells which are invariably stained brown, the colour being much darker than that of the rest of the cells. Similar brown cells sometimes project on other parts of the dome, and produce rhizoids.

When this dome-like structure is detached from the spore, it is seen to be hollow, with the upper part thick-walled; and, in this thick wall, the aforesaid projecting cells are imbedded. Towards the base, the wall is thinner, and terminates in the ring previously mentioned, which surrounds the circular aperture leading into the interior.

After this multicellular structure had been definitely identified, I felt quite satisfied that it represented at least a stage in the development of the female gametophyte. Whether it is the young, or the mature, structure is a question that is not likely to be answered without a resort to section-cutting, after imbedding the material in a suitable medium.

The re-examination of all the material at my disposal tended to support the opinion that the dome-shaped structure may be the fully-formed female gametophyre. During the re-examination, upwards of 100 specimens of this dome-shaped structure, in all stages of development, were carefully studied. The most striking features noted were the uniformity as to structure and dimensions; and the great variability in the colour of the dome-shaped structure, according to age. In the young form, it is fairly transparent, but, when it reaches maturity, it assumes a slightly brownish tint, with the exception of the projecting cells, which remain clear and are visible through the ringed aperture, with their bases imbedded in the wall of the upper part of the dome. Some of these projecting cells appear to be flask-shaped, but they are too much imbedded for the details to be clearly seen. I assume that these projecting cells are the archegonia.

When the dome has attained a diameter of 0·05 mm., it ceases to increase in size, and gradually becomes darker in colour,—the rusty-brown colour always developed in the unfertilised archegonia of ferns.

On one of the slides examined, there were several examples of these domes, measuring about 0·08 mm., and these were fairly transparent, except the ring, which was deeply coloured, and stood out very distinctly. The hollow of the dome appeared to be filled up; and, in some cases, there was an appearance of bulging at the opening,—perhaps showing that fertilisation had taken place.

The pavement-like character of the cell-structure (the cells being imbedded in gum) allows of expansion, within certain limits, to accommodate the growth of the embryo. The ring may be regarded as a ready means of separation from the spore, the dome being left as a protecting cap on the broad end of the embryo, until further growth renders it unnecessary.

On the slide referred to above, there were several peculiar bodies which may be said to reach the climax of the puzzles connected with the study of the gametophyte of Psilotum. The first specimen seen was wedge-shaped, the broad end of the wedge capped by a series of cells resembling greatly the cells on the dome; the narrow end consisted of a continuous cell-structure much like that of a prothallus, but smaller than any I have ever seen. There were other cellular structures present bearing the same kind of cells, but these having been broken in the mounting, the cells were visible only on the inside. These bodies appear to have been round. The outer surface presents a series of projecting cells, many of which bear rhizoids. The material from which the slide was made was procured from the interior of a single synangium.

After the rough draft of this paper had been prepared, the Rev. W. W. Watts called my attention to a note in Spring's "Lycopodiaceæ" (1842 and 1849), which is of great interest in the light of the researches recorded in the present paper. The following is Mr. Watts' translation of Spring's observation, under Psilotum, on p.268 of his work: "If the spores are thrown into water, they execute very rapid movements (mouvements de trépidation) and speedily envelop themselves in a kind of cloud. According to [Sir] Robert Brown's observations (Prodr., p.164), this cloud is due to a fine powder, which escapes from the spores. Kaulfuss has observed, upon the middle of the internal margin of the spores, a black point, which was in touch (en rapport) with a little vesicule, and which vanished, at the same time as this last, in the water. Although I have not had the good fortune to see that kind of 'aile seminal,' I recall this fact to induce botanists, who have living plants of Psilotum at their disposal, to direct their investigations to this point." Robert Brown's description of the species of Psilotum, although brief, gives an accurate account of what happens when antheridia bearing spores are placed in water. The observation recorded by Kaulfuss may possibly refer to the deeply stained female gametophyte, which is just as easily detached from the spore as the male.

After having studied *Psilotum*, I turned to the closely allied *Tmesipteris*. As I could not find spores in just the right stage for sowing, it struck me as possible that suitably developed spores might be found in old synangia. The surmise proved to be correct. When old synangia had been carefully soaked in water, and dissected by means of a brush and needle, spores were found, as I had expected, and some of them had germinated within the synangium, a fact that may be regarded as an important discovery, inasmuch as it offers a possible field in which the whole life-history of the sexual generation may be obtained from the study of spores germinated in Nature's own workshop, and, therefore, almost entirely free from such complications as affect the work of the culturist.

A careful examination of old fruits may be expected to furnish evidence of the sexual development, and even provide some embryos. Possibly this is one of the means by which the plant is propagated. The examination of a large number of synangia will be necessary to success. Weather-conditions, at fruiting time, have an important bearing on the question, and the dryness, or otherwise, of the locality inhabited by the plant.

After my examination of the synangia of *Tmesipteris*, I came to the conclusion that the sexual reproduction, when known, will not differ materially from that of *Psilotum*; and I express this opinion after having seen both the male and the female gametophytes. Old synangia of *Psilotum*, accidentally found in the rhizome-culture, furnished better results than those obtained by cultivation. One example, having been dissected and mounted, provided ample material for study, both the male and the female gametophytes being present in considerable numbers, and in all stages of development, the males predominating and being too numerous to count without special appliances.

In conclusion, believing that I have been able to point the way to the solution of the mystery of the sexual reproduction of *Psilotum*, I am desirous of placing the results of my observations on record, so that others, in command of better appliances and opportunities, may be able to carry the investigation to its final and successful issue.

My thanks are due to Mr. W. Graham, of the University, Sydney, for excellent microphotographs of the male gametophyte, and to Mr. Allan R. McCulloch for the completed drawings which illustrate this paper; also to Master Bert Degotardi for valuable aid in the search for plants of Tmesipteris and fruiting-specimens of Psilotum.

Measurements of spores, and reproductive organs of *Psilotum*.

Male spore.—Length, 0·06 to 0·08 mm.: breadth, 0·03 to 0·04 mm.; antheridial cells, 0·015 to 0·04 mm. Antherozoids as seen *in situ*, average diameter, 0·003 mm.

Female spore.—Length, 0·06 to 0·08 mm.: breadth, 0·027 to 0·03 mm. Unfertilised gametophyte, 0·03 to 0·04 mm. in diameter. Fertilised gametophyte, 0·04 to 0·08 mm. in diameter.

Additional Note.—Several months have elapsed since the published notice of the slides exhibited at the Meeting of the Society in April last, and since the foregoing paper was completed. During the interval, much time has been devoted to a further study of mounted slides, and examples preserved in formalin. The results have exceeded my expectations. Many doubtful points have been cleared up, and some new phases of development observed.

The male spore produces eight or more antheridia; as many as twelve, in one instance, have been seen. When near maturity, the antheridia emerge from the ventral slit, as pear- or comma-shaped bodies, the cell-wall being thin and plastic; before the antherozoids are mature, the wall becomes consolidated, and the cell assumes a globular form. In many cases, the last one or two cells do not completely emerge, but remain deeply imbedded in the spore. So far, no traces of any cell or cells have been found, which might be regarded as a prothallus, either rudimentary or otherwise.

The female gametophyte emerges from the ventral slit as a small, thick-walled vesicle. It is situated in the centre of the nearly straight border, and is drop-like in outline. Structural details are difficult to see, until it has attained a diameter of about 0·015 mm. It is then seen to be a multicellular body, dome-like in shape, and of a slight brown tint. Very many examples have been seen, *in situ*, in all stages of development. Each female spore produces one gametophyte: in no instance have two been observed. During my investigations, upwards of one hundred slides have been mounted in glycerine-jelly, and only about six show the gametophyte *in situ*.

The evidence that this dome-shaped structure is the full-grown prothallus, is now definitely established. Within the last fortnight, fertilised archegonia, and embryos filling the cavity of the dome, have been found on many slides; and one, in particular, has at least a dozen embryos, some visible through the wall of the dome, and also through the ringed aperture at the base. There are also some in which the wall of the dome has been broken away, and the outlines and cell-structure can be seen. In one instance, the embryo is quite free, and exhibits certain indications of the division into regions such as are exhibited in the early stages of Archegoniates generally.

The female gametophyte appears to reach maturity when it has attained to a diameter of about 0·035 or 0·04 mm. On opposite sides of the dome, near the summit, and in a line with the longer axis of the spore, two clusters of cells may be observed. These are transparent, and subtend the aperture in the neck of the archegonia. Each cluster appears to consist of four cells, two of which are more elevated than their fellows. The rest of the archegonium is imbedded in the wall of the dome. In two instances, archegonia have been observed only partly imbedded, more than half being visible. If fertilisation takes place, the whole structure rapidly increases in size generally, and some of the brown cells on the ring and on other parts of the dome become enlarged, and often develop into rhizoids. The inner, cellular portion of the dome appears to be absorbed to furnish nutrition for the growing embryo. The wall becomes thin, and, when fractured, breaks with an angular appearance like broken glass. As growth proceeds, the rhizoids increase in size, and it seems possible that they may be functional all the time, either as simple cells or when elongate.

EXPLANATION OF PLATE XLV.

Fig. 1. Spore, with mature antheridium, before the discharge of the antherozoids. The curved line on the surface indicates the exit-slit by which escape is effected.

Fig. 2.—Spore, bearing female gametophyte, showing basal ring of cells, and the apical cells of a pair of archegonia near the summit.

Fig. 3.—Gametophyte, showing a fertilised archegonium projecting from the surface.

Fig. 4.—Gametophyte, showing contained embryo, and a number of developing rhizoids at the base.

All the figures are greatly enlarged, and more or less diagrammatic.

CONTRIBUTIONS TO A KNOWLEDGE OF AUSTRALIAN *CULICIDÆ*. No. iii.*

By Frank H. Taylor, F.E.S.

(From the Australian Institute of Tropical Medicine, Townsville.)

The present paper contains descriptions of five new species, with notes on synonymy, and additional records for previously known species.

The male of *Stegomyia tasmaniensis* Str., and the female of *Danielsia minuta* Taylor, are described for the first time.

The new species are distributed in the following genera:—*Stegomyia* (one), *Hulecœteomyia* (one), *Culicada* (one), *Leucomyia* (one), and *Lophoceratomyia* (one). The type-specimens have been deposited in the Institute-Collection.

Stegomyia tasmaniensis Strickland.

Entomologist, xliv., No.578, p.249(1911).

♂. Similar to ♀; palpi black; antennæ pale, nodes and last two segments dark, plumes black; fore- and mid-ungues unequal, the larger stout, uniserrate, hind equal and simple. Length, 5 mm.

Hab.—Tasmania: Devonport and St. Patrick's River, Springfield, Bridport (F. M. Littler), New River District (W. H. Twelvetrees).

Evidently a widely distributed species, as it has been found in scattered localities, from Northern to Southern Tasmania. Mr. Twelvetrees has found it, in fairly large numbers, in the New River District. This is the first occasion on which the male has been found.

Co-type in Coll. F. M. Littler.

* Continued from these Proceedings, 1915, p.184.

Stegomyia daliensis, sp.n.

Head pale-scaled. Thorax with dark brown scales. Legs unbanded. Abdomen with basal banding.

♀. Head entirely covered with pale scales, with black, upright-forked ones on the vertex; antennae dark brown, basal lobes and base of second segment yellowish; palpi clothed with dark scales; proboscis black.

Thorax brown, clothed with dark brown, narrow-curved scales, and numerous black bristles over the wing-roots; scutellum brown, clothed with pale scales; posterior border-bristles black; pleurae yellowish, clothed with pale scales and a few dark bristles.

Abdomen clothed with black scales, first segment with numerous dark bristles in addition; segments two to four with pale basal bands, segments five and six with basal lateral pale spots, seventh and eighth without bands or spots; venter with pale scales.

Legs: coxae and trochanters pale, clothed with dark bristles; femora with basal half pale beneath, rest of the femora, the tibiae, and tarsi dark brown; ungues all equal and simple.

Wings with the scales on the costa, subcostal, and first long vein dark brown, brown on remaining veins; first fork-cell longer and narrower than the second, base of the latter nearer the base of the wing; stem of the first fork-cell more than two-thirds the length of the cell, stem of the second a little more than half the length of its cell; anterior basal cross-vein longer than, and about once and one-half its length from the anterior cross-vein; fringe light brown. Halteres with pale stems and dark knobs.

Length, 4 mm. (vix).

Hab.—Northern Territory: Daly River (G. F. Hill).

Mimeteomyia ornata Taylor.

Stegomyia ornata Taylor, Trans. Ent. Soc. London, 1914, p.189.

A re-examination of the unique type of the above shows that it should, properly, be placed in the genus *Mimeteomyia*, on account of the very bristly and truncated apex of the abdomen, and other points of agreement with the genus.

There is an error in the description, the specimen being a female, and not a male.

Mimeteomyia quasiornata Taylor.

Stegomyia quasiornata Taylor, these Proceedings, 1915, p.177, Pl. xxviii., fig.2.

This, like the above species, is placed in *Mimeteomyia*, as it is more closely related to this genus than to *Stegomyia*. The ♂ sign in the first line of the description should be deleted, as only the ♀ is known.

Mimeteomyia hilli Taylor.

Stegomyia hilli Taylor, these Proceedings, 1914, p.456, Pl. xxxv., fig.5.

Mr. Edwards recently suggested to me *in litt.*, that this species and *S. quasiornata* would be more correctly placed in the genus *Mimeteomyia*. A re-examination of the type proves that such is the case, on the same grounds as stated under *M. ornata* Taylor.

Hulecœteomyia milsoni, sp.n.

Head with brown and white scales. Thorax clothed with bronze and pale scales. Abdomen with white basal banding. Legs with basal banding.

♀. Head clothed with dark brown and white flat scales, white narrow-curved and black upright-forked ones in the middle with a narrow, median line of broad spindle-shaped ones in addition; palpi black, first and second segments and apex with narrow apical banding; antennæ black, basal lobes black, with small, broad, white, flat scales, second joint similarly clothed; proboscis black.

Thorax with bronze-coloured, narrow-curved scales, and pale ones, more numerous laterally, a patch of broad white flat ones anterior to the scutellum, the latter clothed with white spindle-shaped scales; pleuræ dark brown, densely clothed with white, flat scales; prothoracic lobes similarly clad.

Abdomen black, first segment black, with a few white scales in the centre, and numerous yellowish bristles, the second to sixth with white basal banding; venter dark with white basal lateral patches, penultimate segment mottled with white scales.

Wings with vein-scales brown: first fork-cell longer and narrower than the second, base of the former slightly nearer the base of the wing; stem of the first about half, of the second about two-thirds the length of the cells; anterior basal cross-vein longer than and about half its length from the anterior cross-vein; fringe brown.

Legs black, femora mottled with white scales, basal half pale beneath, knee-spot white; first three tarsals of fore- and mid-legs with white basal banding, that on the third not so prominent, first four tarsals of the hind-legs with broad white basal banding; ungues equal and uniserrate.

Length, 5 mm.

Hab.—N.S.W.: Milson Island (Dr. Cleland).

Co-type in Coll. Cleland.

Danielsia minuta Taylor.

Bull. Northern Territory, No. i., p.60 (1912).

♀. Head clothed with pale flat scales, with brown narrow-curved and upright-forked ones in the centre; antennæ and palpi brown.

Thorax light brown, with pale narrow-curved scales, border-bristles brown, scutellum pale [denuded]; pleuræ brown with patches of white flat scales.

Abdomen brown-scaled, unbanded, first six segments with white basal lateral spots; venter brown.

Wings: costa black, vein-scales brown; first fork-cell longer and narrower than the second, base of the former nearer the base of the wing, stem of the first about half the length of its cell, stem of the second about the length of the cell; anterior basal cross-vein shorter than, and about thrice its length from, the anterior cross-vein; fringe brown.

Length, 2·5 mm.

Hab.—Northern Territory: Darwin (G. F. Hill).

Described from a single specimen. The type (♂) was in very poor condition, hence the above detailed description of the ♀. There are certain discrepancies in the two descriptions concerning the abdomen, but I feel sure they belong to the same species.

Mr. Hill notes that, when at rest, the ♀ carries the hind legs backwards over the abdomen.

Culicada hybrida, sp.n.

Head with pale and brown scales. Thorax with bronze-coloured scales with golden reflections. Abdomen unbanded. Tarsi with basal banding.

♀. Head densely clothed with pale and brown narrow-curved scales, with mixed pale and black upright-forked scales; palpi black, with a few white scales at the apex of the second segment, apex white-scaled: antennæ brown, verticillate hairs brown, pubescence pale; proboscis black.

Thorax chestnut, clothed with bronze-coloured scales with golden reflections: scutellum paler than the thorax, with pale scales; pleuræ pale brown, with small white flat scales.

Abdomen clothed with dusky scales, unbanded, segments four to six with conspicuous white lateral spots, border-bristles pale: venter mottled with brown and pale scales.

Wings: costa, sub-costal, and first long vein with violet-black scales, remaining vein-scales dusky; first fork-cell longer and narrower than the second, their bases about level, stem of the first about two-thirds the length of the cell, of the second about as long as its cell; anterior basal cross-vein about the length of, and about once and one-half its length from, the anterior cross vein: fringe dusky.

Legs black, femora mottled with pale scales, knee-spots creamy, first three tarsals of fore- and mid-legs with white basal banding, fourth and fifth unbanded, first four tarsals of hindlegs similarly banded, fifth unbanded; ungues equal, uniserrate.

Length, 4·5 mm.

Hab. N.S.W.: Milson Island (Dr. J. B. Cleland).

Type unique. It may be distinguished from *C. bupengaryensis*

Theob., by the differently coloured thorax, the abdomen with but three segments with basal lateral spots, the basally banded tarsi, and the hind-ungues being uniserrate.

Culicada demansis Strickland.

Entomologist, xliv., No.577, p.202 (1911).

Hab.—N.S.W.: Milson Island.—Tasm.: Hillwood (F. M. Littler).

Two specimens received from Dr. Cleland differ from the Tasmanian specimens in the Institute Collection only in having the stems of the fork-cells shorter.

Culicada tasmaniensis Strickland.

Entomologist, xliv., No.576, p.181 (1911).

Additional specimens have been received from Mr. Littler, and Mr. W. H. Twelvetrees *per* Mr. Littler. This seems to be the commonest and most widely distributed Tasmanian species.

Hab.—Tasm.: Devonport, Springfield, St. Patrick's River (F. M. Littler), New River District (W. H. Twelvetrees).

Leucomyia vicina, sp.n.

Head and anterior two-thirds of thorax white-scaled. Abdomen with white basal banding. Tarsi basally banded white.

♂. Head clothed with white scales; antennæ pale, nodes black, plumes dark; palpi black; penultimate and apical segments with a narrow white basal band, apical half of the apical segment white, hairs black except on apical half of last segment; proboscis black, a white band at the apex of the middle third, with a small tuft of hairs beneath at its base.

Thorax with anterior two-thirds clothed with dense white scales, laterally a dense row of flat white ones, posterior third and scutellum covered with brown narrow-curved scales; pre-alar bristles brown; pleuræ brown, clothed with scattered white scales.

Abdomen black-scaled, with white basal banding, seventh and eighth apically banded also, lateral and posterior border-bristles golden; venter pale-scaled.

Legs black, femora pale beneath, first to fourth tarsi of fore- and mid-legs with creamy basal banding, all tarsi of hind-legs with similar banding; ungues of fore- and mid-legs unequal, the larger uniserrate, hind equal and simple.

Wings: costa dark brown, vein-scales light brown: first fork-cell longer and narrower than the second, base of the former nearer the base of the wing, stem of the first about two-thirds the length of the cell, that of the latter about the length of its cell; anterior basal cross-vein longer than, and about twice its length from, the anterior cross-vein.

♀. Similar to ♂ [head damaged]; ungues equal and simple. Wings more densely scaled; costa, subcosta, and first long vein black, remaining veins with dark brown scales; in other respects as in the ♂.

Length, ♂, 4·5; ♀, 5 mm.

Hab.—Northern Territory: Stapleton (G. F. Hill, No.313).

Closely related to *L. annulata* Taylor, but may be distinguished by the absence of apical banding on the palpi and first tarsals, the brown-scaled scutellum, the pale venter, and wing-venation; from *L. plegipennis* Theob., by the thoracic flat scales and the wing-venation.

Culicelsa abdominalis Taylor.

Report Aust. Inst. Tropical Med., 1911, p.53 (1913).

Hab.—Northern Territory: Darwin (G. F. Hill).

Culex sitiens Wiedemann.

Culex saibaii Taylor, Ann. Rep. Commissioner Public Health, Queensland, 1912, p.28.

Having compared the type of *C. saibaii* with a long series of *C. sitiens*, I find that they are one and the same species, and, therefore, place the former name as a synonym of the latter.

Culex sagax Skuse.

Proc. Linn. Soc. N. S. Wales, (2), iii., p.1744 (1888); Taylor, *op. cit.*, 1914, p.758.

A specimen, received from Dr. Cleland, differs somewhat from the type in having the thorax chestnut, with a median black narrow stripe, and clothed with golden scales, the tarsi of the hind-legs with basal pale banding; the stem of the first fork-cell about two-thirds the length of the cell, and that of the second the length of the cell; abdomen, beneath, with basal creamy banding to the segments.

Until further specimens are available, it is thought best to retain it under the above name.

Hab.—N.S.W.: Wollongong.

Culex somerseti Taylor.

Ann. Report Commissioner Public Health, Queensland, 1912, p.28.

This species, though closely related to *C. sitiens* Wied., appears to be a good one, the leg-banding being prominent and well defined.

Through an error in setting up the type, the abdominal characters were omitted. They are as follows:—Abdomen black, first segment black-scaled with numerous yellowish hairs, remaining segments with white basal banding; venter pale-scaled.

Hab.—N. Queensland: Somerset (F. H. Taylor).

Banksinella lineatopennis Ludlow.

Canadian Entomologist, xxxvii., p.133(1915); *Pseudohowardina linealis* Taylor, Rep. Aust. Inst. Trop. Med., 1911, p.57 (1913); Edwards, Bull. Ent. Research, v., p.274(1915).

Specimens of *B. lineatopennis* Ludlow, were recently received from The Imperial Bureau of Entomology, which proved to be the same as *P. linealis* mihi. It is evidently a widely distributed species, as it extends from South Africa through the Philippine Islands to Australia.

Lophoceratomyia annulata, sp.n.

Head-scales dark and pale: palpi longer than proboscis. Thorax with small, bronze-coloured, narrow-curved scales. Abdomen dark brown, with basal banding. Legs brown, unbanded.

♂. Head dark brown, clothed with brown narrow-curved scales medially, rest of head with small flat pale ones: proboscis brown: palpi brown, with a conspicuous thumb-like process on each side at the base, longer than proboscis by the apical third of the penultimate and apical segments, apex of the first and the last two segments clothed with brown hairs; antennæ pale, nodes and last two segments brown, plumes brown, dense, the flat plates on the sixth segment long and black, seventh and eighth segments with short black wavy plates, those on the ninth longer, black, spoon-shaped toward the apex, the pectinated processes on the nodes of the tenth to thirteenth segments conspicuous.

Thorax chestnut-brown, clothed with small narrow-curved, bronze-coloured scales; scutellum paler, with similar narrow-curved scales: pleuræ brown, clothed with brown bristles.

Abdomen clothed with black scales, first segment densely clothed with brown hairs, segments three to seven with basal grey-white bands, scales on eighth segment paler: genitalia light brown with numerous brown hairs: posterior border-bristles yellowish-brown; venter brown.

Legs black, unbanded, femora pale beneath; ungues of fore-legs very unequal, the larger with a stout tooth, mid- unequal, the larger with a small tooth, in both the fore- and mid-ungues the larger is sickle-shaped, the smaller almost straight, hind small, equal and simple.

Wings: the costa, subcostal, and first long veins with dark brown scales, remaining vein-scales paler: first fork-cell longer and narrower than the second, base of the former slightly nearer the base of the wing: stem of the first fork-cell about half, of the second fork-cell about two-thirds, the length of their cells; anterior basal cross-vein about as long as, and about once and a half its length from, the anterior cross-vein; second incrassation well defined: fringe dusky; halteres with pale stems and brown knobs.

♀. Similar to ♂; antennæ brown, verticillate hairs dark brown, pubescence pale; palpi with mixed dark and pale scales; proboscis dark brown; abdomen, wings, and legs similar to ♂, ungues equal and simple.

Length, ♂, 3·75-4; ♀, 4 mm.

Hab.—N. Territory: Stapleton and Daly River (G. F. Hill, Nos.309-312).

Related to *L. fraudatrix* Theob., but distinguished from it by the banded abdomen, ungues, and the palpi possessing but *one* process on each side of their bases. It differs from *L. taeniata* Leic., by the length of the palpi, the ungues, and the wing-venation.

Co-type (♂) in Coll. Hill.

Etorleptiomyia elegans Taylor.

Dixomyia elegans Taylor, Trans. Ent. Soc. Lond, 1914, p.703, Pls. xliii., xliv., figs.19, 18.

There is a close similarity between *Etorleptiomyia* Theobald, and *Dixomyia* Taylor, the chief difference being in the disposition of the head-scales of the two genera. Whereas they are all "mixed" in the former, they are more or less separated into well defined areas in the latter. It is, perhaps, better that *Dixomyia* be sunk as a synonym of *Etorleptiomyia*, and the species regarded, for the present, as an aberrant form of the genus *Etorleptiomyia*,

Ædeomyia venustipes (Skuse).

Proc. Linn. Soc. N. S. Wales, (2) iii., p.1761 (1888); Taylor, *op. cit.*, 1913, Pl. xxx., fig.3; *Æ. catasticta* Knab, Ent. News, xx., p.387 (1909).

The above synonymy is based on specimens of *Æ. catasticta* Knab, recently received from The Imperial Bureau of Entomology, which have been compared with specimens of *Æ. venustipes* (Skuse).

The differences between the two forms are so slight, that they do not seem to me to be of sufficient value to warrant the retention of the two names as distinct species, but the name *catasticta* might be retained as a varietal name for the form described by Knab. The only distinctions found between the specimens examined were the presence of ochre-yellow scales on the base of the wings of *Æ. catasticta*, and the smaller number of white spots on the wings. Also, in *Æ. venustipes*, the mesonotal scales are paler than in *Æ. catasticta*, but are still a distinct ochre-yellow. In all other respects, the two forms agree.

The possibility of the above synonymy was suggested to me some time ago by Mr. F. W. Edwards.

The Institute-specimens of *Æ. catasticta* Knab, come from Bole, Gold Coast, W. Africa. Knab described it from the Philippine Islands.

DESCRIPTIONS OF SOME NEW SPECIES OF AUSTRALIAN, TASMANIAN, AND NEW ZEALAND MOSSES. vi.*

By V. F. Brotherus.

(Communicated by the Rev. W. W. Watts.)

190. Campylopus denticuspes Broth., n.sp.

Dioicus: gracilescens, cæspitosus, cæspitibus densiusculis, viridibus, inferne nigrescentibus, vix nitidiusculis; *caulis* erectus, ad 3 cm. usque longus, parce radiculosus, inferne laxius, superne densiuscule foliosus, simplex; *folia* horride patentia, canaliculato-concava, e basi oblonga lanceolato-subulata, obtusiuscula vel acutiuscula, marginibus superne subconniventibus, subintegris, nervo angusto, basi c. quintam partem folii latitudinis occupante, cum apice evanido, dorso summo apice spinoso-dentato, cellulis stereideis dorsalibus et ventralibus instructo, cellulis laminaribus anguste rhombeis, valde incrassatis, lumine angustissimo flexuosulo, marginalibus angustis, limbum angustissimum, hyalinum efformantibus, basilaribus internis laxioribus, haud incrassatis, alaribus numerosis, laxis, hyalinis. Cætera ignota.

New South Wales: Richmond River, Wardell, heath (Watts, n.5260).

Var. *lutescens* Broth., n.var.

Cæspites densi, lutescentes, nitidiusculi; *caulis* vix ultra 1 cm. longus; *folia* nervo tenuiore, superne raptim multo angustiora, apice vix conspicuo, cellulis alaribus paucioribus et paulum minoribus.

N.S.W.: Richmond River., E. Ballina, heath (Watts, n.4758), and swamp (Watts, n.1739).

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* The preceding Parts were published in Oefversigt af Finska Vet. Soc. Forh. 1890-1900.

Species cum *C. Kirkii* Mitt., comparanda, sed foliis dorso summo apice spinoso-dentato jam dignoscenda.

191. Fissidens (*Heterocaulon*) bryoidioides Broth., n.sp.

Dioicus: gracilis, cæspitosus, cæspitibus laxis, lutescenti-viridibus, opacis; *planta sterilis* erecta, c. 1 cm. longa, gracillima, simplex, foliis inter se remotis, multijugis, subæqualibus, asymmetricis: *planta fertilis* adscendens, vix ultra 5 mm. longa, simplex, densius foliosa, foliis 5-10 jugis, infimis minutis, cæteris multo majoribus, erecto-patentibus: *folia* oblongo-lanceolata, plantæ fertilis c. 1·2 mm. longa et c. 0·28 mm. lata, lamina vera tantum plus minusve distincte limbata, nervo crassiusculo, breviter excedente, lamina vera lamina apicali longior, lamina dorsali breviter decurrente, cellulis rotundato-hexagonis, superioribus c. 0·007 mm., chlorophyllosis, lævissimis; *seta* c. 1 cm. alta, tenuissima, lutea; *theca* subhorizontalis, asymmetrica, ovalis, sicca deoperculata curvatula, sub ore constricta, pallida. Cætera ignota.

N.S.W.: Penshurst (Forsyth, n.676).

Species habitu *Bryoidii*, sed lamina vera tantum limbata.

192. Fissidens (*Bryoidium*) Forsythii Broth., n.sp.

Dioicus: gracilis, cæspitosus, cæspitibus densis, saturate viridibus, opacis; *caulis* adscendens, usque ad 1 cm. longus, infima basi fusco radiculosus, dense foliosus, simplex vel innovando ramosus: *folia* multijuga, falcata, sicca circinato-incurva, infima minuta, cætera multo majora, ligulata vel ovato-ligulata, obtusa, apiculata, summo apice obsolete serrulata vel integra, limbata, limbo angustissimo, hyalino, subcontinuo, nervo ad basin apiculi evanido, lamina vera lamina apicali longior, lamina dorsalis longe decurrens, cellulis minutissimis, rotundato-hexagonis, superioribus vix ultra 0·005 mm., chlorophyllosis, lævissimis; *seta* c. 7 mm. alta, tenuis, lutescenti-rubra; *theca* horizontalis, asymmetrica, ovalis, sicca curvata, nutans, deoperculata sub ore valde constricta, pallida. Cætera ignota.

N.S.W.: Gullies near Barber's Creek (Forsyth, n.566).

Species *F. Dietrichiæ* C. Müll., affinissima, sed foliis densius areolatis dignoscenda.

193. Fissidens (*Bryoidium*) perangustus Broth., n.sp.

Dioicus: gracillimus, cæspitosus, cæspitibus densis, lutescenti-viridibus, opacis; *caulis* procumbens, 1-1·5 cm. longus, infima basi fusco-radiculosus, laxiuscule foliosus, innovando-ramosus vel simplex; *folia* multijuga, erecto-patentia, stricta, linearia, acuta, c. 0·75 mm. longa et c. 0·15 mm. lata, integerrima, limbata, limbo luteo, 3-seriato, infra apicem folii evanido, nervo crassiusculo, infra apicem folii evanido, lamina vera lamina apicali parum longior, lamina dorsali paulum decurrente, cellulis subrotundato-hexagonis, superioribus 0·007-0·010 mm., chlorophyllosis, lævissimis; *seta* c. 3 mm. alta, tenuissima, lutea vel lutescenti-rubra; *theca* suberecta, minuta, subsymmetrica, ovalis, sicca deoperculata sub ore vix contracta; *operculum* ignotum; *calyptra* ignota.

Planta mascula ignota.

N.S.W.: Manly, near Sydney, the Eyrie (Watts, n.6790a, 6792).

Species statura alata sed gracillima foliisque anguste linearibus oculo nudo jam dignoscenda.

194. Fissidens (*Bryoidium*) rigidiusculus Broth., n.sp.

Dioicus: gracilescens, cæspitosus, cæspitibus densis, rigidiusculis, viridibus, inferne fuscescentibus, opacis; *caulis* adscendens, usque ad 2 cm. longus, infima basi fusco-radiculosus, densiuscule foliosus, simplex vel dichotome ramosus, ramis fastigiatis; *folia* multijuga, sicca homomalla, humida erecto-patentia, stricta vel homomallula, infima minuta, cætera multo majora, lanceolato-ligulata, breviter acuminata, obtusiuscula vel acuta, usque ad 1·8 mm. longa et 0·38 mm. lata, integerrima vel summo apice obsolete serrulata, limbata, limbo luteo, biseriato, continuo, nervo rufescente, continuo vel subcontinuo, lamina vera lamina apicali longior, lamina dorsalis ad basin nervi enata ibidemque angustata, cellulis minutissimis, rotundato-hexagonis, superioribus vix ultra 0·005 mm., chlorophyllosis, lævissimis; *seta* vix 5 mm. alta, tenuis, rubra: *theca* inclinata, minuta, paulum asymmetrica, ovalis, pallida: *operculum* e basi conica oblique rostratum; *operculum* ignotum.

N.S.W.: Moss Vale, Fitzroy Falls (Forsyth, n.669).

Species pulchra, rigiditate nec non foliis minutissime areolatis dignoscenda.

Var. *leptocladus* (C. Müll.) Broth., n.var.

Syn., *Fissidens leptocladus* C. Müll., in Herb. Weymouth. Gracilior, folia minora, nervo tenuiore.

Tasmania: Mt. Wellington, Guy Fawkes Rivulet, on wet rocks (Weymouth, n.385), on face of rocks (n.2157), and on damp bank (n.2281).

195. FISSIDENS (*Bryoidium*) PRÆMOLLIS Broth., n.sp.

Robustiusculus, cæspitosus, cæspitibus densis, mollibus, pallide viridibus, opacis; *caulis* erectus, usque ad 3 cm. longus, basi fusco-radiculosus, laxe foliosus, dichotome ramosus, ramis fastigiatis; *folia* multijuga, homomallula, flaccida, sicca contractula et flexuosula, late ovato-oblonga, obtusa, apiculata, 1·4-1·6 mm. longa, c. 0·57 mm. lata, summo apice minutissime serrulata, limbata, limbo biseriato, hyalino, infra summum apicem evanido, nervo pallide viridi, infra summum apicem folii evanido, lamina vera lamina apicali longior, lamina dorsalis ad basin nervi enata, basi angustata, cellulis rotundato-hexagonis, superioribus c. 0·010 mm., parce chlorophyllosis, lævissimis. Cætera ignota.

N.S.W.: Richmond River, Skinner's Head, cliff, cave (Watts, n.5371).

Species distinctissima, mollitie foliorumque forma faciliter dignoscenda.

196. FISSIDENS (*Bryoidium*) ARISTATUS Broth., n.sp.

Dioicus: gracilis, cæspitosus, cæspitibus plerumque densiusculis, viridibus vel lutescenti-viridibus, opacis; *caulis* erectus, 5-10 mm. longus, infima basi fusco-radiculosus, densiuscule foliosus, simplex; *folia* usque ad 10 juga, infima minuta, superiora multo majora, lanceolato-ligulata, breviter acuminata, acuta, usque ad

1·9 mm. longa, integerrima, limbata, limbo viridi, triseriato, continuo, nervo lutescente vel rufescente, in aristam brevem excedente, lamina vera lamina apicali longior, lamina dorsalis ad basin nervi enata, basi angustata, cellulis rotundato-hexagonis, superioribus c. 0·010 mm., chlorophyllosis, lævissimis; *seta* 7-10 mm. alta, tenuis, lutescenti-rubra: *theca* inclinata, sicca submutans, asymmetrica, ovalis, sicca deoperculata sub ore constricta, pallida; *operculum* e basi conica breviter rostratum. Calyptra ignota.

N.S.W.: Mossman's Bay, Falls, damp soil (Watts, n.4585); Brunswick River, on mud-covered log, by creek (Watts, n.5238); Neutral Bay near Sydney, damp waterway (Watts, n.8080); Manly, the Eyrie, Upper Terrace, damp places in gutter (Watts, n.6790).

Species *F. incurvo* Stark affinis.

197. Fissidens (*Bryoidium*) sordidevirens Broth., n.sp.

Autoicus: gracilis, cæspitosus, cæspitibus laxiusculis, sordide et saturate viridibus, opacis: *caulis* erectus, c. 5 mm. longus, infima basi fusco-radiculosus, inferne remote dein densiuscule foliosus, simplex; *folia* 7-10 juga, erecto-patentia, stricta, infima minuta, superiora multo majora, oblongo-lanceolata, breviter acuminata, acuta, usque ad 1·1 mm. longa, integerrima, limbata, limbo lutescente, biseriato, continuo vel subcontinuo, nervo lutescente, infra summum apicem folii evanido, lamina vera lamina apicali longior, lamina dorsalis ad basin nervi enata ibidemque angustata, cellulis rotundato-hexagonis, superioribus c. 0·007 mm., chlorophyllosis, lævissimis: *seta* 2 mm. vel paulum ultra alta, tenuis, inferne rubra, superne lutescens: *theca* inclinata, minuta, paulum asymmetrica, ovalis, pallida. Cætera ignota.

N.S.W.: Cambewarra (Forsyth, n.1140).

Species *F. bryoidi* Hedw., affinis, sed foliis breviter acuminatis, acutis, luteolimbatis, nervo infra apicem folii evanido nec non seta brevi et theca minuta dignoscenda.

198. Leucobryum Wattsii Broth., n.sp.

Dioicum: robustiusculum, cæspitosum, cæspitibus densis, rigidis, humilibus, glauco-viridibus, opacis; *caulis* procumbens, dense ramosus, ramis erectis, 5 mm. vel paulum ultra, rarius usque ad 1 cm. longis, densissime foliosis, obtusis; *folia* erecto-patentia, sicca arcte imbricata, e basi ovali sensim breviter lanceolata, acuta, fusco-mucronata, c. 3·5 mm. longa et 0·85-0·95 mm. lata, marginibus superne conniventibus vel subconniventibus, integris, nervo dorso lævi, leucocystis medianis 3-4 stratosis, cellulis laminalibus basilaribus usque ad 12 seriatis, superne limbum sensim angustiorem efformantibus. Cætera ignota.

N.S.W.: Richmond River, Rous Falls, on rocks (Watts, n.4856); Brooklet, on retaining wall (n.4802); head of Teven (n.2891); East Ballina (n.2261); and head of Wilson's Creek (n.2097).

Species caule brevi foliisque siccis arcte imbricatis, dorso lævibus jam dignoscenda.

199. Leucobryum ballinense Broth., n.sp.

Dioicum: gracile, cæspitosum, cæspitibus densis, mollibus, humilibus, albescenti-viridibus, opacis: *caulis* erectus, vix ultra 5 mm. longus, basi fusco-radiculosus, ramosus vel simplex: *folia* erecto-patentia, sicca imbricata, e basi oblonga sensim lanceolato-subulata, mucronata, c. 2 mm. longa et c. 0·35 mm. lata, marginibus superne subconniventibus, integris, nervo dorso valde scabro, leucocystis bistratosis, cellulis laminalibus basilaribus pauciseriatis, limbum angustum, superne sensim angustiorem efformantibus. Cætera ignota.

N.S.W.: Richmond River, E. Ballina, heath, on sapling (Watts, n.2159, mixed with *L. brachyphyllum* Hamp., 4107).

Species *L. brachyphyllo* Hamp., affinis, sed foliorum forma jam dignoscenda.

200. Tortella Novæ Valesiæ Broth., n.sp.

Autoica: robustiuscula, cæspitosa, cæspitibus densiusculis, mollibus, sordide viridibus: *caulis* erectus, usque ad 1 cm. longus, inferne fusco-radiculosus, dense foliosus, dichotome ramosus: *folia* erecto-patentia, carinato-concava, sicca circinato incurva, e basi oblonga linearia, obtusa, mutica seu mucronata, c. 3 mm. longa et superne usque ad 0·5 mm. lata, marginibus erectis, integris, nervo crassiusculo, superne angustiore, cum apice evanido vel in mucronem brevissimum excedente, cellulis minutissimis, rotundato-quadratis, chlorophyllosis et dense verrucosis, basilaribus elongatis, angustis, teneris, hyalinis, limbo hyalino brevi tantum spatio ultra basin producto: *seta* c. 1 cm. alta, tenuis, lutescenti-rubra; *theca* erecta, parum asymmetrica, anguste subcylindracea, sæpe curvatula, ætate pallide fuscidula. Cætera ignota.

N.S.W.: Sydney, Greenwich (Watts, n.1797).

Species *T. Knightii* (Mitt.) Broth., affinis, sed foliorum forma dignoscenda.

201. TRICHOSTOMUM ARISTATULUM Broth., n.sp.

Dioicum: robustiusculum, cæspitosum, cæspitibus densiusculis, sordide lutescenti-viridibus; *caulis* erectus, usque ad 1 cm. longus, inferne fusco-radiculosus, dense foliosus, dichotome ramosus: *folia* erecto-patentia, carinato-concava, sicca circinato-incurva, e basi ovali linearia, breviter acuminata, aristata, c. 3 mm. longa, superne usque ad 0·4 mm. lata, marginibus erectis, integris, nervo crassiusculo, superne angustiore, in aristam lutescentem excedente, cellulis minutissimis, quadratis, chlorophyllosis, dense verrucosis, basilaribus oblongo-hexagonis, hyalinis. Cætera ignota.

N.S.W.: Richmond River, Ballina, Alstonville (Watts, n.1918).

Species *T. brachydontio* Bruch valde affinis, sed nervo longius excedente, cellulis basilaribus brevioribus dignoscenda.

202. BARBULA (*Helicopogon*) GLAUCULA Broth., n.sp.

Dioica: gracilis, cæspitosa, cæspitibus laxis, glaucescentibus, ætate fuscescentibus: *caulis* erectus, vix ultra 1 cm. longus, laxiuscule foliosus, parce radiculosus, simplex: *folia* patula vel subrecurva, carinato-concava, sicca crispatula, e basi semivaginante, vix latiore ligulata, obtusiuscula vel obtusa, mucronata, usque ad 2 mm. longa et 0·35 mm. lata, marginibus plus minusve alte anguste recurvis, integris, nervo crassiusculo, rufescente, in mucronem fuscidulum excurrente, dorso papilloso, cellulis minutis, subquadratis, dense verrucosis, obscuris, basilaribus breviter rectangularibus, teneris, pellucidis. Cætera ignota.

Victoria: Heyington Road, near Melbourne, in drain (Watts, n.158).—N.S.W.: Nowra, Falls, on ground (Watts, n.6266).

203. POTTIA (*Eupottia*) SUBPHYSCOMITRIOIDES Broth., n.sp.

Autoica: tenella, cæspitosa, cæspitibus densiusculis vel laxis, sordide vel saturate viridibus; *caulis* erectus, vix ultra 5 mm. longus, basi fusco-radiculosus, dense foliosus, simplex; *folia* erecto-patentia, carinato-concava, inferiora minuta, superiora multo majora, spathulata, obtusiuscula vel late acuta, usque ad 1·9 mm. longa, superne usque ad 0·65 mm. lata, marginibus erectis, integris, nervo crassiusculo, plerumque in aristam brevem, strictam excedente, cellulis superioribus rotundato-hexagonis, 0·015-0·020 mm., marginem versus minoribus, quadratis, basilaribus laxe et breviter rectangularibus, omnibus lævissimis; *seta* c. 3 mm. alta, tenuis, rubra; *theca* erecta, obovata, brevicollis, fusca, deoperculata parum dilatata: *annulus* longe persistens; *peristomium* 0; *spori* 0·025-0·030 mm., ochracei, papillosi; *operculum* oblique rostratum.

Vic.: Melbourne, St. Kilda Road, on footpath in garden "Avonhurst" (Watts, n.153); Heyington, on ground (Watts, n.181, 216).—Tasmania: Port Esperance, on ground (Rodway).

Species *P. physcomitrioidi* C. Müll., ex Argentina, valde affinis.

204. TORTULA (*Syntrichia*) EVANESCENS Broth., n.sp.

Dioica: robustiuscula, cæspitosa, cæspitibus densiusculis, mollibus, glauco-viridibus, ætate fuscescentibus: *caulis* erectus, vix ultra 1 cm. longus, inferne fusco-radiculosus, densiuscule foliosus, simplex; *folia* flaccida, faciliter decidua, erecto-patentia, carinato-concava, spathulata, in acumen breve, lanceolatum contracta, superiora c. 4 mm. longa, superne usque ad 1·3 mm. lata, marginibus erectis, integris, nervo rufescente, sat longe infra apicem folii evanido, dorso lævi, cellulis laxis, rotundato-hexagonis, leptodermibus, lævissimis, chlorophyllosis, 0·030-0·040 mm., marginem versus minoribus, basin versus quadratis, dein breviter rectangularibus, hyalinis, ad marginem brevioribus. Cætera ignota.

N.S.W.: Green Gully, near Young, on ground (Watts, n.6914).

Species valde peculiaris, foliis flaccidis, faciliter deciduis, nervo sat longe infra apicem folii evanido cellulisque laxis facillime dignoscenda.

205. Tayloria (*Dissodon*) Maidenii Broth., n.sp.

Autoica: gracilescens, cæspitosa, cæspitibus laxiusculis, pallide viridibus, ætate lutescenti-fuscescentibus, nitidiusculis; *caulis* erectus vel adscendens, vix ultra 1 cm. longus, basi fusco-tomentosus, dein nudus, superne laxe foliosus, simplex vel furcatus; *folia* difficiliter emollita, carinato-concaviuscula, e basi erecta, breviter spathulata patula vel subhorizontalia, inferiora breviter, comatia elongate oblonga, breviter acuminata, plerumque apiculata, usque ad 1-1·2 mm. lata, marginibus erectis, integris, nervo sat tenui, infra apicem folii evanido, cellulis laxis, superioribus ovali-hexagonis, dein sensim longioribus, basilaribus oblongo-hexagonis, marginalibus angustioribus, limbum indistinctum, uniseriatum efformantibus; *seta* 7-10 mm. alta, tenuis, strictiuscula, straminea, ætate fuscescenti-rubra, lævissima; *theca* erecta, cum hypophysi sporangio breviore ejusdemque latitudinis oblonga, c. 2 mm. longa, sicca haud mutata, castanea, cellulis sporangii incrassatis, irregularibus, oblongo- vel ovali-hexagonis, ad orificium in seriebus pluribus transversis, eisdem hypophysis rotundato-hexagonis, leptodermibus, stomatibus numerosis, sub immersis; *peristomium* 0; *spori* 0·025-0·030 mm., fusci, punctulati; *operculum* minutum, cupulatum; *calyptra* mitræformis, lutea, summo apice fuscidula, longirostris, in laciniis 5 brevibus divisa, lævissima.

N.S.W.: Mt. Kosciusko, Merritt's Camp (Maiden et Forsyth, n.184).

Species distinctissima, thecæ forma peristomioque deficiente facillime dignoscenda.

206. Funaria (*Entosthodon*) perpusilla Broth., n.sp.

Pusilla, gregarie crescens, fuscescenti-viridis; *caulis* brevissimus, basi fusco-radiculosus, superne dense foliosus, simplex; *folia* erecto-patentia, sicca vix mutata, concaviuscula, e basi ovata lanceolato-subulata, usque ad 1·5 mm. longa et 0·5 mm. lata, marginibus erectis, integris, elimbata, nervo rufescente, infra apicem folii evanido, cellulis laxis, oblongo-hexagonis, basilaribus rectangularibus; *seta* 3-4 mm., strictiuscula, lutescenti-rubra; *theca* erecta, minuta, cum collo sporangio æquilongo pyriformis, lutescenti-fuscidula, lævis: *annulus* 0; *peristomium* 0; *spori* 0·025-0·030 mm., ferruginei, papillosi; *operculum* convexum: *calyptra* vesiculoso-cucullata, integra.

Victoria: Railway Station, Heyington, on ground (Watts, n.196, 201, 202A, 205).

Species minutie omnium partium, foliis elimbatis, integris nec non peristomio nullo jam dignoscenda.

207. FUNARIA (*Entosthodon*) BULLATA Broth., n.sp.

Tenella, gregarie crescens, pallide viridis; *caulis* erectus, vix ultra 1 mm. longus, infima basi fusco-radiculosus, superne dense foliosus, simplex; *folia* erecta, sicca vix mutata, cochleariformi-concava, e basi breviter et late spathulata obovata, fusco-mucronata vel apiculata, c. 1·3 mm. longa et usque ad 1·1 mm. lata, marginibus erectis, integris, elimbata, nervo rufescente, longe infra apicem folii evanido, cellulis laxis, superioribus rotundato-hexagonis, marginem versus minoribus, basilaribus elongate rectangularibus; *seta* 5-7 mm., strictiuscula, lutescenti-rubra; *theca* erecta cum collo sporangio æquilongo turgide pyriformis, fuscidula, lævis; *annulus* 0; *peristomium* simplex, infra orificium oriundum; *exostomii dentes* erecti, lanceolati, rubri, longitudinaliter striati, papillosi; *spori* 0·030 mm., ferruginei. papillosi; *operculum* subplanum, rubromarginatum; *calyptra* vesiculoso-cucullata, integra.

Vic.: Railway Station, Heyington, on ground (Watts, n.198, 208).

Species *F. gracili* (Hook. fil. et Wils.) Broth., affinis, sed foliis cochleariformi-concavis oculo nudo jam dignoscenda.

208. MIELICHHOFERIA (*Eumielichhoferia*) FORSYTHII Broth., n.sp.

Paroica: gracilis, cæspitosa, cæspitibus densis, fusco-tomentosis, læte viridibus, opacis; *caulis* erectus, vix ultra 1 cm. longus. filiformis, inferne remote, superne dense foliosus, innovando ramosus; *folia* inferiora minuta, erecto-patentia, superiora multo majora, erectiora, carinato-concava, ovato-lanceolata, acuta, marginibus erectis vel inferne anguste recurvis, superne serrulatis, nervo infra apicem folii evanido, cellulis anguste linearibus, infimis laxioribus; *bracteæ perichætii* foliis multo minores, erectæ, cæterum eisdem similes; *seta* c. 1·5 cm. alta, tenuissima, flexuosula, lutescenti-rubra; *theca* erecta, regularis, oblonga, collo sporangium breviore, leptodermis, pallide fusca; *annulus* latus, revolubilis; *peristomium* simplex, internum: *membrana basilaris* exserta, hyalina, lævis; *processus* filiformes, c 0·010 mm. lati, appendiculati, sordide lutei, minutissime papillosi; *spori* 0·015 0·017 mm., læves; *operculum* ignotum.

N.S.W.: Tallewong Creek (Forsyth, n 641).

209. Mielichhoferia (*Mielichhoferiopsis*) turgens Broth, n.sp.

Paroica: robustiuscula, cæspitosa, cæspitibus densis, fuscotomentosis, pallide viridibus, nitidis; *caulis* erectus, usque ad 1·5 cm. longus, filiformis, accrescenti-foliosus itaque clavatus, innovando ramosus; *folia* inferiora inter se remotiuscula, erectopatentia, superiora sensim majora, densiora et erectiora, imbricata, ovato-lanceolata, acuta, marginibus fere ad apicem late revolutis, apice serrulatis, nervo infra apicem folii evanido, cellulis linearibus, basilaribus laxioribus, oblongo-hexagonis, innovationum latioribus, brevius acuminatis, marginibus anguste revolutis; *b acteæ perichætii* foliis multo minores, erectæ, anguste acuminatæ, marginibus erectis, subintegris; *sporogonia* 1-3 ex eodem perichætio; *seta* c. 5 mm. alta, tenuis, sicca flexuosula, lutea; *theca* erecta vel inclinata, regularis, oblonga, collo sporangium subæquante, leptodermis, pallida; *annulus* latus, revolubilis; *peristomium* duplex; *exostomii dentes* lanceolati, c. 0·20 mm. longi et c. 0·05 mm. lati, dense lamellati, pallidi, dorso basi transverse dein oblique superne longitudinaliter striolati, angustissime limbati, sublæves vel papillosi; *endostomium* hyalinum, lævissimum, membrana basilaris altiuscula, processus dentium longitudinis, carinati, haud perforati, cilia brevissima, singula vel nulla; *spori* 0·015-0·017 mm., ochracei, minute papillosi; *operculum* minutum, conicum, acutum, rubellum.

N.S.W.: Koorawatha, on ground among rocks (Watts, n.7219, typus); The Gap near Young (Watts, n.7719, forma); Memagong near Young, under rocks (Watts, n.7902, forma); Mt. Coghlan, near Cootamundra (Watts, n.7867, 7890, forma).

Species pulchra, peristomii structura ab omnibus congeneribus diversa.

210. Plagiobryum Novæ Seelandiæ Broth., n.sp.

Dioicum: tenellum, gregarie crescens, rubescenti-argenteum, nitidiusculum; *caulis* brevissimus, basi radiculis numerosis, longis, fuscis instructus, dense foliosus, innovationibus pluribus, brevibus, julaceis; *folia* caulina erecto-patentia, ovato- vel oblongo-lanceolata, plerumque obtusa, marginibus erectis, integris, elimbata, nervo tenui, rubro, infra apicem folii evanido, cellulis laxis, teneris, hexagono-rhomboideis, basilaribus oblongo-hexagonis vel rectangularibus, innovationum imbricata, cochleariformi-concava, late ovata, obtusissima vel subrotunda, marginibus erectis, integris, cellulis laxioribus; *seta* 1 cm. vel paulum ultra, e basi geniculata erecta, pallide rubra; *theca* nutans, cum collo sporangio longiore clavato-pyriformis, asymmetrica, microstoma, cum collo c. 6 mm. longa et c. 1·75 mm. crassa, lutescens, ore aurantiaco; *annulus* 0·075 mm. latus; *peristomium* duplex, paulum infra orificium oriundum; *exostomii dentes* lanceolati, c. 0·28 mm. longi et c. 0·075 mm. lati, ad medium aurantiaci, dein hyalini, læves; *endostomium* aurantiacum, læve, processus dentibus longiores, lanceolato-subulati, angustissime rimosi, cilia 0; *spori* 0·030-0·045 mm., fusci, papillosi, *operculum minutum*, aurantiacum, conicum, obtusum.

New Zealand: Broken River.

Species *Pl. Zierii* (Dicks.) Lindb., valde affinis, sed foliorum forma dignoscenda.

211. Bryum (*Pseudotriquetra*) subventricosum Broth., n sp.

Dioicum: robustiusculum, cæspitosum, cæspitibus densis, rigidis, fusco-tomentosis, lutescenti-viridibus, opacis; *caulis* erectus, cum innovationibus usque ad 5 cm. longus, dense foliosus, innovationibus erectis, elongatis, æqualiter foliosis; *folia* erecto-patentia, sicca adpressa, carinato-concava, caulina ovatovel oblongo-lanceolata, late acuta, mucronata, marginibus usque ad apicem late revolutis, integris, nervo crasso, fuscescente, in mucronem brevissimum excedente, cellulis ovali-hexagonis, basilaribus breviter rectangularibus, infimis rubris, marginalibus angustis, limbum pluriseriatum, luteum efformantibus, innovationum eisdem caulinis similia, sed minora, plerumque obtusiuscula; *seta* usque ad 3·5 cm alta, fusca; *theca* nutans vel subpendula, obovata, collo sporangio subæquante, sicca deoperculata sub ore haud constricta, pachydermis, fusco-lutescens; *annulus* 0·15 mm. latus; peristomium duplex, paulum infra orificium oriundum; *exostomii dentes* lanceolato-subulati, c. 0 66 mm. longi et c 0·10 mm. lati, fusco-lutei, minutissime papillosi, apice hyalini et distinctius papillosi, dense lamellati; *endostomium* flavescens, sublæve, membrana basilaris ad medium dentium producta, processus late fenestrati, cilia terna, bene evoluta, appendiculata; *spori* immaturi; *operculum* convexum, acute apiculatum, nitidiusculum.

N.S.W.: distr. Tumbarumba (Forsyth, n.725).

212. Bryum (*Pseudotriquetra*) austro-affine Broth., n.sp.

Synoicum: robustiusculum, cæspitosum, cæspitibus densis, fusco-tomentosis, fuscescenti-viridibus, opacis; *caulis* erectus, cum innovationibus usque ad 4 cm. longus, dense foliosus, innovationibus erectis, usque ad 1 cm. longis, dense et æqualiter foliosis; *folia* erecto-patentia, sicca adpressa, carinato-concava, caulina oblongo-lanceolata, breviter acuminata, longe aristata, marginibus recurvis, integris, nervo basi crassiusculo, rubro, dein sensim tenuiore, in aristam longam, plerumque reflexulam, rufescentem, integram vel minutissime serrulatam excedente, cellulis oblongo-hexagonis, basilaribus majoribus, infimis rubris, marginalibus elongatis, angustis, limbum lutescentem, pluriseriatum efformantibus, innovationum eisdem caulinis similia, sed minora, marginibus angustius recurvis, nervo brevius excedente; *seta* usque ad 4 cm., flexuosula, fusco-rubra; *theca* nutans, e collo sporangio breviore oblongo-ovalis, cum collo usque ad 4 mm. longa et 1·5 mm. crassa, sicca deoperculata sub ore plus minusve contracta, pachydermis, fusca; *annulus* 0·015 mm. latus; *peri-*

stomium duplex, paulum infra orificium oriundum; *exostomii dentes* lineari-lanceolati, subulato-acuminati, c. 0·5 mm. longi et c. 0·085 mm. lati, sordide lutei, minutissime papillosi, apice hyalini, distinctius papillosi, dense lamellati; *endostomium* sordide luteum, minute papillosum, membrana basilaris ad medium dentium producta, processus late fenestrati, cilia terna, bene evoluta, longe appendiculata; *spori* 0·015-0·017 mm., lutescenti-virides, læves; *operculum* convexum, acute apiculatum, nitidiusculum.

N.S.W.: Yarrangobilly Caves (Forsyth, n. 1012, 1014); Kiandra (Forsyth, n. 1010, 1011).

213. Bryum (*Cæspitibryum*) laxirete Broth., n.sp.

Dioicum: robustiusculum, cæspitosum, cæspitibus densis, pallide vel lutescenti-viridibus, nitidiusculis; *caulis* erectus, cum innovationibus vix ultra 1 cm. longus, fusco-tomentosus, dense foliosus, innovationibus brevibus vel longioribus, erectis, superne dense foliosis; *folia* erecto-patentia, carinato-concava, sicca imbricata, caulina late oblongo-lanceolata, longe aristata, marginibus revolutis, integris, limbata, nervo crassiusculo, superne multo tenuiore, in aristam elongatam, tenuem, lævem excedente, cellulis laxis, teneris, ovali- vel oblongo-hexagonis, marginalibus angustis, limbum pluriseriatum, lutescentem efformantibus, basilaribus majoribus, infimis rubris, innovationum eisdem caulinis similia; *seta* 2-3·5 mm. alta, strictiuscula, fuscescenti-rubra; *theca* pendula, e collo sporangio breviore oblonga, cum collo c. 4 mm. longa et c. 1·5 mm. crassa, sicca deoperculata sub ore parum constricta, pachydermis, pallide fusca; *annulus* 0·10 mm. latus; *peristomium* duplex, infra orificium oriundum; *exostomii dentes* lineari-lanceolati, subulato-acuminati, c. 0·55 mm. longi et c. 0·12 mm. lati, lutei, minute papillosi, apice hyalini, distinctius papillosi, anguste limbati, densissime lamellati, fundo rubro; *endostomium* sordide flavescens, papillosum, membrana basilaris ad medium dentium producta, processus dentibus breviores, lanceolati, late fenestrati, cilia terna, bene evoluta, longe appendiculata; *spori* 0·010 mm., lutei, læves; *operculum* hemisphæricum; acute apiculatum, nitidiusculum.

N.S.W.: Emu Plains (Forsyth, n.1019). Warrumbungle Ranges (Forsyth, n.1022); Jenolan Caves (Blakely, n.970); Hill Top (Maiden, n.406); gullies near Barber's Creek (Forsyth, n.409).

Species *Br. cæspiticio* L., affinis, sed foliis laxius areolatis jam dignoscenda.

214. BRYUM (*Argyrobryum*) CALODICTYON Broth., n.sp.

Dioicum: tenellum, cæspitosum, cæspitibus parvis, densis, lutescentibus, nitidis; *caulis* erectus, vix ultra 5 mm. longus, inferne dense fusco-radiculosus, dense et julaceo-foliosus, innovationibus brevissimis, erectis; *folia* imbricata, concava, ovata, breviter acuminata, acuta, marginibus erectis, integris, nervo sat tenui, infra summum apicem folii evanido, cellulis anguste linearibus, basilaribus laxioribus, alaribus numerosis, rectangularibus vel subquadratis. Cætera ignota.

N.S.W.: Green Gully, near Young (Watts, n.7206), and damp bank, back of Cemetery, Young (n.7244).

Species ex affinitate *Br. chrysei* Mitt., sed foliis breviter acuminatis, nervo ante apicem folii evanido, cellulis angustioribus longe diversa.

215. BRYUM (*Erythrocarpa*) LUTEOLIMBATUM Broth., n.sp.

Dioicum: tenellum, cæspitosum, cæspitibus densis, lutescenti-viridibus, nitidis; *caulis* vix ultra 5 mm. longus, basi fusco-radiculosus, dense foliosus, innovationibus paucis, erectis, brevibus; *folia* sicca imbricata, humida erecto-patentia, carinato-concava, marginibus erectis vel recurvis, apice minutissime serrulatis, limbata, nervo tenuiusculo, subcontinuo, cellulis oblongo-hexagonis, teneris, basin versus sensim longioribus, basilaribus rectangularibus, marginalibus elongatis, angustis, limbum luteum, triseriatum efformantibus; *seta* vix ultra 15 mm. alta, tenuis, rubra; *theca* nutans, cum collo sporangio subæquante clavato-pyriformis, c. 2 mm. longa, leptodermis, fuscidula; *annulus* latus, revolubilis; *peristomium* duplex, infra orificum oriundum: *exostomii dentes* lineari-lanceolati, subulato-acuminati, lutei, apice hyalini, papillosi, limbati, dense lamellati; *endostomium* sordide flavidulum, papillosum, membrana basilaris ad medium dentium producta, processus anguste lanceolati, anguste perforati, cilia ?; *spori* 0·015-0·018 mm., fusciduli, læves; *operculum* alte convexum, muticum.

New Zealand: Auckland (Petrie, in Herb. Naylor Beckett).

Species *Br. chrysoneuroni* C Müll., habitu similis, sed folii structura jam longe diversa.

216. Bryum (*Apalodictyon*) filarium Broth., n.sp.

Dioicum: gracillimum, cæspitosum, cæspitibus compactis, superne læte viridibus, ætate fuscescentibus, inferne fusco-rubris; *caulis* fragilis, erectus, usque ad 2·5 cm. longus, fusco-tomentosus, dense foliosus, simplex vel innovando ramosus; *folia* erecto-patentia, sicca arcte adpressa, carinato-concava, oblongo-lanceolata, breviter acuminata, acuta, usque ad 1 mm. longa et 0·38 mm. lata, marginibus erectis vel angustissime recurvis, integerrimis, nervo crasso, rufescente, continuo vel brevissime excedente, cellulis ovali- vel oblongo-hexagonis, teneribus, alaribus abbreviatis, marginalibus angustioribus, limbum indistinctum, uniseriatum efformantibus. Cætera ignota.

N.S.W.: Richmond River, Skinner's Head, sea-cliff (Watts, n.4127).

Species *Br. pachypomatulo* Broth., affinis, sed caule dense folioso, foliis brevioribus, nervo crasso dignoscenda.

217. Bryum (*Alpiniformia*) subcurvicollum Broth., n.sp.

Dioicum: robustiusculum, cæspitosum, cæspitibus compactis, rigidis, fuscescenti-viridibus, vix nitidiusculis: *caulis* erectus, cum innovationibus usque ad 2 cm. longus, fusco-tomentosus, dense foliosus, innovationibus erectis, vix ultra 5 mm. longis, strictis; *folia* erecto-patentia, sicca imbricata, carinato-concava, caulina anguste oblongo-lanceolata, breviter acuminata, aristata, marginibus anguste revolutis, integris, limbata, nervo crassiusculo, fuscescente, in aristam brevem, rigidam, lævem producto, cellulis rhomboideo-hexagonis, marginalibus elongatis, angustis, limbum angustissimum, lutescentem efformantibus, basilaribus laxioribus, oblongo-hexagonis, innovationum eisdem caulinis similia, integra vel apice indistincte serrulata; *seta* usque ad

3 cm. alta, tenuis, sicca flexuosula, inferne rubra, superne lutescenti-rubra; *theca* nutans, paulum asymmetrica, collo sporangio oblongo-ovali subæquante, cum collo c. 4·5mm. longa et c. 1·2mm. crassa, pallide fusca, pachydermis, sicca deoperculata sub ore haud constricta; *annulus* c. 0·12 mm. latus; *peristomium* infra orificium oriundum; *exostomii dentes* lineari-lanceolati, subulato-acuminati, c. 0·55 mm. longi et c. 0·10 mm. lati, lutei, apice hyalini, inferne minutissime, apice distinctius papillosi, estriolati, dense lamellati; *endostomium* sordide flavidum, minute papillosum; membrana basilaris ad medium dentium producta; processus dentium longitudinis, late lanceolati, carinati, fenestrati; cilia terna, bene evoluta, nodulosa, parce appendiculata; *spori* 0·015-0·018 mm., lutei, læves; *operculum* convexum, acute apiculatum.

N.S.W.: Apsley Falls (Forsyth, n.749).

Species *Br. curvicollo* Mitt., affinis, sed statura multo robustiore foliisque nervo tenuiore jam dignoscenda.

218. Bryum (*Alpiniformia*) Cheelii Broth., n.sp.

Dioicum: robustiusculum, cæspitosum, cæspitibus densis, inferne pallidis, dein viridibus, apice purpureis, nitidiusculis; *caulis* paulum ultra 1 cm. longus, inferne fusco-radiculosus, dense et æqualiter foliosus, simplex; *folia* sicca imbricata, humida erecto-patentia, carinato-concava, oblongo-lanceolata, acuta, mucronata, marginibus recurvis, apice minutissime serrulatis, nervo crasso, superne sensim angustiore, brevissime excedente, cellulis laxe hexagono-rhombeis, marginibus multo angustioribus, basilaribus breviter rectangularibus; *seta* c. 2 cm. alta, fuscescenti-rubra; *theca* pendula cum collo sporangio æquante pyriformis, c. 4 mm. longa, pachydermis, fusca; *annulus* latus, revolubilis; *peristomium* duplex, ad orificium oriundum; *exostomii dentes* lineari lanceolati, subulato-acuminati, lutei, apice hyalini, papillosi, anguste limbati, dense lamellati; *endostomium* flavescens, papillosum, membrana basilaris ultra medium dentium producta, processus lanceolati, fenestrati, cilia terna, bene evoluta, longe appendiculata; *spori* 0·012 mm., lutescenti-virides, sublæves; *operculum* alte convexum, mammillatum, nitidum.

N.S.W.: Shellharbour (Cheel, n.407).

Species *Br. alpino* Huds., habitu simillima, sed foliis nervo crassiore, cellulis laxioribus jam dignoscenda.

219. BRYUM (*Alpiniformia*) KIAMÆ Broth., n.sp.

Dioicum: gracilescens, cæspitosum, cæspitibus densiusculis, viridibus, opacis; *caulis* vix ultra 3 mm. longus, basi radiculosus, dense foliosus, innovationibus paucis, brevibus vel simplex; *folia* subæqualia, sicca imbricata, humida erecto-patentia, carinato-concava, oblonga, acutiuscula, marginibus erectis, superne minutissime serrulatis, nervo crassiusculo, continuo vel subcontinuo, cellulis laxe rhomboideo-hexagonis, marginem versus angustioribus, basilaribus rectangularibus; *seta* vix ultra 1 cm. alta, tenuis, rubra; *theca* pendula, cum collo sporangio æquante pyriformis, c. 3 mm. longa, pachydermis, fusca; *annulus* latus, revolubilis; *peristomium* duplex, paulum infra orificium oriundum: *exostomii dentes* lineari-lanceolati, subulato-acuminati, lutei, apice hyalini, papillosi, dense lamellati; *endostomium* sordide luteum, papillosum membrana basilaris vix ultra medium dentium producta, processus lanceolati, anguste perforati, cilia ?; *spori* 0·018-0·020 mm., virides, sublæves; *operculum* alte convexum, muticum.

N.S.W.: Kiama (Forsyth, n.381).

Species *Br. Sullivani* C. Müll., valde affinis, sed thecæ forma dignoscenda.

220. BRYUM (*Rosulata*) FORSYTHII Broth., n.sp.

Dioicum: robustiusculum, cæspitosum, cæspitibus densis, sordide viridibus, opacis; *caulis* usque ad 2 cm. longus, fusco-radiculosus, dense et comoso foliosus; *folia* comatia sicca erecta humida patentia, carinato-concava, e basi breviter spathulata, breviter oblonga vel ovalia, obtusiuscula, brevissime aristata, c. 3 mm. longa et usque ad 1·3 mm. lata, marginibus fere ad apicem revolutis, superne minute et æqualiter serratis, limbata, nervo crassiusculo, brevissime excedente, cellulis ovali- vel rhombeo-hexagonis, marginalibus angustioribus et longioribus, limbum pauciseriatum, infra apicem folii desinentem efformantibus; *seta* c. 2 cm. alta, rubra; *theca* nutans, minuta, cum collo sporangio longiore obconica, fuscidula; *operculum* alte convexum, mammillatum.

N.S.W.: Kiama (Forsyth, n.384).

Species *Br. leptothecio* Tayl., affinis, sed folii forma, limbo angusto, infra apicem folii evanido dignoscenda.

221. Papillaria (*Eupapillaria*) nitidiuscula Broth., n.sp.

Dioica: mollis, gracilescens, læte viridis, nitidiuscula; *caulis* elongatus, per totam longitudinem cortici arborum affixus, laxiuscule foliosus, dense et regulariter ramosus, ramis haud complanatis, plerumque brevibus, dense foliosis, curvatulis, simplicibus, attenuatis, rarius elongatis, pendulis, multo tenuioribus, pinnatim ramulosis: *folia caulina* patentia, e basi breviter decurrente late cordata, lanceolato-subulata, piliformiter attenuata, alis inflexis, marginibus erectis, minutissime crenulatis, nervo tenui, ad medium folii evanido, cellulis elongatis, anguste lineari-rhomboideis, minutissime papillosis, basilaribus laxioribus, alaribus subquadratis, hyalinis, lævibus: *folia ramea* angustiora, lanceolato-acuminata. Cætera ignota.

N.S.W.: Richmond River, Alstonville Road (Watts, n.4032, 4043, 4062), E. Ballina (Watts, n.207, 3401, 4003, 4110, 4351), Tintenbar (Watts, n.4363), Pimlico (Watts, n.4882), Uralba Road (Watts, n.3711, 3715), Pearce's Creek (Watts, n.441), Brooklet (Watts, n.4793), Teven Creek (Watts, n.4093, 4396, 4418), North Creek (Watts, n.4755); Brunswick River, Myocum (Watts, n.4337).

Species a congeneribus australiensibus foliis nitidiusculis, mollibus jam dignoscenda.

222. Anacamptodon Wattsii Broth., n.sp.

Autoicus: gracilis, cæspitosus, cæspitibus densiusculis, læte viridibus; *caulis* elongatus, repens, laxiuscule foliosus, dense ramosus, ramis brevibus, adscendentibus, simplicibus; *folia* patula, concava, e basi ovata vel ovali sensim longe lanceolato-subulata, marginibus erectis, integris, nervo crassiusculo, continuo, cellulis rhomboideo-hexagonis, basin versus laxioribus, alaribus numerosis quadratis; bracteæ perichætii internæ erectæ, sensim lanceolato-acuminatæ, integræ; *seta* c. 1 cm. alta, strictiuscula, lutea, inferne rubra, ætate omnino rubra, lævissima;

theca erecta, ovalis, crassicollis, pachydermis, pallida, ætate rubra: *peristomium* duplex, infra orificium oriundum; *exostomii dentes* incurvi, siccitate reflexi, late lanceolati, c. 0·37 mm. longi et c. 0·085 mm. lati, fusciduli, papillosi: *processus* filiformes, medium dentium attingentes, fusci, læves; *spori* 0·008-0·010 mm., ochracei, læves; *operculum* e basi conica breviter et oblique rostratum.

N.S.W.: Richmond River, Cooper's Creek (or Wilson's Creek), on burnt wood (Watts, n.5189).

Species foliis longe subulatis, nervo continuo dignoscenda.

223. Amblystegium austro-hygrophilum Broth., n.sp.

Autoicum: gracile, cæspitosum, cæspitibus densiusculis, pallide viridibus; *caulis* elongatus, repens, hic illic fusco-radiculosus, laxe foliosus, irregulariter et remote subpinnatim ramosus, ramis patulis, usque ad 1·5 cm. longis, laxe foliosis, simplicibus; *folia* squarroso-patula, concaviuscula, e basi longe decurrente, ovata sensim longe lanceolato-subulata, marginibus erectis, subula excepta minutissime denticulatis, nervo tenui, in subula evanido, cellulis elongate hexagonis, basin versus brevioribus, alaribus numerosis, laxis, oblongis; *bracteæ perichætii* internæ erectæ, e basi pallida, lata lanceolato-subulatæ, marginibus subulæ minute serrulatæ; *seta* 2-3 cm., tenuis, flexuosula, rubra, superne lutescens; *theca* horizontalis, cylindracea, sicca curvata et sub ore contracta, fusco-lutea; *operculum* ignotum.

N.S.W: Mt. Duval, near Armidale, wet places among grass in gully (Watts, n.7386).

224. Plagiothecium Novæ Seelandiæ Broth., n.sp.

Dioicum: robustum, cæspitosum, cæspitibus densis, mollibus, turgescentibus, viridissimis, nitidis; *caulis* elongatus, procumbens, parce radiculosus, dense foliosus, subpinnatim ramosus, ramis patentibus, plus minusve complanatis, brevioribus, obtusis vel longioribus, arcuatis, sæpe plus minusve attenuatis, simplicibus; *folia* concava, longe decurrentia, late ovalia, obtusa, integra, lateralia asymmetrica, nervo furcato, brevi vel usque ad medium folii producto, cellulis elongate sed laxe rhomboideis, alaribus brevioribus et laxioribus; *bracteæ perichætii* late vaginantes, breviter acuminatæ, integræ; *seta* c 2·5 cm. alta, flexuosa, rubra; *theca* erecta vel suberecta, e collo brevi oblongo-cylindrica, pallide fusca, lævis; *operculum* conicum, acutum.

New Zealand: Kelly's Range, Kelly's Creek, on dripping rocks, and at top of Otira Gorge, 2830 ft., damp rocks in scrub (T. W. Naylor Beckett).

Species inflorescentia dioica, statura robusta foliorumque forma faciliter dignoscenda.

225 PLAGIOTHECIUM NOVÆ VALESIÆ Broth., n.sp.

Autoicum: robustiusculum, cæspitosum, cæspitibus densis, turgescentibus, lutescenti-viridibus, nitidis; *caulis* elongatus, repens, per totam longitudinem plus minusve fusco-radiculosus, densiuscule foliosus, subpinnatim ramosus, ramis patulis, vix ultra 1 cm. longis, complanatulis, simplicibus, obtusis; *folia* concava, vix decurrentia, dorsalia et ventralia symmetrica, ovato-lanceolata, lateralia asymmetrica, ovata, breviter sed anguste acuminatis, marginibus erectis, apice minutissime serrulatis vel subintegris, nervis binis, brevissimis, cellulis laxe elongate rhomboideis, alaribus brevioribus et laxioribus; *bracteæ perichætii* vaginantes, subulato-acuminatæ, integræ; *seta* 1·5 cm. alta, pallide rubra. Cætera ignota.

N.S.W.: Richmond River, Skinner's Creek, on rock (Watts, n.5619) and log in Byron Creek (Watts, n 5839).

Species *Pl. lamprostachydi* (Hamp.) Jæg., affinis, sed foliis vix decurrentibus, lateralibus anguste acuminatis, apice minutissime serrulatis, laxius areolatis optime diversa.

226. VESICULARIA RIVALIS Broth., n.sp.

Autoica: gracilis, cæspitosa, cæspitibus laxiusculis, depressis, saturate viridibus, opacis; *caulis* elongatus, repens, per totam longitudinem fasciculatim fusco-radiculosus, laxiuscule foliosus, pinnatim ramosus, ramis patulis, complanatis, vix ultra 1 cm. longis, cum foliis c. 2 mm. latis, simplicibus, obtusis; *folia* ramea lateralia patula, concava, plus minusve asymmetrica, ovalia, raptim plus minusve longe cuspidata, marginibus erectis, integerrimis, enervia, cellulis laxe ovali- vel oblongo-hexagonis (superioribus 3:1 vel 4:1), basin versus longioribus, ventralia et dorsalia multo minora, symmetrica, ovato-lanceolata; *seta* 1·5cm., pallide rubra; *theca* nutans, ovalis, c. 1 mm. longa, sicca deoperculata sub ore constricta, fusca; *operculum* e basi convexa acute apiculatum.

N.S.W.: Richmond River, rock in Whian Creek (Watts, n.5666).

Species *V. pinnatulæ* (C. Müll.) valde affinis, sed foliis latioribus, cellulis laxioribus, firmioribus dignoscenda.

NEW AUSTRALIAN SPECIES OF *CARABIDÆ* BELONGING TO THE TRIBE *SCARITINI*.

[COLEOPTERA.]

BY THOMAS G. SLOANE.

It had been my intention to have reviewed the tribe Scaritini as represented in Australia, as a whole, and to have dealt with the classification of the genera, and the arrangement and synonymy of the species; but the realisation of this idea has had to be postponed, so that only the new species (including the interesting species found by Mr. H. W. Brown in the Murchison District of Western Australia, at Cue and Anketell) which have accumulated in my hands; and for which, in some cases, my correspondents are waiting for published names, are dealt with herein.

RHYSOCARA, n.gen

Allied to *Clivina*. *Head* irregularly and strongly longitudinally furrowed, the median furrow deep; front with a strong transverse ridge behind median part of clypeus; supra-antennal plates wide, obliquely tumid in front of eyes, external margin bordered; clypeus strongly angularly-emarginate, lateral parts* rounded; eyes large, globose. *Antennæ* short, incrassate; two basal joints glabrous, third cylindrical, hardly shorter than second, sparsely setulose; joints 5-11 short, wide, pubescent. *Mentum* with prominent median tooth; a setigerous puncture

* It is now proposed to use the term *lateral parts* for the side-pieces of the clypeus situated between the median part of the clypeus and the supra-antennal plates of the head. Hitherto, I have followed Putzeys in calling these side-pieces the "wings" of the clypeus, but there are decided objections to the use of the military term *wing* for the lateral part of a body-segment; therefore, it is better to discontinue its use.

beside each basal angle. *Prothorax* short, transverse, convex, widest at posterior angles, strongly narrowed to apex; basal curve short, inner angles hardly marked; apex truncate; anterior angles rounded; lateral furrow wide, closed behind by a transverse ridge connecting border with pronotum at posterior angles; two lateral setigerous punctures as in *Clivina*; anterior transverse sulcus deep. *Elytra* stout, convex, strongly striate-punctate; striæ free at base; interstices convex, most strongly so on apical declivity, extremities of 2-6 distant from apex, seventh convex on apical declivity. *Ventral segments* transversely sulcate. *Prosternum* convex, wide between coxæ; intercoxal declivity transversely sulcate; peduncle with a concavity on each side; metasternum not long. *Legs* stout; anterior femora short, wide; anterior tibiæ large, 3-dentate, teeth strong, upper one opposite insertion of upper inner spine, middle one before insertion of inner apical spine, apical one long, stout, curved outwards, obtuse at apex; middle tibiæ incrassate, with a strong apical spur and an obtuse prominence on outer side above apical spur; posterior coxæ contiguous.

A new genus has seemed necessary for the reception of this remarkable species, which, in facies, resembles the species of the American species *Aspidoglossa*, though it is not allied to that genus. I know of no species nearly allied to it; probably its position is between *Dyschirius* and *Clivina*. Attention may be drawn to the lateral furrow of the elytra, in which, towards the base, the punctures of the normal eighth stria of the Carabidæ may be seen, as well as those of the seventh stria; between these rows of punctures, the umbilicate punctures of the normal ninth interstice occur; the ninth interstice itself is lost in the lateral furrow, as is always the case in *Clivina*, though not in *Dyschirius*.

Rhysocara crassa, n.sp.

♀. Robust, convex, winged. Head rugose, eyes prominent, clypeus with median part deeply emarginate, not divided from lateral parts; prothorax short, subtrapezoid; elytra truncate at base, strongly punctate-striate, striæ entire, five inner ones free at base, submarginal humeral carina obsolete; prosternum with intercoxal part cordiform, narrow and longitudinally sulcate anteriorly; pro-episterna smooth; lateral cavities of peduncle smooth; metasternum longer between median and posterior coxal cavities than the length of the posterior coxæ; legs stout: anterior tibiæ strongly 3-dentate; intermediate tibiæ thick, wide at apex, a strong obtuse external spur at apex: posterior tibiæ short, incrassate. Black.

Head not large (1·6 mm. across eyes); front strongly rugose; clypeus with median part deeply emarginate, lateral parts rounded externally, not divided from median part on anterior margin, concave, the inner margin of this concavity sharply defining the median part; supra-antennal plates large, rounded externally divided from lateral parts of clypeus by a sinuosity; eyes globose, prominent. Labrum 7-setose. Palpi stout. Antennæ short, moniliform, incrassate, second joint longer than third. Prothorax smooth, convex, broader than long (2·1 × 2·75 mm.), widest just before posterior marginal puncture, strongly and roundly narrowed anteriorly (ant. width 1·7 mm.); basal curve short; anterior margin truncate; anterior line deeply impressed: lateral channel wide; border strongly developed, particularly on each side of basal curve, not sinuate on each side of base, inner basal angles not marked. Elytra truncate-oval (5 × 2·9 mm.), convex, abruptly declivous at base, strongly declivous to apex; striæ deep, strongly punctate the punctures reaching apical extremity—seventh entire: interstices convex, sixth and seventh uniting at base to enclose sixth stria, eighth narrow on apical curve. Intercoxal declivity of prosternum narrowed and strongly transversely sulcate in middle. Anterior femora short, thick, compressed; anterior tibiæ stout, strongly 3-dentate, apex stout and curving outwards; posterior trochanters shortly subreniform, obtusely pointed at apex. Length, 8·6, breadth 2·9 mm.

Hab.—Northern Territory. Type in Coll. Sloane (unique); given to me by Mr. C. French.

A very remarkable and isolated species, representing a new genus among the Australian Clivinides. The head differs from that of all Australian species of *Clivina* by the strong rugosity of the front; the clypeus, too, is more triangularly emarginate than in any of our species of *Clivina*. The short, subtrapezoid prothorax, with the border thick behind the posterior angles, and not curved downwards to meet the median basal part of the border; the truncate, strongly punctate-striate elytra, with the five inner striæ free at the base, and the third, fifth, and seventh interstices strongly developed on the apical declivity; together with the four posterior tibiæ stout and wide, are characteristic, unusual features of this species. I have been unable to see any trace of the usual four setigerous punctures of the third elytral interstice. In a general way, it has the appearance of a stoutly built species of the genus *Aspidoglossa*.

CLIVINA BRUNNICOLOR, n.sp.

Allied to *C. riverinæ* Sl.: parallel, depressed. Head similar to that of *C. obliquata* Putz., and resembling that of *C. riverinæ* Sl.; prothorax subquadrate; elytra subdepressed, strongly punctate-striate, fifth, sixth, and seventh striæ entire, fifth joining sixth at base, a humeral carina at base of seventh and eighth interstices; prosternum with intercoxal part very narrow anteriorly, episterna minutely shagreened under a lens, and with lightly impressed wavy striolæ; anterior tibiæ 3-dentate. Brownish, head and prothorax piceous-brown, legs fuscous-red.

Head large; vertex wide between facial carinæ, punctate; facial carinæ elongate, well developed; facial sulci recurved (recurved part longer and less oblique than in *C. obliquata*). Prothorax depressed, wide (1·9 × 2·1 mm.). Elytra lightly and widely subconvex, hardly wider than prothorax (4 × 2·15 mm.); striæ punctate, extending on to apical declivity, seventh well-marked, entire, finely punctulate before apical curve. Anterior femora wide, lower side arcuate; anterior tibiæ wide, strongly 3-dentate, with a small prominence above upper tooth; intermediate tibiæ with ante-apical spur well developed. Length 7·7, breadth 2·15 mm.

Hab.—North-West Australia: King's Sound (Froggatt and W. D. Dodd). Type in South Australian Museum.

This is the species I have referred to in these Proceedings (1896, p.276) as a variety of *C. riverinæ*. An examination of three specimens from the South Australian Museum, ticketed "Derby, W. D. Dodd," indicates that it is a distinct, though closely allied species. From *C. riverinæ*, it differs by its brownish colour, less depressed form (especially of elytra); elytra more strongly striate, the lateral striæ strongly impressed.

CLIVINA DAMPIERI, n.sp.

Narrow, cylindrical. Front depressed, punctate; prothorax longer than broad; elytra strongly punctate-striate, fourth and fifth striæ confluent at base, seventh entire, eighth interstice carinate at base; prosternum with intercoxal part attenuate anteriorly, episterna feebly shagreened, overhanging anteriorly; anterior femora wide, posterior margin of lower side rounded, anterior tibiæ 4-dentate. Ferruginous.

Head ordinary; front punctate; vertex without punctures in middle, a few punctures on each side of extremities of facial carinæ, these short; clypeus not divided from front, clypeal elevation lightly raised, arcuate, median part emarginate-truncate, bordered, angles slightly more prominent than lateral parts, divided from them by an angular notch, lateral parts small; supra-antennal plates raised, declivous to facial carinæ; eyes convex, not much more prominent than supra-antennal plates, standing out sharply from head at base. Prothorax longer than broad (1·35 × 1·2 mm.), hardly narrowed anteriorly, declivous to base, smooth (a few striolæ near sides); lateral basal impressions obsolete; border narrow, not curving downwards at junction with basal border, inner basal angles marked. Elytra a little wider than prothorax (2·6 × 1·35 mm.), parallel, strongly declivous to apex; base lightly emarginate; shoulders rounded but marked; striæ strongly impressed, entire; interstices convex, depressed on apical declivity. Length, 5-5·5; breadth, 1·35-1·5mm.

Hab.—North-West Australia: Carnot Bay. Type in Coll. Sloane.

Three specimens are before me, one received from Mr. C. French as from Carnot Bay, and two belonging to the South Australian Museum, from the Blackburn Coll., ticketed "N.W.A."

Allied to *C. bovillæ* Blkb., but much smaller, more cylindrical, more parallel; prothorax longer, less narrowed to apex. Compared with a species from Fortescue River (South Australian Museum Coll.), and Cue (Coll. Sloane) which is hardly larger (length 5-6 mm.), and which seems to me a dwarfed form of *C. bovillæ*, it differs by prothorax longer than broad, less narrowed to apex; eyes less roundly prominent; vertex depressed; facial carinæ shorter. I am unable to compare it with *C. australica* Sl., from the description of which it differs by size larger; clypeus with median part more strongly separated from lateral parts; facial sulci not "recurved"; elytra more strongly striate.

Clivina exilis, n.sp.

Parallel-elongate. Head small, eyes not protuberant, clypeus with median part angulate on each side; prothorax longer than broad, punctate; elytra long, parallel, punctate-striate, fourth stria free at base, seventh interstice narrowly carinate near base, eighth carinate near apex; prosternum with intercoxal part attenuate anteriorly, posterior declivity not transversely sulcate; anterior femora with posterior margin of lower side roundly protuberant in middle; anterior tibiæ 4-dentate. Ferruginous-testaceous.

Head wide and convex between eyes, finely punctate; clypeus with median part advanced, decidedly angulate on each side (these intermediate angles sharply marked), lateral parts rectangularly angulate, a triangular notch dividing lateral parts from supra-antennal plates. Prothorax depressed, long (1 × 0·7 mm.), parallel on sides; anterior margin truncate; anterior angles obtuse; lateral border narrow, lightly sinuate near apex, inner angles of base obtuse. Elytra long, narrow (2 × 0·75 mm.), parallel on sides; striæ entire, not deep, seventh strongly impressed for the whole length. Prosternal episterna strongly transversely striolate near outer margin. Length, 3·8; breadth, 0·75 mm.

Hab.—Port Darwin (Dodd). Type in Coll. Sloane (unique).

A very distinct species, which may be placed near *C. cribrifrons* Sl., but also shows some affinity to *C. coronata* Putz. It is the most elongate, and most depressed of the small Australian species of *Clivina*. Such species as *C. inconspicua* Sl., *C. cribrifrons* Sl., and *C. nana* Sl., seem of quite robust form beside it. Its small size, slender form, head with non-prominent eyes, clypeus decidedly quadri-angulate, prothorax long with upper surface punctate, and elytra with fourth stria free at base, are features, which, taken together, help to distinguish it readily from all other Australian species.

Clivina femoralis, n.sp.

Elongate, parallel. Head subdepressed, punctate, clypeus emarginate (as in *C. sellata*, etc.); prothorax longer than broad, subdepressed; elytra punctate-striate, fourth and fifth striæ uniting at base, basal striole of first interstice obsolete (faintly perceptible only on basal declivity), eighth interstice carinate at base; anterior femora strongly lobate on lower side; anterior tibiæ 4-dentate. Ferruginous.

Head rather depressed; front and vertex punctate; clypeus not divided from front, clypeal elevation slightly raised, roundly truncate, anterior margin of clypeus lightly emarginate, median part not divided from lateral parts; supra-antennal plates decidedly divided from lateral parts of clypeus, declivous to frontal impressions; facial sulci shallow; eyes not large, deeply set in orbits, convex, but not greatly more prominent than supra-antennal plates. Prothorax smooth, longer than broad (1·5 × 1·3 mm.), very lightly narrowed anteriorly; disc rather depressed along median line; basal declivities very short; lateral basal impressions linear, distinct. Elytra parallel, a little wider than prothorax (3 × 1·45 mm.), subcylindrical; striæ strong, entire, seventh strongly marked in all its course; interstices convex. Prosternum with intercoxal part attenuate anteriorly, transversely sulcate on base; episterna lightly overhanging anteriorly, finely shagreened, a few fine transverse striolæ near sides. Anterior coxæ prominent at apex beneath femora; anterior femora with posterior margin of lower side strongly raised into a wide obtuse prominence at middle; intermediate tibiæ with ante-apical spur well developed. Length, 5·5; breadth, 1·45 mm.

Hab.—North-West Australia: Fortescue River, Hammersley Range (W. D. Dodd). Unique in South Australian Museum Coll.

This species is such an important one, connecting *C. punctaticeps* Putz., with *C. ferruginea* Putz., etc., that I have ventured to describe it on a single specimen. It can be readily separated from all other Australian species of the genus *Clivina* by the presence of the following two characters which occur together in no other Australian species, viz., (*a*) clypeus emarginate as in *C. sellata* Putz.; (*b*) femora with posterior margin of lower side strongly lobate; the lobe is about half-way between the point of the coxa and the apex of the femur, and is more suddenly raised, and more prominent than in *C. punctaticeps* Putz., or *C. tumidipes* Sl.

Clivina darwini, n.sp.

Robust, convex. Head wide, clypeus deeply truncate-emarginate; prothorax as broad as long (2 × 2 mm.), anterior angles marked; elytra oval, fourth and fifth striæ uniting at base, seventh and eighth interstices uniting at base to form a short carina, eighth interstice not indicated by a carina near apex; prosternum with intercoxal part wide anteriorly, basal declivity non-sulcate, episterna shagreened, finely transversely striolate; metasternum between intermediate and posterior coxæ shorter than posterior coxæ, episterna small and short; anterior tibiæ 3-dentate. Piceous-black, undersurface and legs reddish-piceous, antennæ and palpi ferruginous.

Head large, convex; eyes prominent, clypeus deeply and widely truncate-emarginate (as in *C. froggatti* Sl.); lateral parts of clypeus not divided from median part, lightly and roundly advanced; supra-antennal plates rounded externally, divided from lateral parts of clypeus by a light sinuosity. Prothorax convex (2 × 2 mm.), lightly narrowed anteriorly; anterior margin truncate; anterior angles well marked, subrectangular; basal curve short. Elytra oval (3·7 × 2·1 mm.), convex; shoulders rounded; striæ deep, finely crenulate; interstices convex near base, depressed on apical declivity; submarginal humeral carina short, feebly developed. Length, 5·5-7; breadth, 1·65-2 mm.

Hab.—Port Darwin (Dodd, several specimens). Type in Coll. Sloane.

Closely allied to *C. froggatti* Sl., with which it agrees in shape of head and elytra, but differs by smaller size: prothorax with anterior angles prominent (not rounded off): elytra with eighth interstice not showing as a carina on apical curve; metasternum shorter, the metepisterna much smaller and shorter.

Clivina kershawi, n.sp.

Allied to *C. elegans* Putz.: elongate, lightly convex. Clypeus emarginate-truncate, lateral parts advanced; prothorax longer than broad, narrowed to apex: elytra subdepressed, strongly punctate-striate, fourth stria joining fifth at base, interstices convex, eighth obsolete on apical curve; prosternum with intercoxal part wide; peduncle smooth, concavities impunctate; metasternum and metepisterna short; anterior tibiæ 3-dentate: intermediate tibiæ with external spur above apex. Black: antennæ, tarsi, and palpi piceous-red.

Head smooth; facial carinæ narrow, a slight impression dividing them from supra-antennal plates: clypeus with lateral parts prominent, rounded, median part truncate; eyes prominent. Prothorax smooth, a little broader than long (3·4 × 3·6 mm.), narrowed to apex (2 6 mm.), subdepressed; basal declivity short: border narrow, hardly interrupted at basal angles, not wide at anterior angles. Elytra subdepressed, oval (7·6 × 3·75 mm.): striæ well marked to apex, strongly impressed and decidedly crenulate: seventh interstice lightly carinate at base: posterior setigerous puncture of third interstice near extremity of fourth striæ. Length, 12-13·7: breadth, 3·1-3·75 mm.

Hab.—Tropical Queensland: Claudie River (J. A. Kershaw). Type in the National Museum, Melbourne.

In facies, resembling *C. elegans* Putz., but differing by antennæ longer and less moniliform (joints 4-11 not so short, wide, and bead-like); facial carinæ more or less divided from supra-antennal plates; orbits projecting less strongly from head behind eyes;

peduncle smooth; elytra more deeply crenulate-striate, interstices more convex, eighth obsolete on apical curve; metasternum longer between middle and posterior coxæ. From *C. abbreviata* Putz., it can be differentiated readily by the less moniliform antennæ, and smooth peduncle From *C. obliquicollis* Sl., it may be separated by its more depressed form; metasternum much shorter between coxal cavities, etc. And from *C. brevisterna* Sl., by its more depressed shape ; longer prothorax ; elytra more strongly striate, posterior setigerous puncture of third interstice placed near apex, etc.

Clivina brevisterna, n sp.

Allied to *C. nyctosyloides* Putz.: robust, elongate-oval. Head as in *C. nyctosyloides*, clypeus widely and deeply truncate-emarginate; prothorax hardly broader than long, strongly narrowed anteriorly; elytra oval, convex, punctate-striate, fourth stria joining fifth at base, interstices convex on disc, eighth obsolete on apical declivity, submarginal humeral carina feebly developed; prosternum with intercoxal part wide anteriorly, pro-episterna smooth, with some minute wavy transverse scratches; lateral cavities of peduncle smooth; metasternum shorter between intermediate and posterior coxal cavities than the length of the posterior coxæ, metepisterna longer than broad; anterior tibiæ 3-dentate; intermediate tibiæ with external spur near apex. Black; tibiæ piceous; tarsi and antennæ reddish-piceous.

Head large (2·15 mm. across eyes): sides sloping forward obliquely from a little before eyes (a very slight sinuosity indicating the division between the supra-antennal plates and the lateral parts of the clypeus): clypeus with median part truncate, lateral parts shortly advanced, oblique on inner side. Labrum 7-setose. Prothorax of almost equal length and breadth (3·2 × 3·3 mm.), widest a little before posterior angles, strongly narrowed anteriorly (ant. width 2·25 mm.), deeply declivous to base; anterior angles obtuse, widely bordered; basal curve short. Elytra oval (6·7 × 3·7 mm.), convex; shoulders rounded, striæ all strongly impressed towards base, fifth and seventh obsolete, or nearly so, towards apex. Length, 11·5-15; breadth, 3·5-4 mm.

Hab.—Northern Territory: Pine Creek District. Type in Coll. Sloane. I am indebted to Mr. C. French for several specimens.

Closely allied to *C. nyctosyloides*, but differing by metasternum shorter between intermediate and posterior coxal cavities than the length of the posterior coxæ; prothorax longer (and, therefore, appearing less strongly narrowed to apex); elytra with the shoulders more rounded off (*i.e.*, less strongly ampliate from peduncle). The elytral interstices have a tendency to present four irregular raised ridges on the apical declivity formed by the first, third, fifth, and seventh interstices; a similar tendency is noticeable in *C. nyctosyloides*; but, owing to the greater convexity of the even interstices towards the apex in that species, the odd interstices are not so conspicuous as in *C. brevisterna*, in which the even interstices are depressed.

Laccoscaphus doddi, n.sp.

Elliptical-oval, robust, convex. Head with two supraorbital punctures on each side; each elytron with four rows of deep foveæ, and a row of small lateral ocellate punctures not placed in foveæ; anterior tibiæ 3-dentate.

Head large (3·3 mm. across eyes), convex; frontal sulci lightly divergent backwards, out-turned to define the posterior margin of the lateral frontal spaces, connected by a rounded impression defining posterior margin of median frontal space; eyes lightly convex, not prominent. Prothorax convex, transverse (2·6 × 3·9 mm.); anterior margin truncate; anterior angles small, hardly advanced; sides subparallel in middle, lightly and roundly narrowed to anterior angles, rounded at posterior angles, lightly sinuate on each side of basal lobe; border narrow, lightly reflexed, forming a thick strongly raised ridge on basal lobe; two marginal setigerous punctures on each side. Elytra convex, oval (5·3 × 3·7 mm.); base widely and lightly emarginate; four rows of foveæ on each elytron, first (sutural) row with two small foveæ on disc and two on apical declivity, second and third rows with five or six foveæ, fourth row with four foveæ; border narrow, strongly upturned at humeral angles; apical curve with a narrow margin on each side; three setigerous punctures on each side of base. Intercoxal part of prosternum with a setigerous puncture on each side near coxal cavity.* Posterior trochanters with a setigerous puncture. Length, 11; breadth, 3·7 mm.

Hab.—Port Darwin (Dodd). Type in Coll. Sloane (unique).

This small species is allied to *L. darwiniensis* Macl., from which it differs by its black colour, smaller size, etc. It differs from *L. macleayi* Sl., by its shorter and more convex form; eyes less prominent; border of elytra and prothorax narrower; elytral foveæ smaller, lateral ocellate punctures not placed in depressions, etc.

CARENUM LEPIDUM, n.sp.

Elliptical, convex. Head depressed, frontal sulci short, lightly divergent; prothorax transverse, convex, margins wide, posterior angles rounded off; elytra convex, widely subemarginate at base, impunctate, border dentate at humeral angles; anterior tibiæ 3-dentate. Head and undersurface black; prothorax black, becoming violaceous towards sides, border viridescent; elytra purple, bluish-green near sides.

Head transverse (6 mm. across eyes); front subdepressed; frontal sulci arcuate-sinuate, lightly divergent backwards; eyes subprominent; intermediate angles of clypeus stout, triangular, obtuse at apex; preocular process small, rounded externally. Antennæ submoniliform, setaceous. Prothorax convex, transverse (5·3 × 8·4 mm.); sides rounded, anterior angles wide, obtuse, decidedly advanced; posterior angles rounded, not marked; basal curve arcuate on each side behind posterior angles, lightly sinuate on each side of base; border reflexed, hardly wider at posterior angles; marginal channel wide; base shortly lobate; median line strongly impressed; two marginal setigerous punctures on each side. Elytra oval, wider than prothorax (13 × 9 mm.), wide at base; border folded over and upturned at humeral angles; lateral channel wide; four or five punctures on base of each

* A similar puncture is found in *L. darwiniensis* Macl., *L. cyaneus* Fabr., and *L. humeralis* Sl., but not, that I have been able to detect, in *L. loculosus* Newm., *L. spenceri* Westw., and *L. macleayi* Sl.

elytron; a row of closely placed punctures along lateral margin: suture strongly impressed. Anterior tibiæ 3-dentate: inferior ridge raised, strongly serrate: apical plate dentate at apex below tarsus. Length, 24; breadth, 9 mm.

Hab.—W.A.: Anketell, Cue District (Brown). Type in Coll. Sloane (unique).

A distinct species. From *C. transversicolle* Chaud., and *C. brevicolle* Sl., it is readily distinguished by the shape of the prothorax, which is less subquadrate and transverse, and has the posterior angles rounded off, not widely margined and prominent. From *C. leai* Sl., it is separated by size larger; form less convex; prothorax more rounded on sides, more widely margined; elytra far less convex, wider across base, lateral border much wider. From *C. macleayi* Blkb., it differs by head with preocular processes (anterior angles) not prominent; prothorax less convex, margins wider; elytra with lateral channel wider.

Carenum leai, n.sp.

Elliptical-oval, very convex. Head with frontal sulci short, one supraorbital puncture on each side; prothorax transverse, lobate, anterior angles prominent, posterior angles rounded: elytra very convex, lævigate, impunctate; anterior tibiæ 3-dentate. Head and undersurface black; prothorax black, with wide bluish-green margins; elytra nitid, rich purple on disc, chalybeous towards sides.

Head transverse (5·2 mm. across eyes); front subdepressed: preocular process small, rounded, not prominent; frontal sulci short, deep, hardly divergent backwards: eyes convex, not very prominent. Prothorax transverse (4·5 × 6·6 mm.), convex, strongly declivous to base; a light impression on each side of base: sides subparallel; anterior angles narrow, prominent: basal angles rounded: basal curve short, sinuate on each side of base; basal lobe distinct, narrowly margined; border narrow, hardly more prominent at posterior angles; marginal channel narrow, slightly wider at posterior angles: median line lightly impressed. Elytra oval (10 × 6·8 mm.), evenly rounded on sides; suture deep: base not wide, very strongly declivous to peduncle: border on sides hardly divergent to humeral angles; lateral border narrow, strongly folded over and raised at humeral angles; marginal channel narrow; three or four punctures in a single row at base of each elytron; a row of punctures along lateral margins. Length, 19; breadth, 6·8 mm.

Hab.—Queensland : Cunnamulla (Hardcastle). Type in Coll. Sloane.

I owe my single specimen of this brightly coloured species to the generosity of Mr. A. M. Lea. It most resembles *C. dispar* Macl., but differs by elytra without discal punctures; marginal border and channel of prothorax and elytra narrower; elytra more convex, side-border of base less divergent to the humeral angles; elytra of a beautiful shining blue. From *C. macleayi* Blkb., it differs by head with anterior angles (preocular processes) rounded, not prominent; prothorax much less narrowed anteriorly; elytra narrower, more convex, base narrower, more abrupt, side-borders far less divergent to humeral angles.

Note.—There is no trace of the usual setigerous punctures in the lateral channels of the prothorax in the specimen before me.

CARENUM BLACKBURNI, n.sp.

Oblong-oval, convex, lævigate. Head with one supraorbital puncture on each side; prothorax transverse, anterior angles strongly porrect, posterior angles widely reflexed, obtuse, but marked, base lobate; elytra bipunctate towards apex, humeral angles prominent, anterior tibiæ 3-dentate. Black, polished; marginal channel of prothorax and elytra obscurely violaceous.

Head large (5·2 mm. across eyes), convex on occiput; frontal sulci deep, parallel; median frontal space convex; lateral frontal spaces abruptly declivous externally; clypeus with median part truncate, intermediate angles widely and obtusely triangular; preocular sulcus distinct, short; preocular process small; eyes a little convex, not prominent. Prothorax convex, transverse (4·15 x 7 mm.), about equally wide at posterior and anterior angles; sides subparallel, a little narrowed anteriorly; anterior angles prominent, but obtuse; posterior angles rounded, but marked; base decidedly lobate; border narrow in middle of sides, a little wider anteriorly, wide at posterior angles; median line strongly impressed; one marginal setigerous puncture on each side at posterior angle. Elytra not wider than prothorax (9·3 × 6·9 mm.), convex, lightly rounded on sides; base widely truncate-emarginate, strongly declivous, a few punctures on each side; border reflexed, erect at humeral angles: margin wide, especially on apical curve; a catenulate row of evenly and rather closely placed punctures along sides. Prosternum with intercoxal part wide, lightly concave, two or three punctures on each side. Legs rather light; anterior tibiæ 3-dentate; intermediate tibiæ not dentate at apex on outer side. Length, 18·5; breadth, 7 mm.

Hab.—South Australia: Nullabor Plain. Type in Coll. Sloane.

Two specimens were given to me by Mr. C. French. The position of this species is in the *C. smaragdulum*-group beside *C. interiore* Sl.; it can be readily distinguished from the latter by size smaller; prothorax less quadrangularly transverse, posterior angles more obtuse, far less marked, base much more strongly lobate; elytra with humeral angles far more strongly marked and erect. The position of the posterior marginal setigerous puncture at the posterior angle will in itself differentiate it from *C. emarginatum* Sl., in which this puncture is considerably before the posterior angle.

Carenum virescens Sl., var. viridiventris, n.var.

Robust, convex. Head with one supraorbital puncture on each side. Prothorax transverse (3·8 × 6·6 mm.), rounded at posterior angles, lobate; two marginal punctures on each side. Elytra oval, bipunctate. Anterior tibiæ 3-dentate. Green, nitid; legs, middle of prosternum, metasternum, and abdomen, also anterior parts of head, mandibles, and apical ventral segment black; disc of prothorax more or less atrous. Length, 17·8-20; breadth, 6·8-7·7 mm.

Hab.—W.A.: Cue, Kalgoorlie, Lake Darlot. Type in Coll. Sloane.

This form differs from the typical *C. virescens* by elytra wholly green; ventral segments, excepting apical, viridescent.

Note.—There seems a likelihood that *C. virescens* may itself be only a variety of *C. smaragdulum* Westw.; but, at present, *C. smaragdulum* is unknown to me in nature Its habitat seems to be the Swan River district.

Carenum browni, n.sp.

Elliptical-oval, subdepressed, lævigate. Head large, frontal sulci strongly divergent: prothorax transverse, sides rounded, anterior angles porrect, posterior angles rounded, base bisinuate and widely sublobate, border reflexed, widest at posterior angles, lateral channel wide, 3-punctate; elytra truncate-oval, bipunctate above apical declivity, border wide, thickened at humeral angles, obsolete on base; anterior tibiæ 3-dentate. Black.

Head transverse (7 mm. across eyes), lightly narrowed behind eyes, depressed: frontal sulci rather short, strongly divergent posteriorly; clypeus sloping gently to anterior margin, median part wide, truncate, intermediate angles prominent, triangular: preocular sulcus well marked; eyes convex, prominent. Prothorax transverse (6·3 × 9·3 mm.); margins wide: sides rounded: anterior angles wide, rounded, strongly advanced; posterior angles rounded, subprominent near basal sinuosities: basal curve short, bisinuate, median part wide, lightly rounded between sinuosities; border reflexed on sides, wide at posterior angles, narrow on middle of base: marginal channel wide; median line lightly impressed: three marginal punctures on each side, the posterior puncture a little before posterior angle. Elytra oval, hardly wider than prothorax (14·5 × 9·5 mm), lightly rounded on sides: base wide, lightly emarginate; apical curve wide, even: humeral angles thick, raised, not bordered on inner side; lateral border reflexed, thickened at humeral angles, closing lateral channel by uniting with body of elytra: lateral channel wide: a transverse row of four fine punctures on each side of base; a row of closely placed ocellate punctures along sides. Prosternum wide between coxæ, two or three setigerous punctures on each side: basal declivity wide, abrupt, its outer angles projecting strongly near peduncle. Length, 28; breadth, 9·5 mm.

Hab.—W.A.: Anketell (Brown). Type in Coll. Sloane.

I received this fine species from Mr. H. W. Brown, who discovered it, with other new species, at Anketell, 70 miles south-west of Cue.

It can be compared only with *C. emarginatum* Sl., var. *æqualis* Sl., with which it forms a separate group in the genus *Carenum*, distinguished by having the posterior marginal seta situated considerably before the posterior angle. I cannot compare it with *C. emarginatum* Sl., but from its var. *æqualis* Sl., also found by Mr. Brown at Anketell, it differs by head more narrowed behind eyes, frontal sulci strongly divergent, eyes more prominent; prothorax less convex, less declivous to sides, more widely margined, three marginal setæ on each side; elytra with sides of base not bordered, etc.

Carenum emarginatum Sl., var. æqualis, n.var.

Elliptical-oval, subparallel, lævigate. Head with frontal sulci short, subparallel, one supraorbital seta on each side. Black, prothorax and elytra with a faint purple tinge in lateral channels.

Prothorax transverse (5·4 × 8·6 mm.), lobate, of equal width (6·8 mm.) at base and apex; anterior angles lightly prominent; posterior angles rounded; border widely reflexed, especially at posterior angles; lateral channel wide, bipunctate, the posterior puncture considerably before basal angle. Elytra truncate-oval (14 × 8·75 mm.), bipunctate above apical declivity; humeral angles prominent, obtuse; border reflexed, strongly upturned and folded back at humeral angles, continued along sides of base. Anterior tibiæ 3-dentate; posterior coxæ and trochanters bearing a setigerous puncture. Length, 22-28; breadth, 7·8-10 mm.

Hab.—W.A.: Anketell (Brown). Types in Coll. Sloane.

Closely allied to *C. emarginatum* Sl., the type of which is in Coll. French, at the National Museum, Melbourne, and with which I am not now able to compare it. Judging from the description of *C. emarginatum*, the form found by Mr. Brown at Anketell offers the following evident differences:—form more elongate; elytra not more emarginate than usual in the genus; I believe, too, that the posterior angles of the prothorax are less marked.* The unusual length of the elytra, in proportion to the length of the prothorax, is a striking character of *C. emarginatum* var. *æqualis.*

Note.—At first, I considered var. *æqualis* a distinct species, but having been given a specimen by Mr. H. M. Giles, taken by him on the Strelly River, which has the prothorax with the posterior angles more prominent than in var. *æqualis*, and which is evidently intermediate between the typical form of *C. emarginatum* and var. *æqualis*; I have thought that the form from Anketell may not be truly distinct from *C. emarginatum*; it is, at least, a variety of *C. emarginatum*, which seems to require a name, and being from an exact locality, can always be known, if specimens from Anketell are before one. The specimen from Strelly River is 22 mm. in length.

Carenum nitidipes, n.sp.

Narrow, cylindrical, lævigate. Head large, convex, with long strongly divergent frontal sulci, suborbital antennal scrobes divided longitudinally in middle by a short oblique ridge, two supraorbital punctures on each side; prothorax a little broader than long, widely lobate at base, two marginal setigerous punctures on each side; elytra oval, 4-punctate, inflexed margin narrow behind first ventral segment; anterior tibiæ 2-dentate. Head atrous, viridescent on lateral frontal spaces and occiput, gulæ, basal part of mentum on each side of median tooth brightly viridescent; prothorax atrous, with viridescent tints on disc and wide brassy-green basal and lateral margins; undersurface brightly viridescent with atrous tints, especially on middle and near sides; elytra brassy-green, inflexed margins dark purple, brightly viridescent in middle of wide anterior part; abdomen viridescent; purplish-black in middle (between ambulatorial setæ); mesosternum and metasternum black with side-pieces viridescent (metasternum viridescent laterally between intermediate and posterior coxæ); legs, antennæ, and palpi black;

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* A mistake occurs in the description of *C. emarginatum* where it is written "posterior angles rounded not marked"; this should read "posterior angles rounded *but* marked," from my MS. notes.

posterior coxæ laterally, and bottom of channel of lower sides of femora iridescent.

Head convex (3·5 mm. across eyes), transversely impressed behind frontal spaces; frontal sulci long, divergent backwards, out-turned anterior part lightly impressed; lateral frontal spaces lightly depressed near frontal sulci; clypeus with median part declivous, truncate, intermediate angles narrow, prominent, a punctiform fovea at base of each intermediate angle, the usual clypeal setigerous puncture placed obliquely outward and backward from this fovea; preocular prominences small, prominent, divided from lateral frontal space by a sharply defined preocular sulcus; eyes depressed, deeply set in orbits, these sloping gently to sides of head, not thick or prominent. Labrum short. Prothorax a little wider than head (3 5 x 3·7 mm.), convex, shortly and rather strongly declivous to base, subparallel (hardly rounded) on sides; basal curve short, rounded on each side, strongly sinuate on each side of basal lobe; apex truncate between anterior angles; border narrow, reflexed, wider and prominent at anterior angles (these obtuse). Elytra oval (6·8 x 3·8 mm.), convex; base truncate, lightly subemarginate at suture, deeply declivous to peduncle: apex strongly declivous, rounded; suture strongly impressed; border narrow, folded back and prominent at humeral angles; four punctures on each side of base (three near humeral angle on a depressed space, the fourth larger, placed half-way between the suture and the three humeral punctures); a row of rather closely placed punctures along lateral margins. Intercoxal part of prosternum narrow posteriorly, with a setigerous puncture on each side of base near middle. Ventral segments 3-5 with a puncture on each side of middle, apical segment with upturned edge foveate on each side. Anterior femora wide, compressed, lower side sinuate before apex; intermediate tibiæ stout, incrassate, with an apical spur externally; posterior coxæ and trochanters each with a setigerous puncture. Length, 13·5; breadth, 3·8 mm.

Hab.—Port Darwin (Dodd). Type in Coll. Sloane.

This species belongs to the *C. quadripunctatum*-group, its affinity being towards *C. digglesi* Macl., which it resembles generally in size and appearance; but from which it differs notably by its brighter colouring (*C. digglesi* having the upper surface of the head merely showing some obscure purple reflections, mentum wholly black, gulæ purple; under-parts of prothorax, inflexed part of elytra, and ventral segments obscurely purple; mesosternum and metasternum wholly black): head larger, with preocular sulcus far more strongly marked, eyes more depressed, labial palpi far less securiform, median tooth of mentum longer, narrower, and more strongly keeled; prothorax shorter (in *C. digglesi*, 3·8 × 3·8 mm.), anterior angles advanced (in *C. digglesi*, not the least advanced); elytra with inflexed margins wider anteriorly; anterior femora narrower, much less strongly sinuate before apex on lower side, etc. Compared with *C. quadripunctatum* Macl., the palpi are similar, but have the apical joint of the labial less securiform; antennæ shorter, basal joint shorter, joints 6-11 shorter, more moniliform, less pubescent. This is the only Carenum known to me, which shows any bright colouring on the legs.

Carenum montanum, n.sp.

Narrow, subcylindrical. Head with frontal sulci long, subparallel, two supraorbital punctures on each side; prothorax with anterior angles obtuse, not the least advanced, two marginal setigerous punctures on each side; elytra subdepressed on disc, 4-punctate, a punctate fovea on base near each humeral angle; anterior tibiæ 2-dentate. Head black, violaceous beneath and behind eyes; prothorax black, with metallic tinge towards sides, particularly near posterior angles; elytra nitid, greenish-metallic, with chalybeous reflections; prosternum and abdomen violaceous.

Head large (3·65 mm. across eyes), convex, transversely impressed behind vertex; frontal sulci long, hardly divergent backwards, united at posterior extremities by a light curved impression; clypeus trisinuate behind labrum, intermediate angles prominent; preocular sulcus obsolete; eyes convex, prominent, strongly enclosed behind, more prominent than postocular part of orbits, these rather prominent. Prothorax hardly as long as broad (3·8 × 4 mm.), lightly convex; sides subparallel, a little rounded to apex, rounded at posterior angles; basal curve short, subsinuate on each side; basal lobe short, wide, rounded, defined by a strong transverse impression on each side; border narrow, equal; marginal channel narrow, shortly but distinctly recurved at anterior angles; an impression on each side before basal lobe. Elytra subcylindrical, widely depressed on disc, parallel-oval (7·3 × 4 mm.); a strongly impressed discal puncture on basal fourth and apical third of each elytron; border thick, narrow, a little upturned and folded over at humeral angles; lateral channel well developed, seriate-punctate, the punctures wide apart, except towards base and apex; intra-humeral fovea of base 4-punctate. Anterior tibiæ bidentate; intermediate tibiæ wide at apex, external apical spur hardly developed; posterior trochanters impunctate. Length, 14·3; breadth, 4 mm.

Hab.—N.S.W.: Ben Lomond. Type in Coll. Sloane. A single specimen occurred to me under a log, near the Ben Lomond railway-station (4500 feet), in December.

Allied to *C. tinctillatum* Newm., but differing by colour, elytra 4-punctate, etc.; in these respects it resembles *C. digglesi* Macl., but I cannot regard it as conspecific with that species. Comparing it with a small specimen of *C. digglesi* from Brisbane, I note the following differences: frontal sulci less strongly divergent, tooth of mentum narrower and more pointed; prothorax less convex, strongly impressed on each side of base; elytra much less convex, lateral channel well developed, and with its punctures more distant from one another, basal punctures placed in a well marked fovea beside each humeral angle; posterior trochanters impunctate; intermediate tibiæ wider at apex; external apical tooth feeble, far less developed.

Carenum longulum, n.sp.

Elongate, parallel. Head with frontal impressions long, lightly divergent, suborbital scrobes to receive antennæ short, single, two supraorbital setæ on each side; prothorax parallel on sides, widely lobate at base, anterior angles prominent, two marginal punctures on each side; elytra hardly wider than prothorax, depressed on disc, 4-punctate, humeral angles obtusely dentate, inflexed margins of elytra narrow: anterior tibiæ 2-dentate. Head atro-viridescent: pronotum bright green with slightly cupreous tints towards sides, atrous in middle near anterior margin; elytra golden-green, disc purple-black near suture; pro-episterna with viridescent tints; body black, nitid, with faint viridescent tints on sides of ventral segments: legs piceous-black.

Head large (4 mm. across eyes), convex, declivous to anterior margin, transversely impressed across occiput: frontal sulci long, deep, divergent. frontal spaces convex, middle space filling all the interval between posterior extremities of frontal sulci: clypeus with median part obsoletely 3-sinuate; intermediate angles short, obtuse; eyes deeply enclosed in orbits, not prominent: suborbital channel short, wide, concave, not divided by a longitudinal ridge; submentum strongly raised from gulæ; foveate on each side behind genæ. Prothorax a little wider than head (4·1 × 4·5 mm.), convex, strongly declivous to posterior angles; basal area defined by a transverse impression; sides parallel, rounded at posterior angles, sinuate on each side of base; anterior margin truncate; anterior angles slightly prominent; border narrow, thickened across basal lobe. Elytra of about same width as prothorax (8·7 × 4·6 mm.), subparallel on sides; base truncate, vertical above peduncle, punctate; disc depressed; sides strongly and roundly declivous: border narrow, thickened towards apex, upturned in a short subdentiform prominence at humeral angles; a closely placed row of punctures along sides. Ventral segments 3-5 bipunctate: reflexed border of apical ventral segment not foveolate on each side. Legs long; anterior femora compressed; anterior tibiæ strongly 2-dentate, apical plate without a dentiform process below tarsus: intermediate tibiæ with a short triangular external spur at apex: posterior legs long, light; posterior trochanters narrowed to apex, bearing a setigerous puncture. Length, 16·5: breadth, 4·6 mm.

Hab.—Northern Territory: Darwin (Spencer). Type in National Museum, Melbourne.

Resembles *C. digglesi* Macl., in facies, but differs, apart from colour, by orbits more developed behind eyes, suborbital scrobes not divided by an oblique ridge, palpi more securiform, especially maxillary; prothorax more declivous to posterior angles, anterior angles more prominent; elytra with disc depressed on each side of suture, punctures along sides more closely placed.

Var. ATROVIRIDIS, n.var. Colour not so bright as typical form; prothorax and elytra widely margined with green, having no golden tint; anterior angles of head less prominent: elytra not depressed along suture.

Hab.—Queensland: Chillagoe District (Dodd). Type in Coll. Sloane.

Specimens taken by Mr. F. P. Dodd differ considerably from the type of *C. longulum* as noted above, but do not seem more than a variety of that species.

Note.—There is a species of *Carenum* in my collection from North Queensland (my specimens are from Normanton, Atherton, and Herberton) which I have ticketed as "*C. digglesi* Macl., var. *tropicum*"; it resembles *C. longulum* var. *atroviridis* so closely in shape and colour, that it is hard to separate them, but differs by having the subocular scrobes divided by an oblique longitudinal ridge; the lateral channel of prothorax shortly but decidedly recurved at anterior angles; legs shorter (especially posterior tarsi); palps less widely securiform. It is possible this may prove to be conspecific with *C. angustipenne* Macl., but this could be determined only by comparison with the type of that species, to which I have not access at present.

Carenum eximium, n.sp.

Narrow, cylindrical. Head with frontal sulci long, divergent, labrum emarginate; prothorax as long as broad, parallel on sides, posterior angles rounded, sinuate on each side of wide basal lobe; elytra convex, impunctate, border folded over and raised at humeral angles; anterior tibiæ 2-dentate. Black; elytra coppery-green, centre of disc atrous

Head large, convex (3·2 mm. across eyes), feebly transversely impressed behind vertex; frontal sulci long, divergent, extending backwards to opposite postocular part of orbits; clypeus narrow, intermediate angles short, obtuse, median part emarginate; preocular sulcus obsolete; eyes convex, rather prominent; postocular part of orbits small but sharply protuberant; two supraorbital punctures on each side; suborbital scrobe narrow and close to gena, an oblique ridge forming its external margin. Labrum short, emarginate, six equally placed setæ along its anterior margin. Prothorax convex (3·4 × 3·4 mm.), not declivous to base in middle; sides subparallel, rounded to apex, rounded at posterior angles, strongly but widely sinuate before base; apex truncate; anterior angles obtuse, not marked; basal lobe wide, defined by a strong transverse impression on each side; border narrow, equal; marginal channel shortly but distinctly recurved at apex; median line strongly impressed, a marginal setigerous puncture on each side of posterior angle.* Elytra oval (6·5 × 3·5 mm.); suture lightly impressed; border thick, narrow; lateral channel narrow, not altogether closed and divided from basal punctate impression by humeral angle of border; base with a light oblique transverse impression on each side, these impressions with a double row of punctures (four punctures in lower row); a row of punctures along lateral channel, these punctures wide apart in middle. Ventral segments convex, 3-6 bipunctate, sixth with a fovea on each side of apex on upturned margin above inner apical seta. Posterior trochanters oval, obtuse, impunctate. Anterior tibiæ 2-dentate; intermediate tibiæ wide at apex, a very small external spur at apex. Length, 13·5; breadth, 3·5 mm.

Hab.—Australia. Type in Coll. Sloane. I obtained this species among the duplicates of the Van de Poll collection, where it was ticketed as from the Richmond River, N.S.W.

Very distinct in the genus *Carenum*, and a puzzling species to place in its true position; the emarginate labrum and clypeus show an affinity to *Carenidium frenchi* Sl., but no species has yet been admitted into the genus *Carenidium* which has the

* The usual anterior marginal setigerous puncture is not present in my unique specimen.

shoulders of the elytra angulate. The small, upturned protuberance at the humeral angle of the elytra in *C. eximium* is wholly a process of the border, and is not attached to the elytra to close the lateral channel, as is usually the case in *Carenum.* In facies, *C. eximium* resembles *C. tinctillatum* Newm., but, from that and other allied species, it differs by labrum emarginate, clypeus not with two small tubercles behind labrum; prothorax more gently narrowed to base, basal curve not so short; elytra impunctate; from *C. splendidum* Macl., it differs in many ways, *e.g.*, labrum emarginate; elytra more convex, pluripunctate on base, etc.

NEOCARENUM DINGO, n.sp.

Elongate, cylindrical. Antennæ short, moniliform; prothorax subparallel, base wide, arcuate, an antebasal sinuosity on each side, two marginal setigerous punctures on each side; elytra emarginate at base, humeral angles prominent, each elytron 4-punctate on apical third*; anterior tibiæ 2-dentate. Piceous-black.

Head moderate (4·5 mm. across eyes), convex, lightly impressed across occiput; frontal sulci divergent backwards, curved anteriorly; preocular sulcus well marked, acute; preocular process subprominent, clypeus declivous, truncate behind labrum, intermediate angles prominent, a fovea on each side on inner side of base of intermediate angles; eyes not prominent; orbits small, two supraorbital punctures (close together) on each side. Prothorax hardly longer than broad (5·2 × 5·1 mm.), not declivous behind; sides lightly rounded at basal angles; apex truncate; basal curve lightly sinuate on each side; border very narrow, median line fine. Elytra convex, hardly wider than prothorax (12 × 5·2 mm.), slightly narrowed to base; disc not depressed; base emarginate, strongly declivous, two punctures on each side; border narrow; marginal channel distinct, seriate-punctate.

* My unique specimen has, besides the four punctures towards the apex of the elytra, one on the disc of the right elytron towards the base; probably it will be found that there is normally a puncture near the base on each elytron.

Anterior femora wide, lower side protuberant, and with an ante-apical emargination; anterior tibiæ with two long teeth and a small tubercle externally; intermediate tibiæ slender, with a sharp external apical spur; posterior coxæ and trochanters impunctate. Length, 22; breadth, 5·2 mm.

Allied to *N. rugulosum* Macl., with the type of which I have compared it, but differing by the clypeus declivous, and with a lateral fovea on each side; prothorax less transverse, less rounded on sides, especially behind anterior angles; elytra similarly emarginate at base, but with shoulders more sharply marked, each elytron 2-punctate towards apex; anterior tibiæ with a small denticle above two large teeth. It somewhat resembles *N. elongatum* Macl., but is very distinct by small size, lighter form; eyes much less prominent; prothorax longer, more strongly sinuate on each side of base; elytra more deeply emarginate at base, humeral angles less strongly dentate, etc. From *N. angustatum* Sl., it differs by small size, more cylindrical form; clypeus not trisinuate, etc.

Carenidium atrum, n.sp.

Robust, elongate, convex. Labrum lightly emarginate; prothorax cordate, convex, shortly lobate; elytra narrow, convex, impunctate, bimucronate at apex; anterior tibiæ 2-dentate. Black.

Head large (6·7 mm. across eyes), smooth, convex; frontal sulci long, deep, divergent; clypeus with median part strongly declivous, very lightly emarginate, intermediate angles subprominent, obtuse; eyes prominent, deeply enclosed in orbits posteriorly; two supraorbital punctures on each side. Prothorax broader than long (6·5 x 7·7 mm.), declivous to base; sides roundly curved, decidedly narrowed to apex, shortly and lightly sinuate on each side of base; apex emarginate; anterior angles subprominent, obtuse; base rounded; border narrow, thick, subequal, hardly reflexed, obsolescent on basal lobe; basal area well defined, lateral channel very narrow, impunctate. Elytra a little narrower than prothorax (15 x 7·3 mm.), convex, widest about middle, rounded on sides; base emarginate, deeply declivous; apical mucro of each elytron thick, conical, a little upturned, points distant from apical margin; border narrow, thickened posteriorly; four punctures in a single row on base of each elytron. Posterior coxæ and trochanters, and ventral segments impunctate. Length, 29; breadth, 7·3 mm.

Hab.—W.A.: Anketell (Brown). Type in Coll. Sloane.

A thoroughly distinct species, characterised by its elongate, but robust, convex form, black colour, and mucronate elytra. The short, thick, pointed mucrones, distant from the apical margin, seem to indicate that the type-specimen is the ♂; I should expect the ♀ to have narrower and more pointed mucrones placed near the apical margin, as is the case with *C. leai* Sl.

Carenidium bifurcum, n.sp.

Elongate, depressed, lævigate. Head with two supraorbital punctures on each side, labrum deeply emarginate; prothorax strongly lobed, two marginal punctures on each side; elytra narrow, impunctate, two elongate sharp horns at apex, disc flattened, slightly concave towards base, border not dentate at humeral angles; anterior tibiæ 2-dentate. Black; prothorax and elytra widely margined with green, inflexed margins of elytra green inwardly.

Head smooth, large (6·4 mm. across eyes), sub-depressed; mandibles with upper surface flattened towards base; frontal sulci long, deep, diverging backwards; clypeus with median part widely arcuate emarginate, intermediate angles prominent; preocular process narrow; preocular sulcus well marked; eyes prominent, convex, enclosed behind, postocular parts of orbits not as prominent as eyes, strongly and obliquely narrowed behind. Prothorax broader than long (5·7 × 7·3 mm.), widest just before posterior marginal seta, sub-depressed, hardly declivous to basal area in middle, strongly rounded at posterior angles, strongly sinuate on each side of basal lobe (this more developed than usual); anterior margin truncate; anterior angles lightly advanced, widely obtuse; border wide (particularly behind anterior and posterior angles); median line strongly impressed; basal area defined by a strong transverse impression. Elytra narrower than prothorax (12·7 × 6·6 mm.), widest about basal fourth; disc lightly concave between fifth interstice of each elytron, edge of this depressed area sharply defined (almost subcarinate towards base); sides strongly and subobliquely declivous from edge of discal area; lateral channel wide (particularly near beginning of apical curve); border narrow; a row of small, separate punctures along sides; two or three punctures on basal declivity of each elytron; inflexed margins wide anteriorly, gradually narrowed backwards; apical mucrones long (1·5 mm.), sharply pointed, distant from one another. Intercoxal part of prosternum with a setigerous puncture on each side; basal declivity abrupt. Legs light; four posterior coxæ impunctate; posterior trochanters impunctate, narrowed, but obtuse, at apex; posterior femur with a setigerous puncture a short distance from apex of trochanter. Length, 25·5; breadth, 6·6 mm.

Hab.—Western Australia. Type in Coll. Sloane. I do not know the exact locality of the type-specimen, which I received from Mr. French; but two specimens were given to me by Mr. H. M. Giles, ticketed "Mundaring, Giles," which, though not so brightly coloured, are evidently conspecific.

It belongs to the *C. mucronatum*-group, and is closely allied to *C. leai* Sl. It differs from *C. mucronatum* Macl., (also from the other two species of the group) by eyes more prominent; prothorax with basal sinuosities stronger, basal lobe more developed; elytra with apical mucrones developed into elongate horns. It also differs decidedly from *C. mucronatum* by the depressed and slightly concave, discal area of the elytra, which is sharply defined by the fifth interstice becoming subcarinate. It differs from *C. leai* [from comparison with a specimen (♂) in my possession from Onslow, W.A] by prothorax with border wider, particularly near anterior angle, a flat depression near each anterior angle; elytra with flattened discal area quite black, apex with two long single sharp horn-like mucrones (not with short mucrones, above each of which is a strong obtuse tubercle). From the description of *C. longipenne* Sl., it differs by its wider and less elongate form; prothorax more transverse, with border wider, posterior angles evidently less rounded off; elytra more depressed, the depressed area more sharply defined, apical mucrones more strongly developed.

Carenidium pertenue, n.sp.

Very long, parallel, cylindrical, disc of elytra depressed. Elytra impunctate, inflexed margins very narrow. Head and under-surface black; prothorax black, with bluish-green margins; elytra violaceous, with viridescent reflections along sides.

Head large, as long as broad (4·2 x 4·2 mm.), convex, lightly narrowed behind eyes; frontal sulci long, narrow, deep, diverging lightly backwards; mandibles stout, right with upper margin arcuate; labrum emarginate; intermediate angles of clypeus short, prominent, triangular; preocular sulcus wide, shallow; eyes deeply set in orbits, depressed; postocular part of orbits as long as eye, not prominent, gently raised from neck; two supra-orbital punctures on each side. Prothorax not wider than head, longer than broad (4·6 x 4·15 mm.), not declivous to base; a wide lightly depressed marginal channel across base; sides parallel, widely rounded at posterior angles, shortly sinuate before base, apex truncate; border very narrow, slightly advanced at anterior angles, thick on base; median line finely marked. Elytra more than twice as long as broad (11 x 4·3 mm.), parallel on sides, declivous to peduncle; apex obtusely pointed; border very narrow, not dentate at shoulders; a few punctures on each side of base. Anterior tibiæ 2-dentate. Length, 21; breadth, 4·3mm.

Hab.—W.A.: Cue (Brown). Type in Coll. Sloane.

This is proportionally the most slender Carenum known, being narrower in proportion to its length than any of the species of *Teratidium*. It is allied to *C. frenchi* Sl., from which it differs, apart from colour, by head longer, with eyes and orbits less prominent; prothorax longer, more parallel; elytra longer, more depressed on disc.

Carenidium frenchi, n.sp.

♂. Long, narrow, cylindrical. Head very large, mandibles very stout, right mandible with upper edge strongly raised into an obtuse prominence near base, labrum and clypeus (in middle) lightly emarginate, narrowed to base; elytra elongate-oval, disc impunctate,* humeral angles not dentate, inflexed margins narrow behind first ventral segment; anterior tibiæ 2-dentate. Head black, becoming green above, behind and below eyes and in posterior part of frontal sulci; prothorax black, pronotum widely margined with green, the green margins confluent behind, but the basal margin of the lobe black; elytra (including inflexed margins) green, blackish in middle of disc; body, abdomen, legs, and antennæ black.

Head as wide as prothorax (4·35 mm. across eyes), convex, roundly declivous to anterior margin and above eyes, gently narrowed behind eyes; frontal sulci long, narrow, deep, diverging lightly backwards; out-turned anterior part of their course obsolete; clypeus strongly declivous in middle, median part lightly emarginate, intermediate angles strongly developed, prominent, triangular; preocular sulcus wide, shallow; eyes deeply set in orbits, not prominent; postocular part of orbits large, rising roundly and obliquely from head; three supraorbital setæ on each side. Prothorax hardly broader than long (4·25 × 4·35 mm.), not declivous to base in middle; sides parallel, widely rounded at posterior angles, feebly sinuate on each side of base; anterior margin truncate; border narrow, prominent, but hardly advanced on anterior angles, thick on base, median line finely marked; a lightly marked wide depression on each side of base. Elytra narrow (9·6 × 4·35 mm.), subparallel on sides, strongly declivous to peduncle, shortly and strongly declivous at apex, depressed on disc along suture; apical curve short; border narrow, a little raised in a wide curve (but without any dentiform prominence) at shoulders; four or five punctures in a slight wide depression near each humeral angle; a marginal row of punctures on each elytron. Ventral segments 3-5 with two ambulatorial setæ; apical segment with four setigerous punctures, and with a

* This refers to the discal, setigerous punctures so frequently found on the elytra among the Carenides (e.g., *Carenidium riverinæ* Macl.). The specimen before me shows rows of distinct punctures on the elytra, and their surface is covered with minute punctures; but the presence of all these punctures I consider a *post mortem* effect caused by long immersion in alcohol.

punctiform fovea on upturned edge of segment, just above each posterior setigerous puncture. Anterior femora without a subapical seta on posterior face; posterior coxa with a setigerous puncture; posterior trochanters impunctate. Length, 19·5; breadth, 4·35 mm.

Hab.—Northern Territory: Katherine River. Coll. French (unique). The type is now in the National Museum, Melbourne. Mr. F. P. Dodd afterwards sent me a specimen (♀) from Port Darwin.

In facies, this remarkable species resembles a species of Teratidium, but is at once distinguished from that genus by having the anterior tibiæ bidentate. It is allied to *C. aberrans* Sl., from which it differs by ♂ with head larger, less strongly narrowed behind eyes, posterior parts of orbits and eyes less prominent, paragenæ much more developed, right mandible with upper side near base raised into a strong wide prominence, labrum and median part of clypeus emarginate; prothorax shorter, border narrower, less advanced at anterior angles, lateral marginal channel not forming a sulciform gutter and without any marginal setæ; elytra more widely rounded at apex, etc.

Teratidium robustum, n.sp.

Elongate, convex, lævigate. Head as wide as prothorax, eyes protuberant, frontal sulci long, deep; prothorax as broad as long, widest before middle, rounded on sides; elytra elongate-oval, impunctate; anterior tibiæ unidentate at apex. Black, nitid.

Head large (5 mm. across eyes), convex, roundly declivous to anterior margin, strongly declivous to eyes; clypeus trisinuate behind labrum, intermediate angles short, obtuse; three setigerous supraorbital punctures on each side placed very close together near posterior margin of eye; eyes deeply set in orbits, convex, prominent; orbits narrow behind eyes, rising sharply but roundly from neck; submentum plurisetose on each side. Prothorax of same width as head with eyes (5 × 5 mm.), strongly angustate to base; disc subdepressed; sides lightly rounded; posterior angles not marked; basal curve strongly sinuate on each side; base forming a wide rounded lobe; anterior margin truncate; anterior angles distant from neck, marked, obtuse; border narrow (narrowed at basal sinuosities), thickened at anterior angles; marginal channel narrow, 5-punctate; median line fine; basal area defined by a light transverse impression; a shallow wide impression on each side near basal sinuosities. Elytra a little wider than prothorax (11 x 5·3 mm.), convex, widest about middle, strongly declivous to sides and apex ; suture deeply impressed; base lightly emarginate, abruptly declivous, pluripunctate (9 punctures) on each side in an irregular depression; border thick, rounded at humeral angles (not folded back or dentate). Ventral segments impunctate, except at apex. Anterior femora wide at union with coxæ; intermediate coxæ, posterior coxæ, and trochanters without setigerous punctures. Length, 21; breadth, 5·3 mm.

Hab.—Queensland : Kuranda (Dodd). Type in Coll. Sloane (unique).

This is the species referred to as *T. grandiceps* Chaud., in the table of species I have given in these Proceedings, 1905, p.131; but having recently obtained a species ticketed "Queensland," which agrees closely with Chaudoir's description of his *Monocentrum grandiceps*, I can see that my former identification was erroneous, and that the Kuranda species is undescribed.

Note.—*T. grandiceps* Chaud., as now identified by me, differs from *T. robustum* by its narrow, parallel form; less ampliate head, eyes much less prominent, the spaces on each side between the frontal sulci and eyes wider posteriorly and more abruptly declivous to eyes; prothorax narrower, longer, more cylindrical, parallel on sides, lateral border narrower, anterior angles less wide and prominent, two marginal setigerous punctures on each side; elytra narrower, not wider than prothorax, more parallel. Length, 20·5; head, 4·5 across eyes; prothorax, 5·3 x 4·5; elytra, 10 x 4·4 mm.

Teratidium procerum, n.sp.

Narrow, elongate, subcylindrical. Head as in *T. laticeps* Sl., but clypeus decidedly trisinuate, intermediate angles more prominent, orbits less prominent, less strongly raised from head;

prothorax subdepressed on disc, lightly angustate to the wide base; elytra long, depressed on disc, impunctate; anterior tibiæ unidentate. Head, antennæ, legs, and undersurface black; prothorax black, with a purplish tinge towards sides, viridescent in marginal channel; elytra viridescent, with violaceous reflections.

Head large, convex (5 mm. across eyes), lævigate; anterior angles rounded, almost as prominent as eyes; frontal sulci obsolescent, only indicated and linear on each side of clypeus; clypeus quadridentate, outer teeth (at each side of labrum) prominent, sharply triangular, inner teeth similar, but less developed; orbits rather small, rising in a gentle curve from head and enclosing eyes at base; eyes deeply set in orbits, subprominent, not more prominent than orbits; two supraorbital punctures close together on each side. Prothorax as wide as head, longer than broad (6 × 5 mm.); disc a little depressed, not declivous to base in middle; apex truncate; anterior angles not prominent; sides parallel, gently narrowed to base; posterior angles obsolete; basal angles obtuse; border narrow, thicker at basal angles, lightly sinuate opposite transverse basal impression, this impression well marked; marginal channel narrow, bearing two setigerous punctures as usual in the Carenides (posterior at place of posterior angle); median line lightly impressed; basal area well defined by a transverse impression. Elytra elongate (12·5 × 5·2 mm.), widest about middle, strongly declivous on sides and apex; disc a little depressed along suture; base rather strongly emarginate; a raised, rounded, oblique, basal ridge extending inwards from humeral angle for three-fourth the width of each elytron; a deep punctate furrow behind this basal ridge; apical curve of elytra wide, apex itself projecting beyond lateral border in a short triangular obtuse prominence; lateral border narrow towards base, very thick on apical third, strongly and widely upturned at shoulder. Ventral segments, posterior coxæ, and posterior trochanters impunctate. Anterior femora narrow, anterior tibiæ wide, unidentate at apex. Length, 23; breadth, 5·2 mm.

Hab.—Western Australia: Anketell (Brown). Type in Coll. Sloane.

One of the most remarkable species found by Mr. H. W. Brown at Anketell, about 80 miles S.W. from Cue, and one of the richest localities known for Carenides. In the genus *Teratidium*, it is thoroughly distinct; taking the table of the genus which I have given in these Proceedings (1905, p.131), its position would be beside *T. laticeps* Sl., (found by Mr. Brown at Cue) from which it differs decidedly (apart from colour) by size larger; clypeus quadridentate, orbits smaller in comparison with eyes and projecting much less sharply from head; prothorax more elongate, wider at base, far less strongly angustate to base; elytra with border more strongly upturned at humeral angles, basal ridges much more developed, basal furrows deeper, longer, etc.

ORDINARY MONTHLY MEETING.

October 25th, 1916.

Mr. A. G. Hamilton, 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, 1917, from qualified Candidates. Applications should be lodged with the Secretary, who would afford all necessary information to intending Candidates, not later than 30th November, 1916.

The President expressed the regret of Members on hearing of the accident to Major David while serving with the troops in France.

A letter from Mr. G. H. Aurousseau, of Cremorne, was read, by request furnishing information about Lieutenant Marcel Aurousseau, a Member of the Society, who had been wounded in France, and who had been awarded the Military Cross.

The President offered the cordial congratulations of Members to Mr. C. Hedley, F.L.S., on the award of the Syme Prize for 1916, by the University of Melbourne.

The President, with regret, formally announced the decease of Mr. Edgar A. Smith, I.S.O., the Society's senior Corresponding Member, on July 22nd, 1916.

The Donations and Exchanges received since the previous Monthly Meeting (27th September, 1916), amounting to 2 Vols., 69 Parts or Nos., 5 Bulletins, one Report, and 7 Pamphlets, received from 42 Societies, etc., and two private donors, were laid upon the table.

NOTES AND EXHIBITS.

Mr. A. H. S. Lucas showed evidence of Japanese botanical activity in the Caroline Islands.

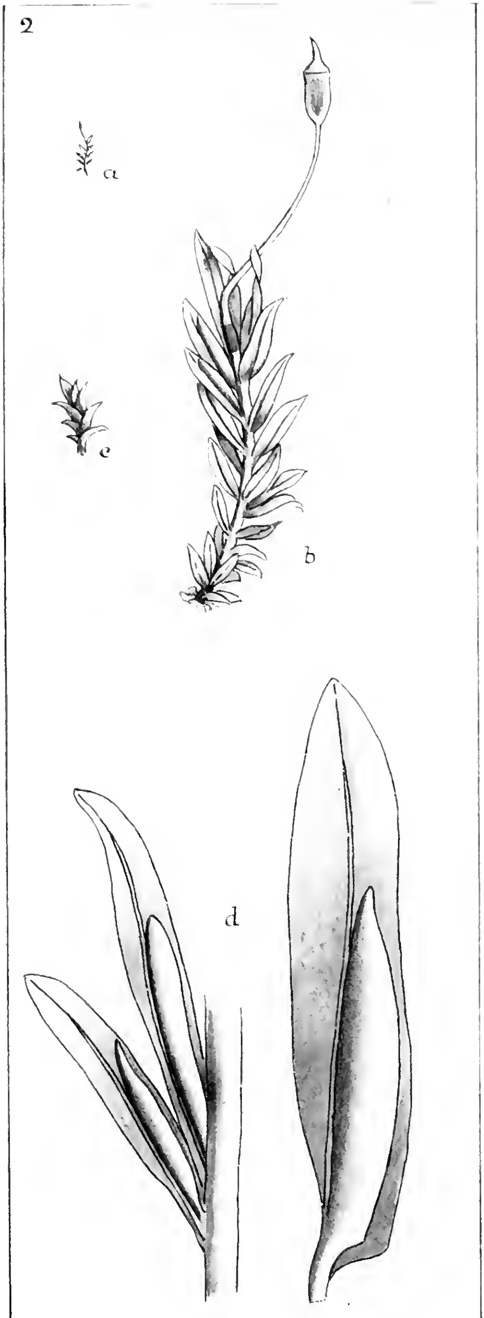
Mr. Turner said that he had recently seen three abnormal heads of flowers of the Waratah (*Telopea speciosissima* R.Br.) on a plant growing in a garden at Chatswood, in which the involucral bracts and flowers were normal, but there was present an intermediate whorl of green leaf-like structures. He remarked also that he had collected *T. oreades* F.v.M., at Fitzroy Falls, and asked if this species was known from any locality still further to the north.

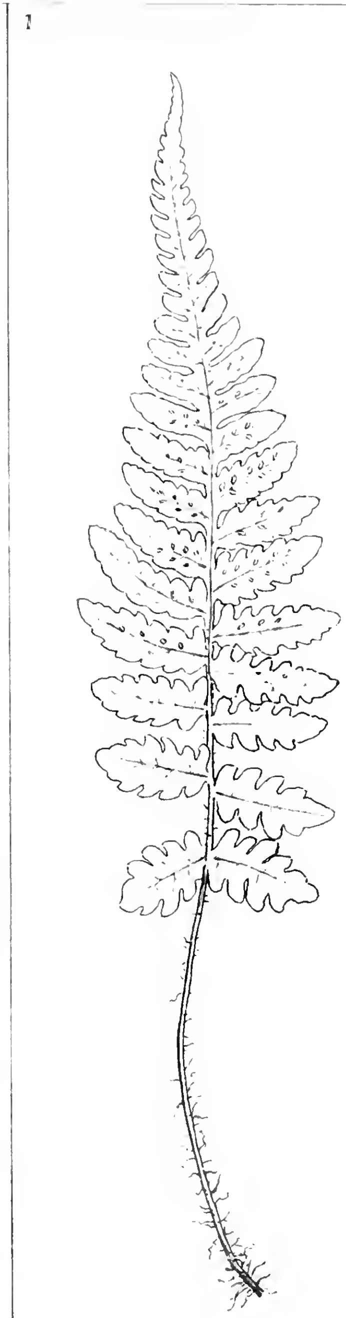
Mr. A. S. Le Souëf exhibited a broken tusk of a male elephant, fourteen years old, now in the Taronga Park Zoological Gardens. The tusks of this animal were abnormally long for their girth. The exhibit weighed 14 lbs.

Mr. Tillyard showed specimens representing five new species of *Perlidæ*, reared from larvæ recently collected by him at Orange, N.S.W., and two from Stanwell Park. Also the larva of a Buffalo-gnat (*Simulium*, n.sp.) from the former locality.

Mr. Cheel exhibited specimens of three species of "Evening Primrose". (1) *Œnothera odorata* Jacq., a native of Chile, figured in Bot. Mag. tab. 2403, is very common throughout the State, but has evidently been mistaken for *Œ. biennis* L., hence the record in Moore and Betche's Handbook of the Flora of N. S. Wales, p.523. Specimens of *Œ. odorata* have been collected by the exhibitor from Hill Top, Southern Line, and from Woy Woy, Northern Line. In the National Herbarium, there are also specimens from the Hawkesbury Agricultural College, Richmond; Emu Plains, Bega, Blackheath, Jenolan Caves, Orange, Wagga, Wallenbeen, Cootamundra, Bathurst, and Barber's Creek. Also from Claremont, W.A.; and Murray Bridge, S.A. It is interesting to note that it is listed in Mr. J. M. Black's Naturalised Flora of S.A. (1909), 63, but has not previously been recorded

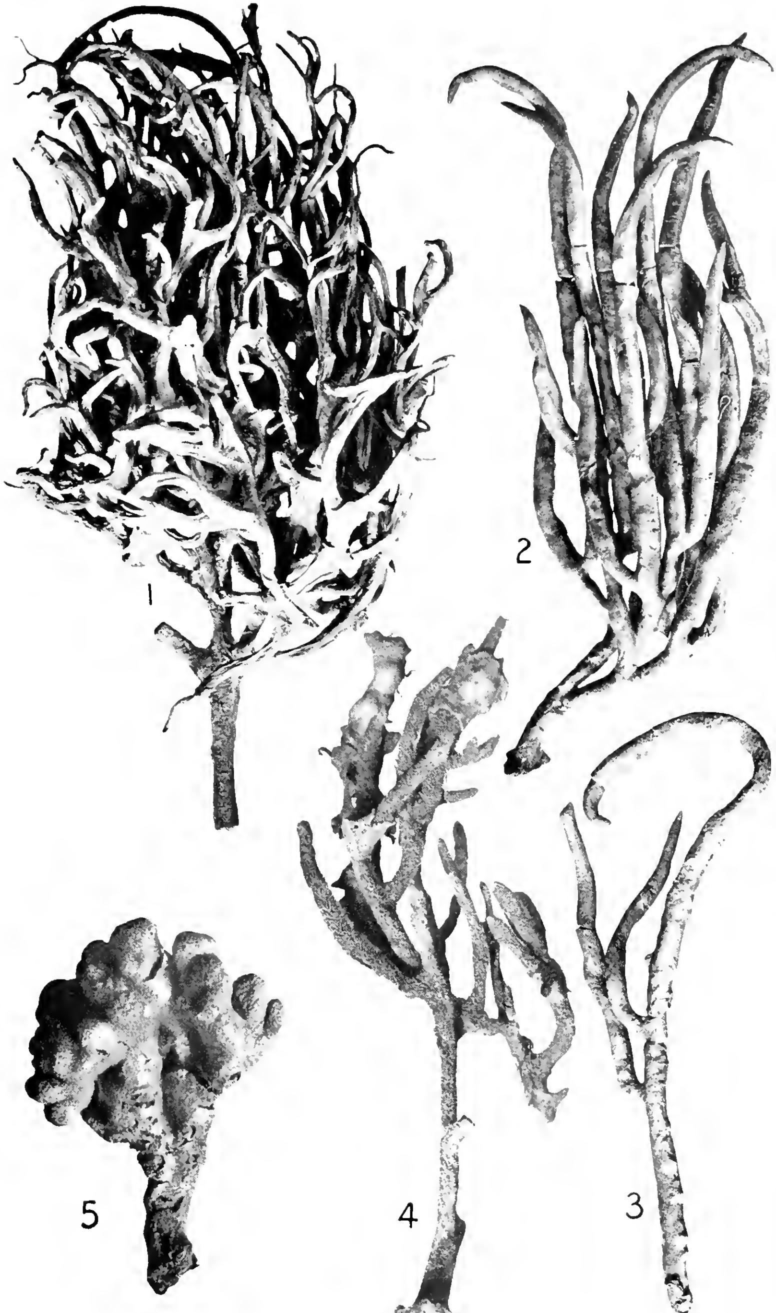
[Printed off 5th December, 1916.]



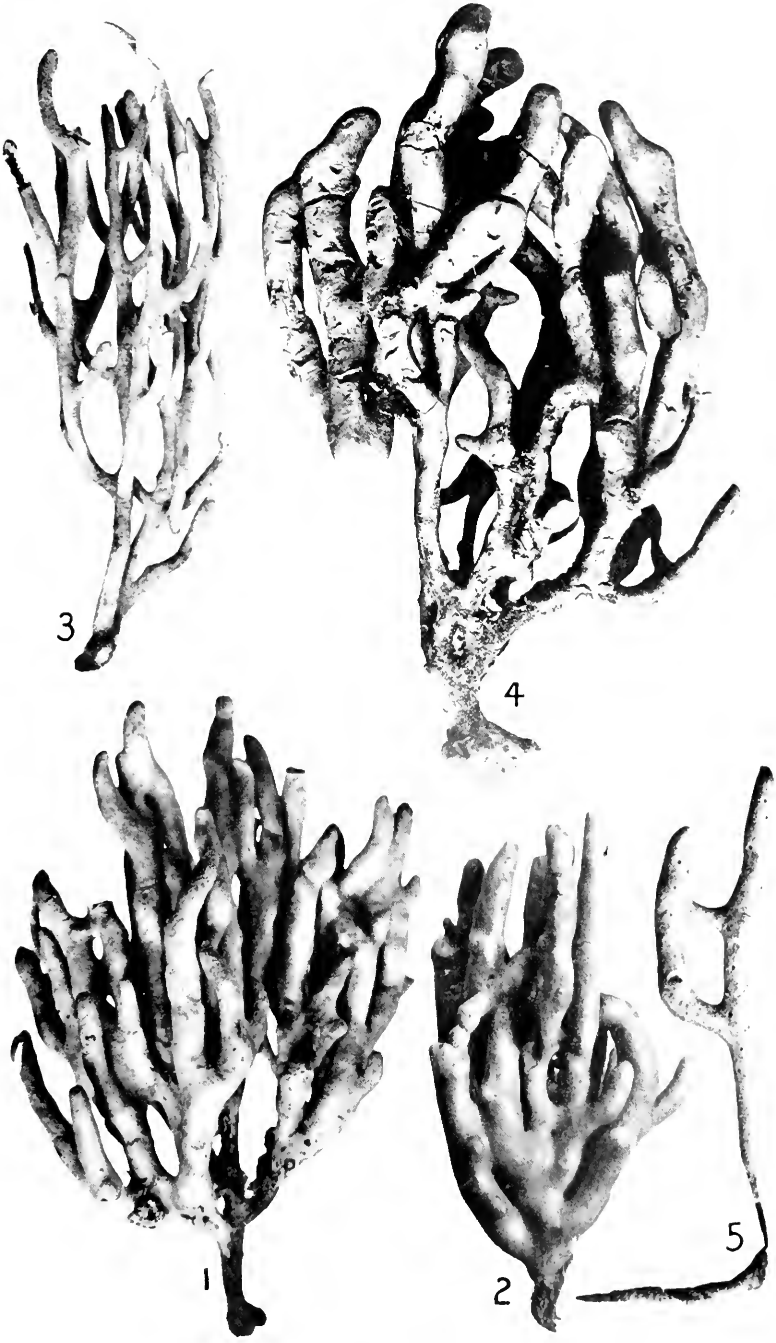


M. Flockton del.

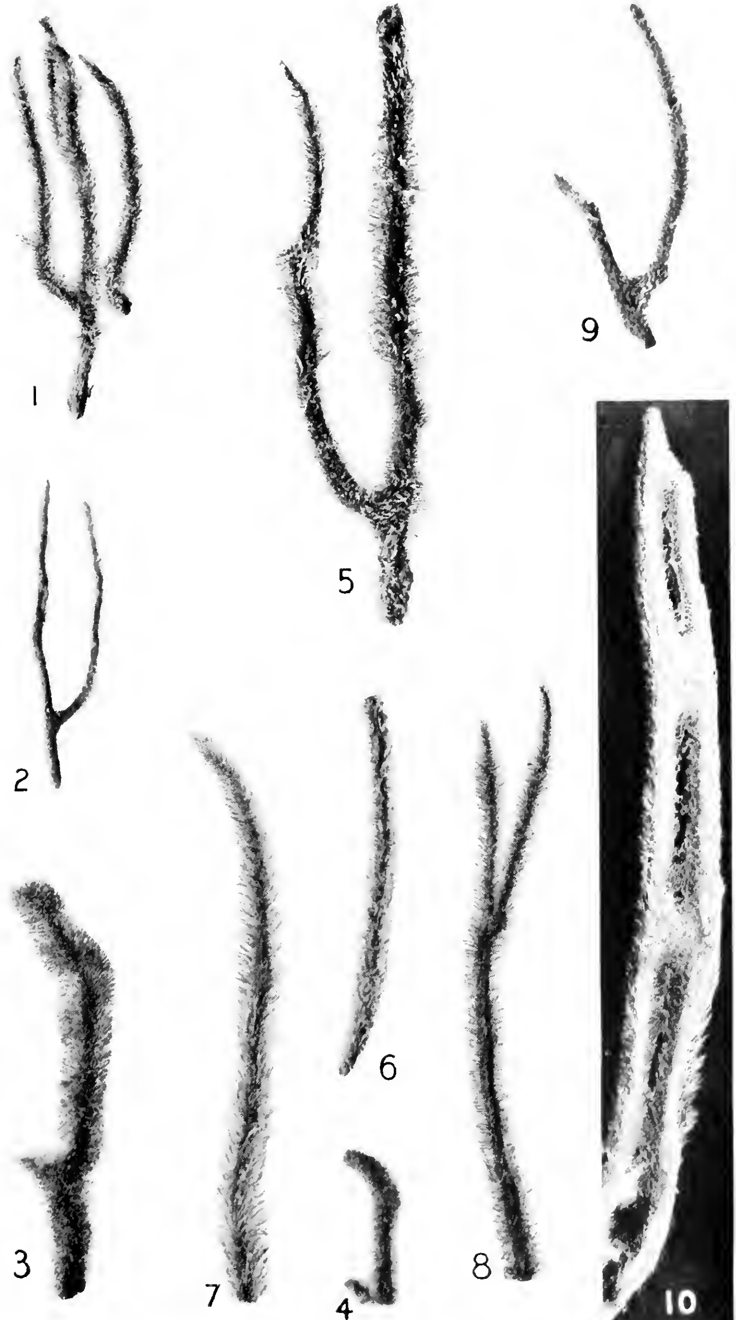
1. *Athyrium humile*, sp.n. 2. *Fissidens humilis*, sp.n.



Trachycladus spp.



Trachycladus spp.



Trachycladus spp.

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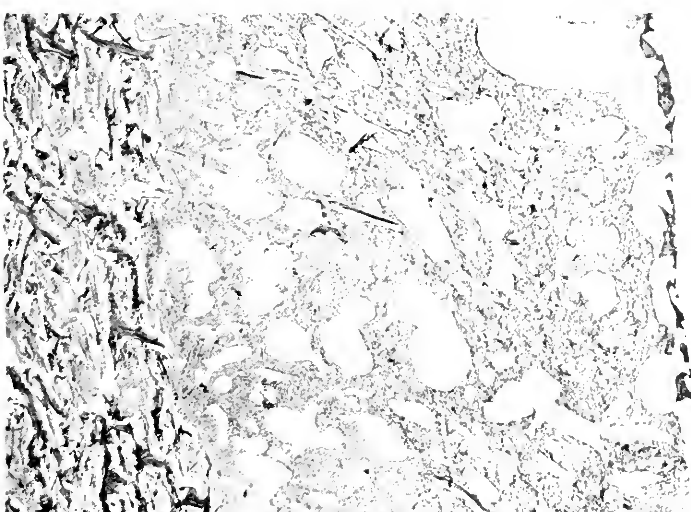
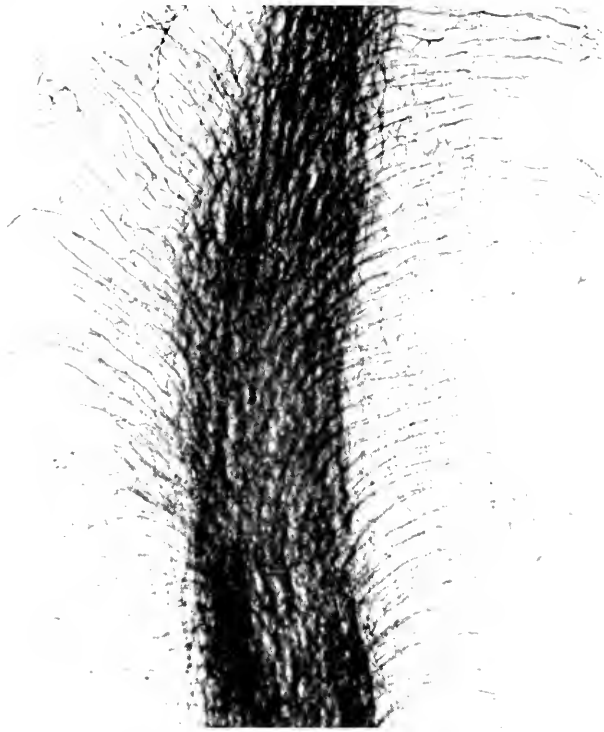


Trachycladus formosus, n.sp.



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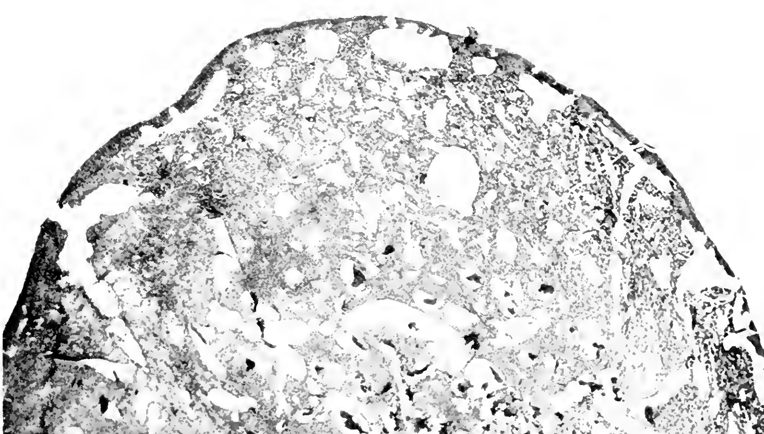

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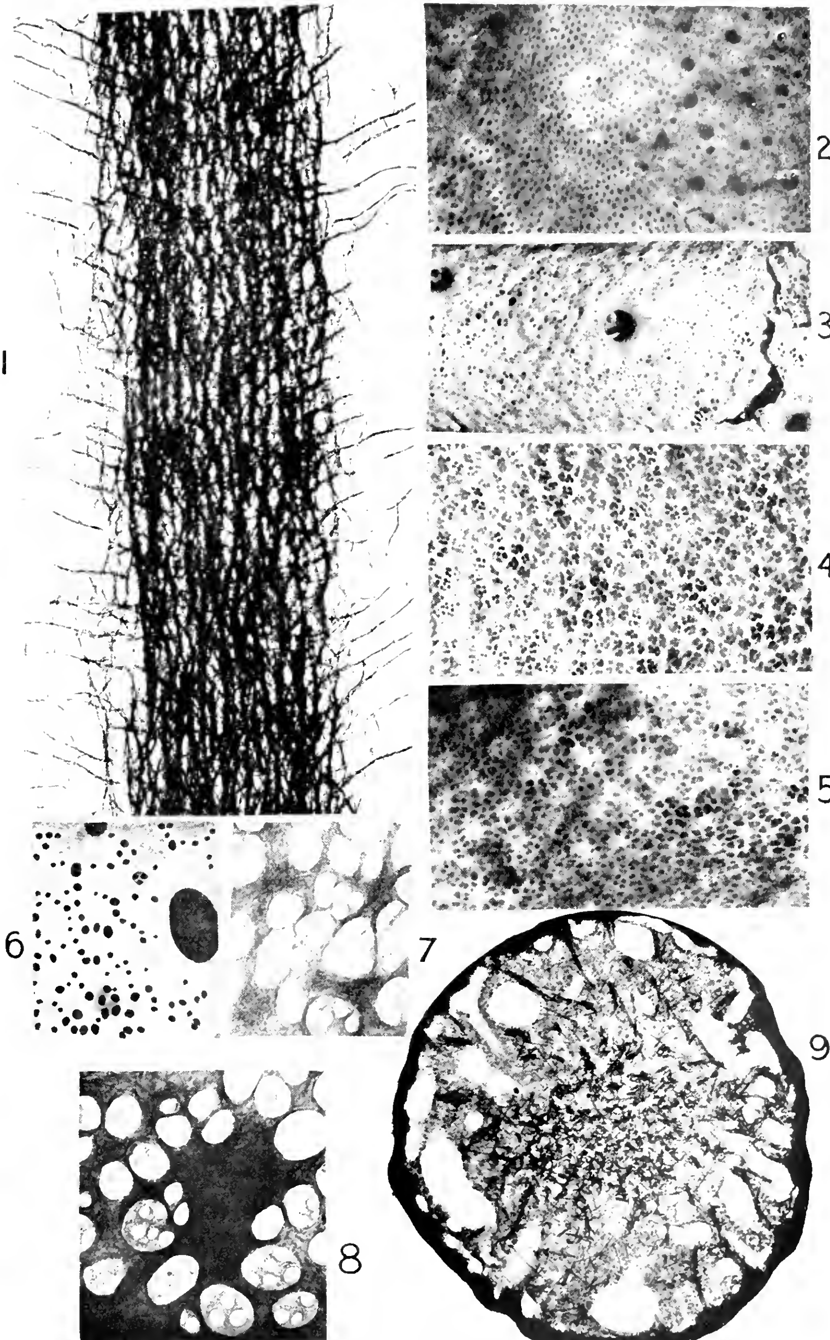
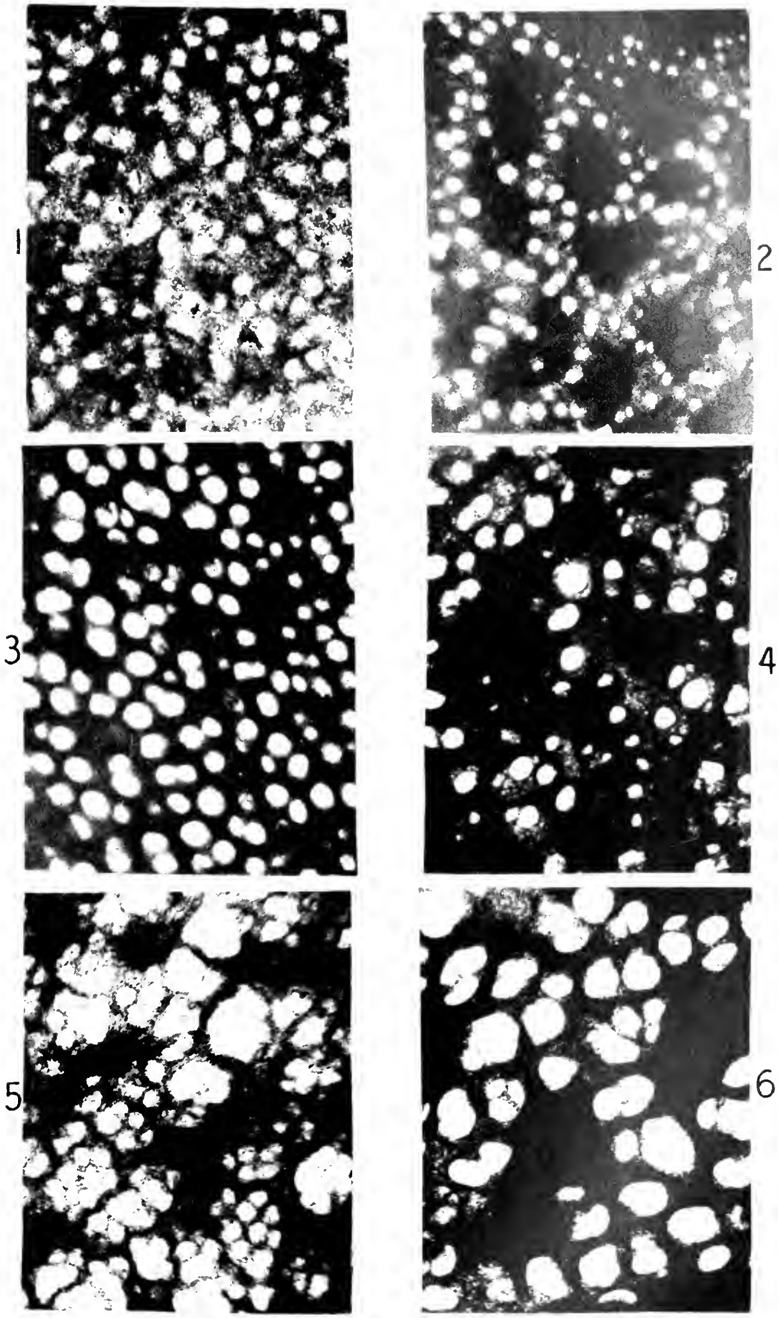
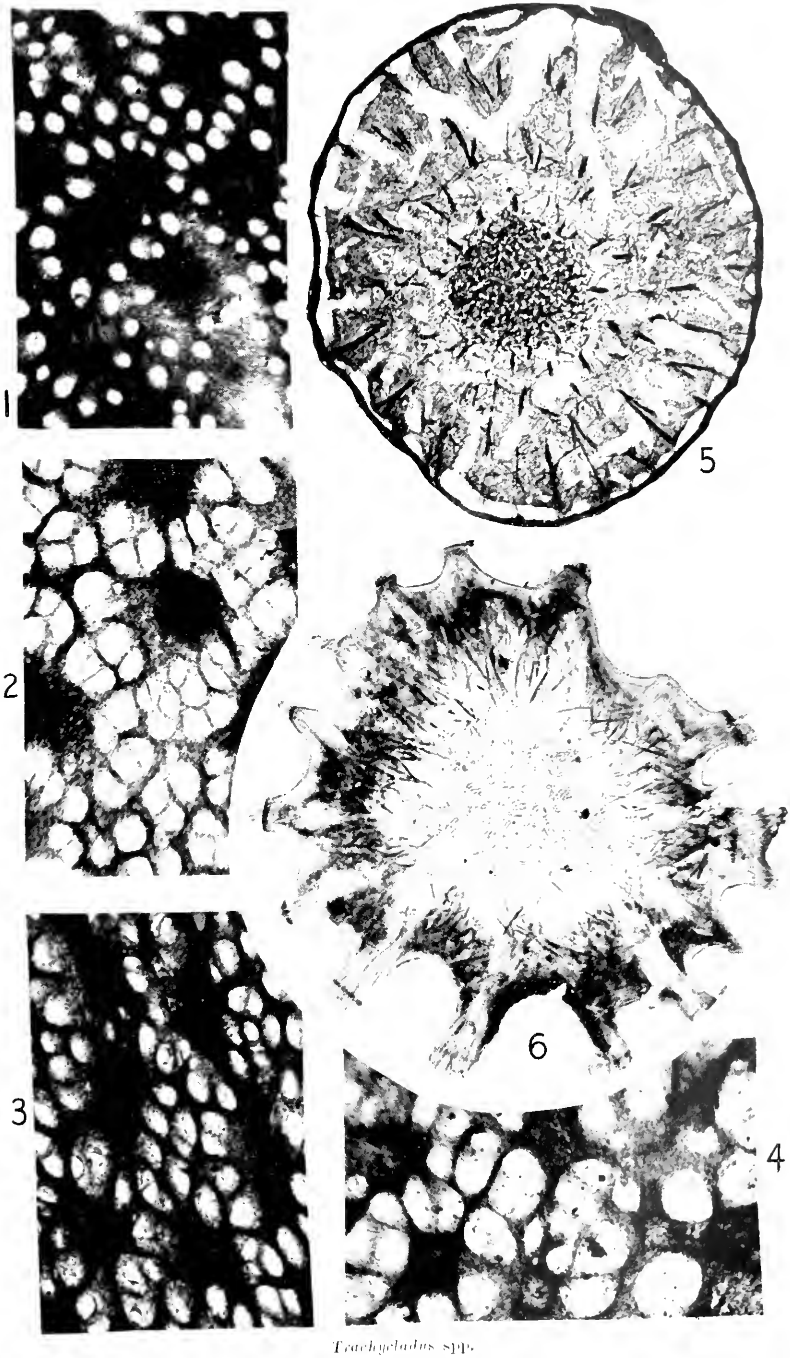
1. *Trachycladus reteporosus*, n.sp. 2. *T. clavatus*, n.sp.



Trachycladus spp.



Trachycladus spp.: showing the different arrangement of the dermal pores (× 40).



Trachycladus spp.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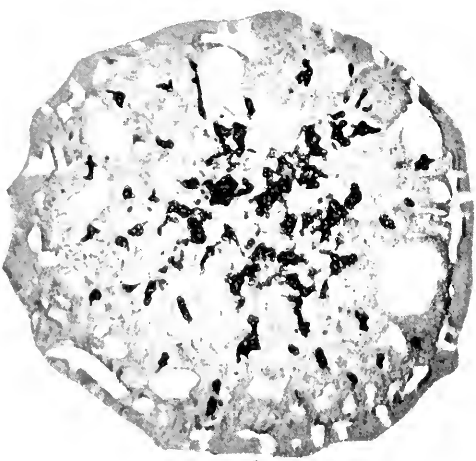
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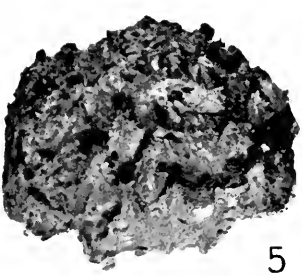
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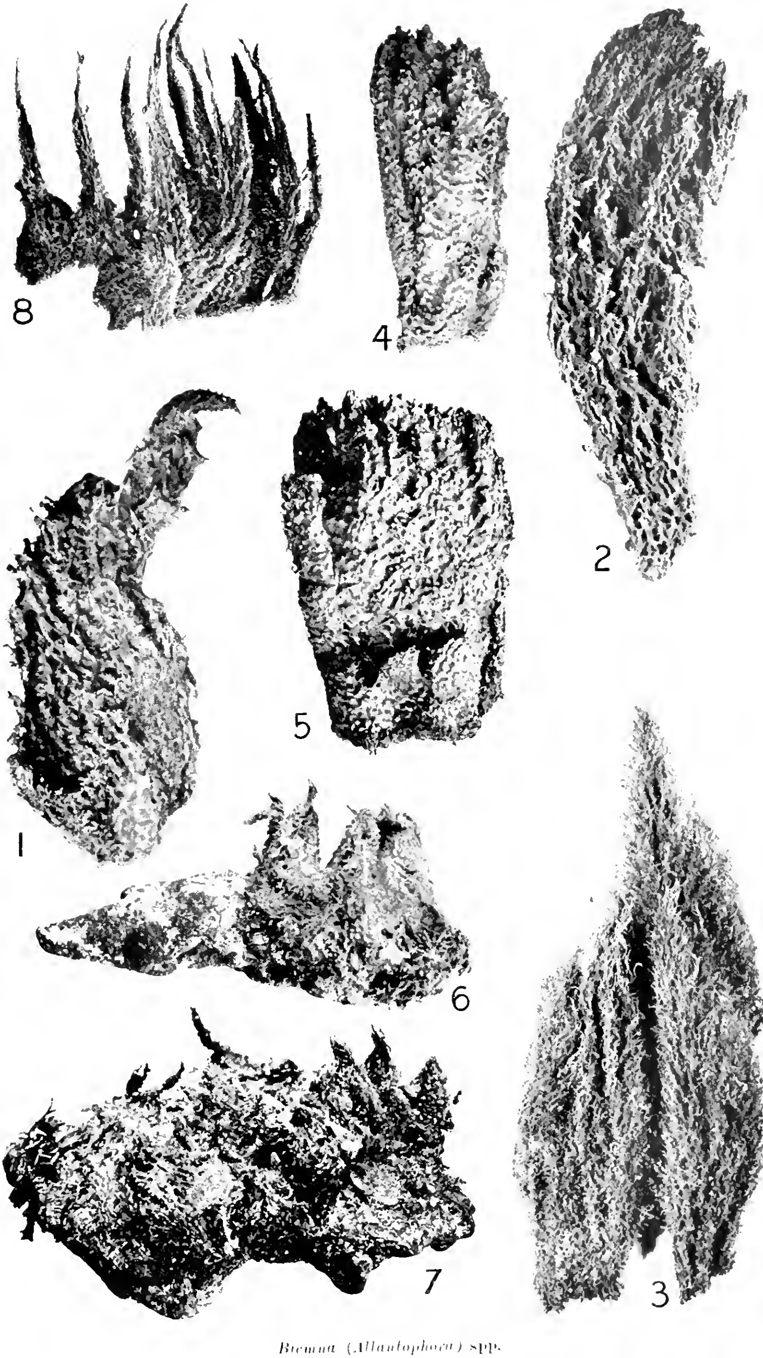
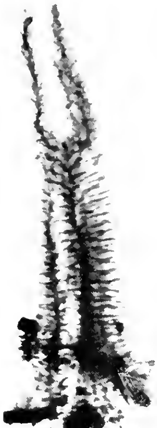
6

1. *Trachycladus digitatus* var. *clavatus*. 2. *T. reteporosus*. 3. *Rhaphoxya typica*.
4. *Allantophora plicata*. 5. *Desmoxya lunata*. 6. *Higginsia coralloides* var. *massalis*.



Biemna (Allantophora) spp.



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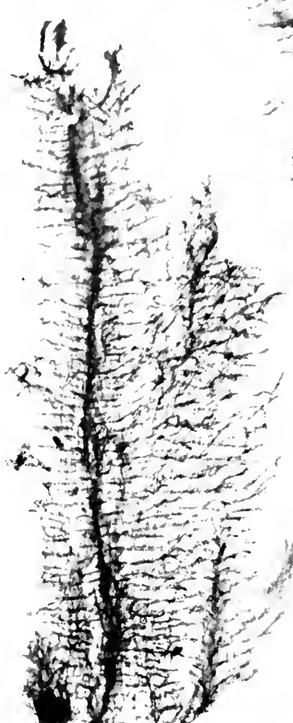

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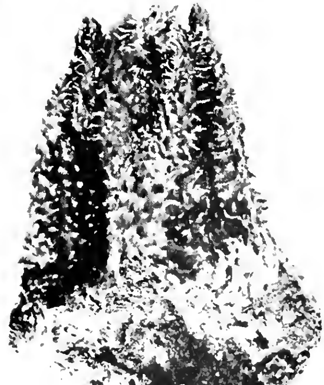

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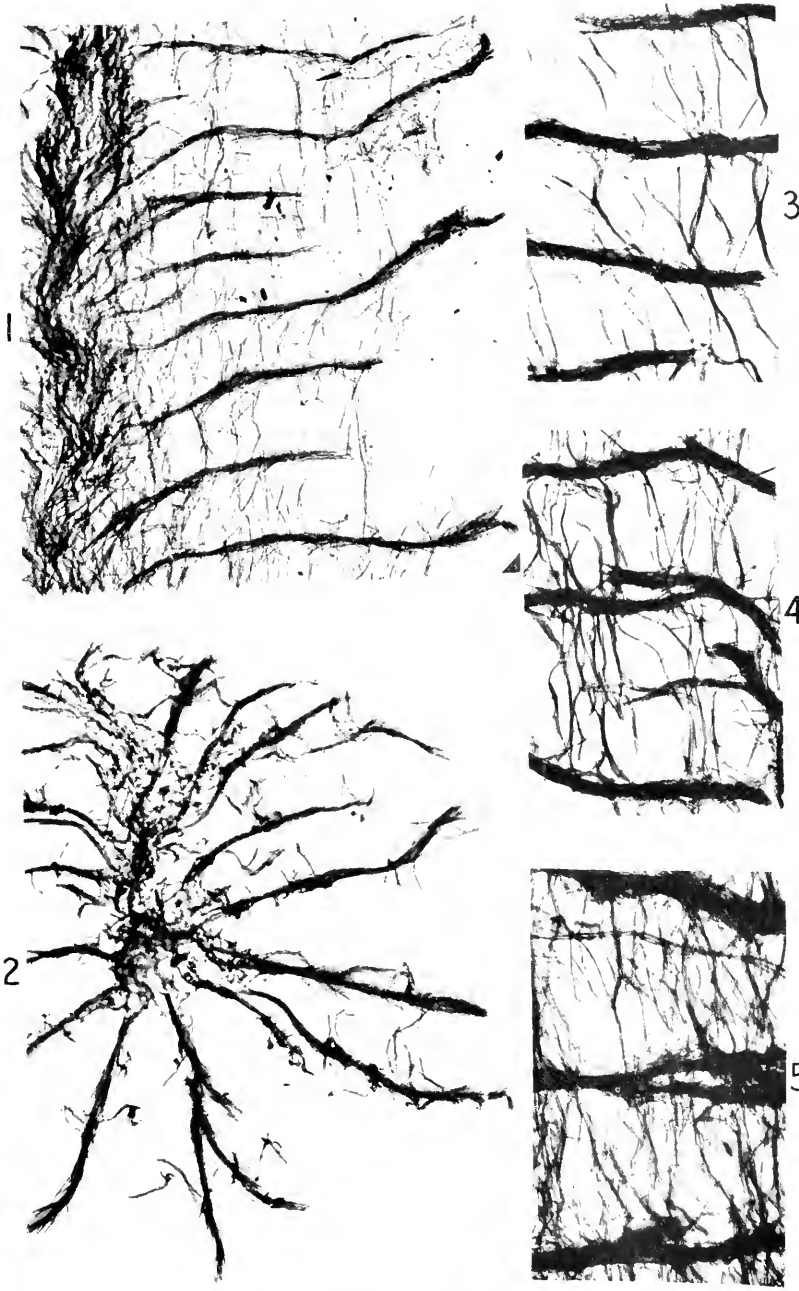
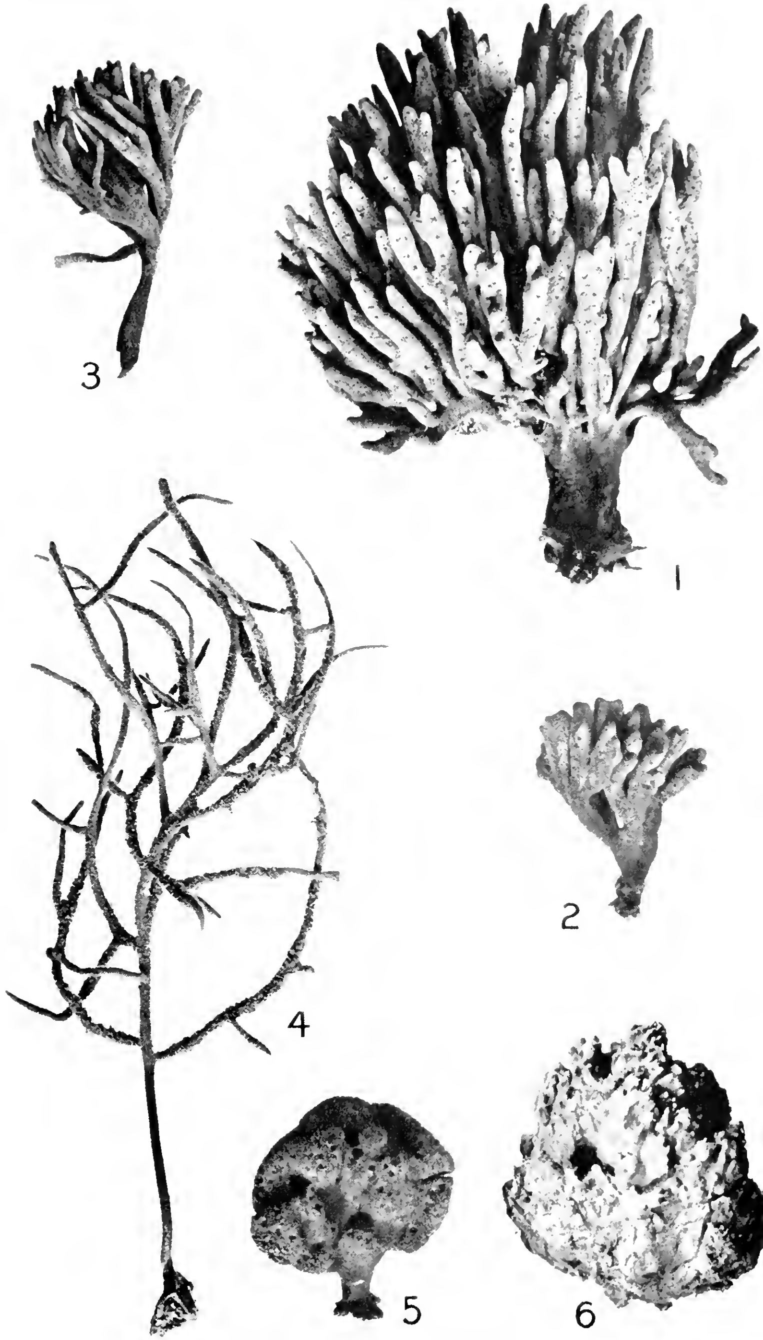
Biemna (Allantophora) victoriana, n.sp.



Biemna (Allantophora) victoriana, n.sp.



Sigmaxinella; Sigmaxia, n.g.; Rhaphoxya, n.g.

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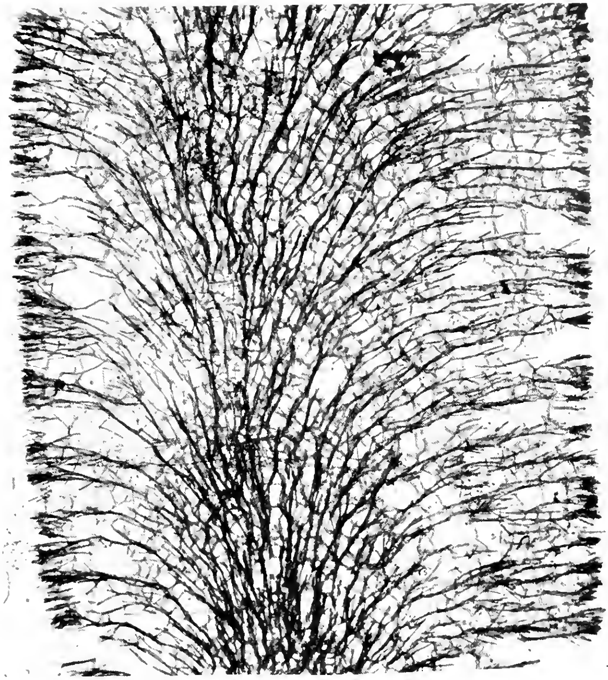

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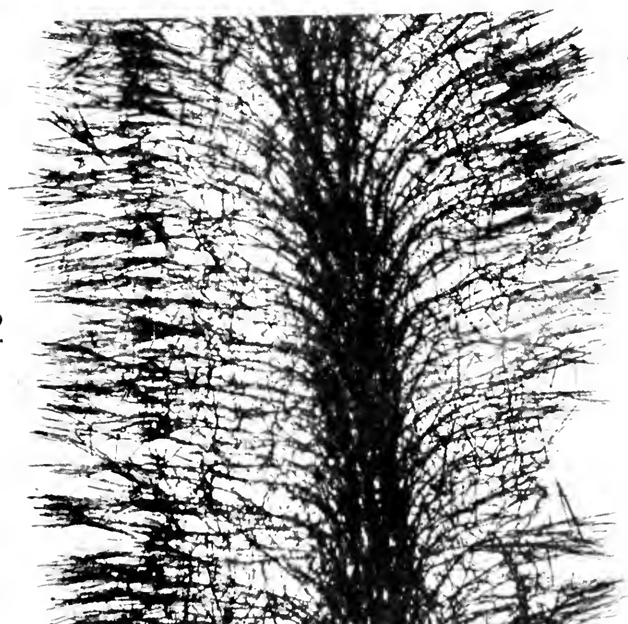

1. *Sigmaxinella australiana* Dendy. 2. *S. dendroides* Whitelegge.

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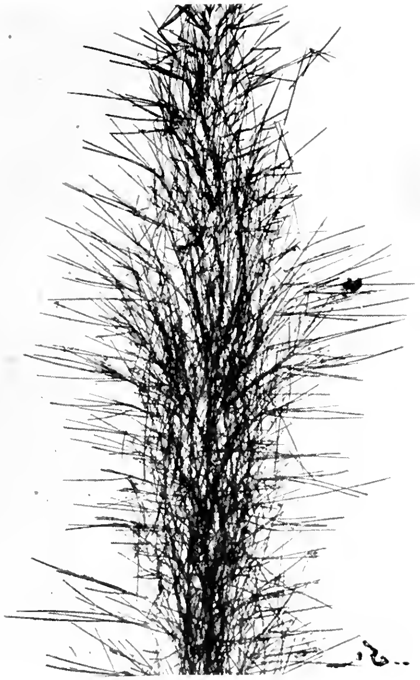

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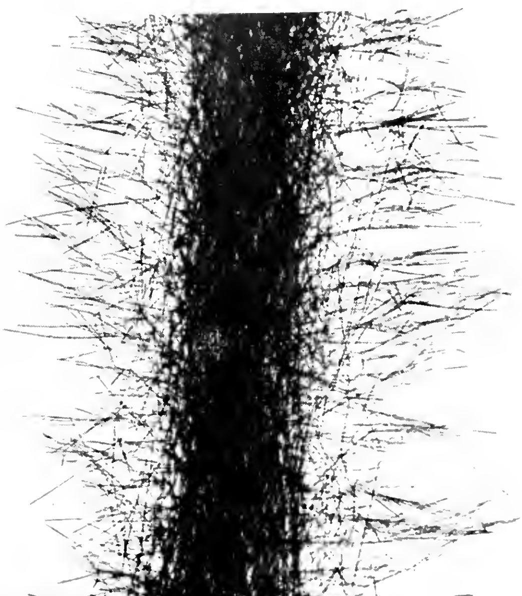

Sigmaxinella viminalis, n.sp.

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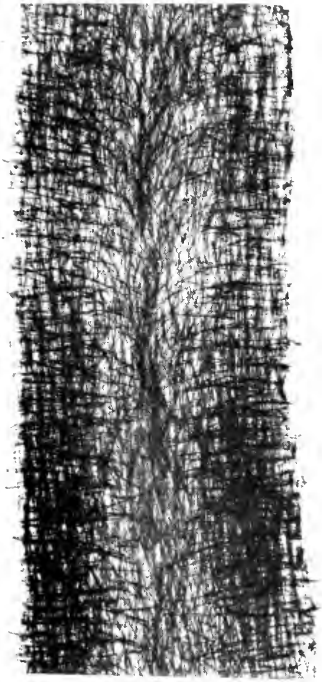

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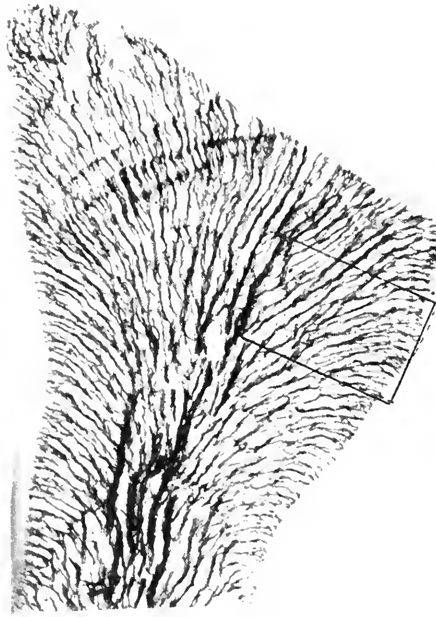

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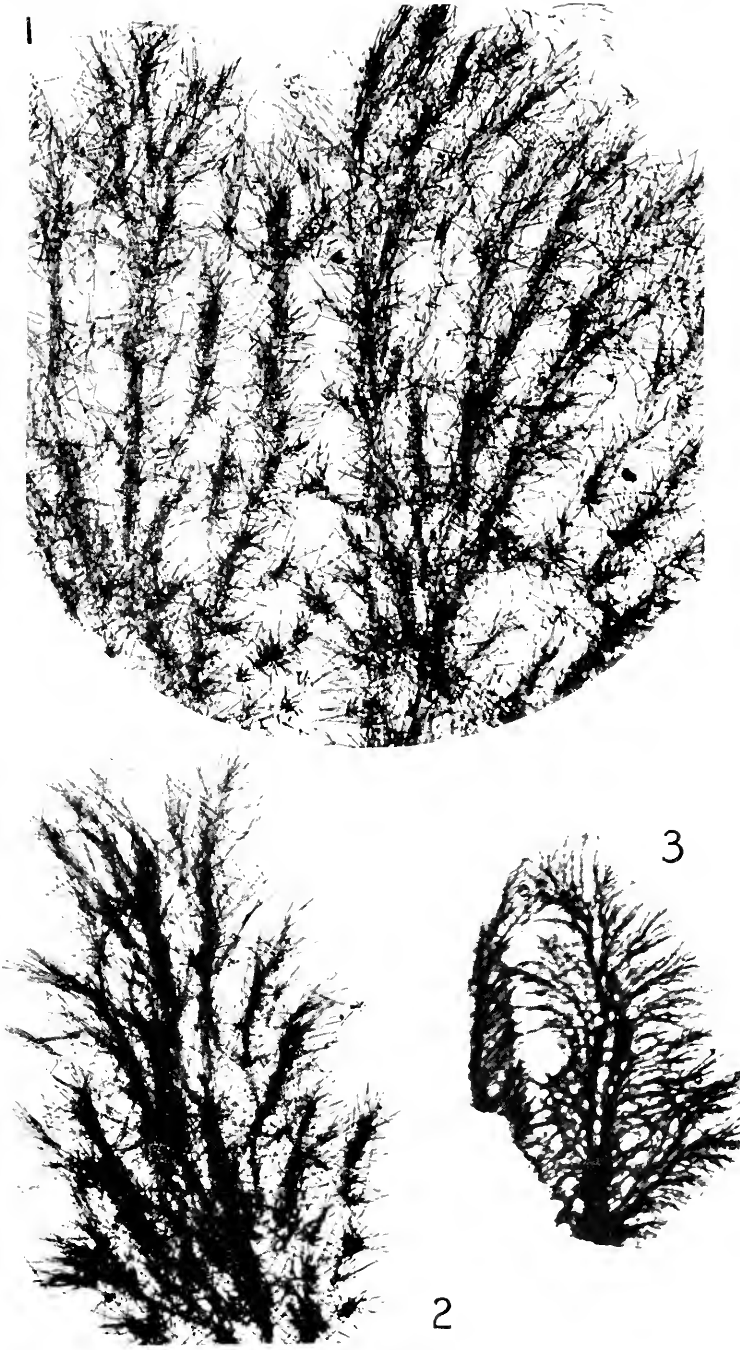
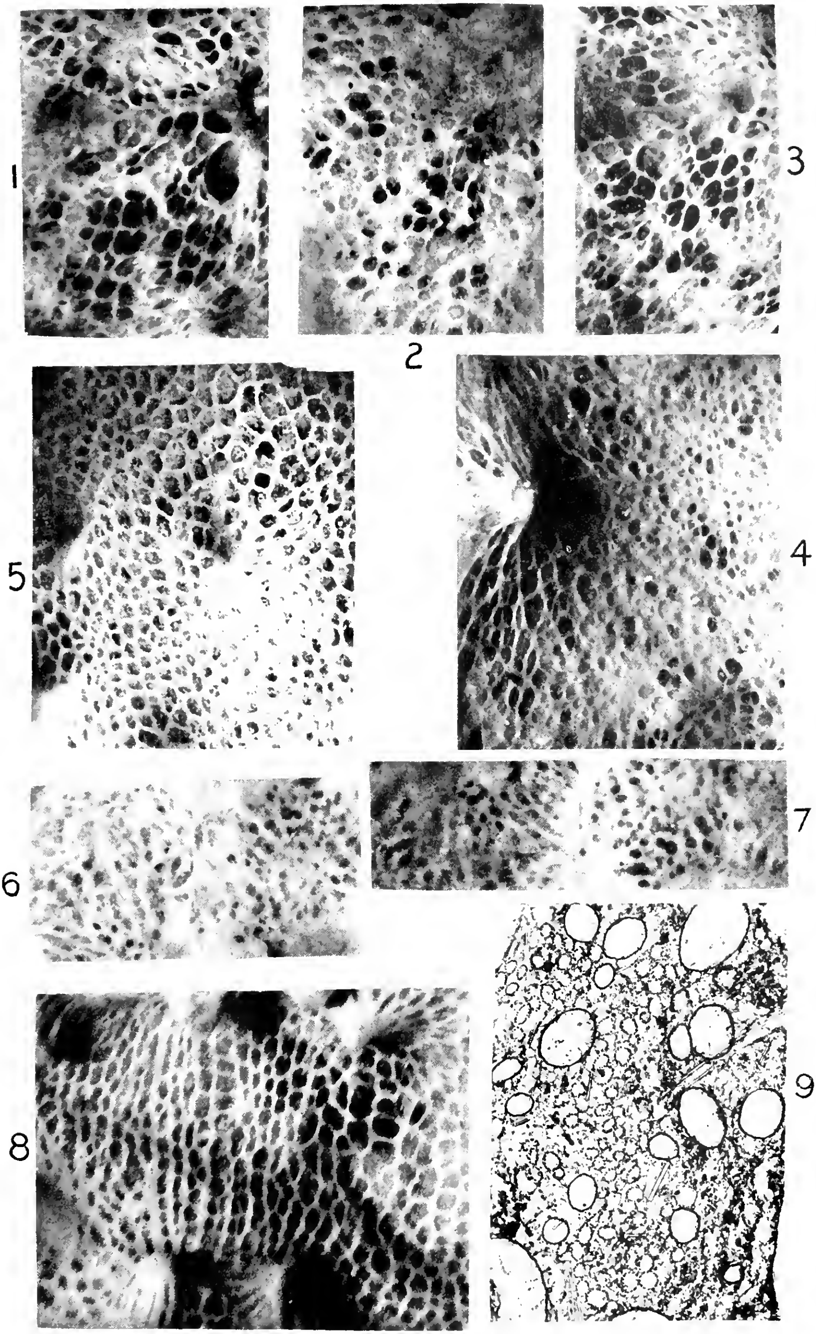
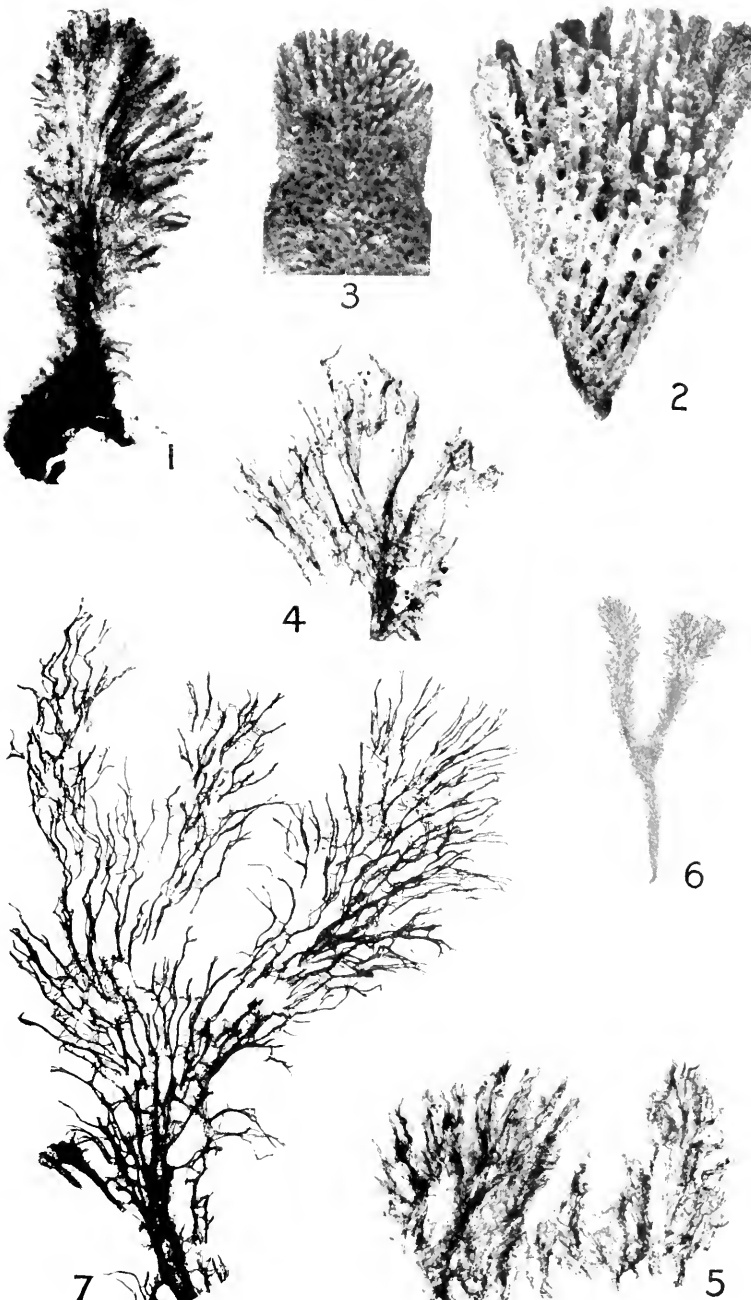
1. *Sigmatocinella viminalis*, n.sp. 2-3. *Sigmaxia flabellata* (Carter)



Dragmacia variabilis (Whitelegge).



1-4. *Allantophora plicata.* 5. *Desmoxya lunata.* 6-7. *Higginsia coralloides* var. *massalis.* 8-9. *Rhaphoxya typica.*



1-3. *Higginsia.* 4-5. *Rhaphoxya.* 6-7. *Trachycladus.*

for any other State, although it is the most common species.—(2) *Œ. longiflora* Jacq. This species has been recorded from South Australia, by Mr. Black (*l.c.*), and from Queensland by the late Mr. F. M. Bailey (Weeds and Suspected Poisonous Plants Plants of Queensland, p.56, 1906). It is fairly plentiful at Tweed Heads and Woy Woy. There are also specimens in the National Herbarium labelled *Œ. biennis*, which belong to this species, from Conjola, Bingarra, Bega, Cobargo, and Norfolk Island.—(3) *Œ. Lamarkiana* Ser. in DC., regarded by some botanists as a variety of *Œ. biennis* Linn. It is figured in Eng. Bot., tab.1534. The specimens exhibited were grown at Ashfield in December, 1915, from seed obtained from specimens collected at Inverell by Mr. F. Lewin in March, 1912. The only other specimens of this species seen are from plants cultivated in the Botanic Gardens.—Mr. Cheel showed also specimens of (*a*) *Rosa lævigata* Michx., (*R. sinica* Ait.) collected at Murwillumbah, probably an escape from cultivation.—(*b*) The "Frankfurt Rose" (*R. turbinata* Ait.), from Cook's River (A. A. Hamilton; December, 1912), and Armidale (J. H. Maiden: May, 1916), two additional localities to that recorded for this species in these Proceedings for 1912, p.137.—(*c*) *Emilia sonchifolia* DC., [COMPOSITÆ] a native of Asia and Tropical Africa now naturalised in the neighbourhood of Tweed Heads.

Mr. E. I. Bickford, F.L.S., communicated a Note on the economic resources of West Australia.

A REVISION OF THE GENERA WITH MICROSCLERES INCLUDED, OR PROVISIONALLY INCLUDED, IN THE FAMILY *AXINELLIDÆ*; WITH DESCRIPTIONS OF SOME AUSTRALIAN SPECIES. Part iii.

[Porifera.]

By E. F. Hallmann, B.Sc., Linnean Macleay Fellow of the Society in Zoology.

(Plates xxix., figs.3, 5, 6; xxxiii., fig.6: xxxviii., figs.5-9; xxxix., figs.1-5; xl., figs.1-4, xli.-xliv.; and Text-figs.17-20.)

Genus Thrinacophora Ridley.

Definition.—Axinellidæ typically of ramose habit, perhaps also sometimes encrusting or massive, with even or conulose surface, and a skeleton consisting (in the ramose forms) of a dense central axis from which paucispicular fibres (in some species reduced to single spicules) radiate to the surface. Megascleres of at least three kinds: (i.) comparatively short oxea, typically occurring chiefly or only in the central axis; (ii.) long, setaceous styli, composing the radial fibres; and (iii.) monactinal, sometimes apically pronged, dermal megascleres forming surface-tufts or lying in the dermal membrane tangentially, but not necessarily confined to the ectosomal layer exclusively. In addition, oxeote or strongylote modifications of one or both kinds of the monactinal megascleres are commonly present. Microscleres: trichodragmata, accompanied or not by singly scattered trichites.

Type-species, *T. funiformis* Ridley & Dendy.

Originally founded by Ridley(**32**) to designate the peculiar *T. funiformis*, and conceived as being essentially characterised by the possession of dermal megascleres in the form of "cladostrongyla," the genus *Thrinacophora* was next modified by Ridley and Dendy(**33**) to receive also the species named by them *T. cervicornis*, and was defined by them thus: "Sponge ramose, with a dense central axis of spiculo-fibre; megasclera styli and (or) oxea, and (in some species) cladostrongyla. Microscleres present in the form of trichodragmata." More recently Dendy(**8**) has amplified the definition so as to embrace in the genus all Axinellidae in which the microscleres are trichodragmata and the skeleton is more or less plumose. A similar disposition to employ the genus in a wider sense than that in which it had been understood by Ridley and Dendy, had previously been shown by Topsent(**46**), when he assigned to it provisionally, under the name *Thrinacophora*(?) *spissa*, a species of massive habit and halichondroid skeletal structure, with oxea alone as megascleres. This species was also admitted in the genus by Dendy; but as the result of a second investigation of it Topsent(**53**) has found that the microscleres include toxa (in addition to trichodragmata), thereby definitely establishing the correct position of the species to be in the genus *Gellius* as defined by Lundbeck(**30**). The known species that properly admit of inclusion in *Thrinacophora* as defined by Dendy, are ten in number*,—comprising, in addition to those already assigned to the genus, *Axinella padina* Topsent(**47**), *Raspailia* (*Syringella*) *rhaphidophora* Hentschel(**15**), and the species originally described by Whitelegge as *Spongosorites variabilis*. The great diversity of spiculation and skeletal structure exhibited by these species renders it obvious that they do not constitute a natural genus; and the only justification for their association together in a single genus would be the impossibility of separating them into simpler and apparently more homogeneous groups susceptible of precise and adequate definition. It is easy, however, to subdivide them into at least four such groups, distinguished by differences sufficiently great to be regarded as generic. I propose, therefore, to restrict the name *Thrinacophora* to the species with special dermal megascleres,

* Since this was written, I have discovered the existence of trichodragmata in Whitelegge's *Ciocalypta incrustans*(**58**), which, therefore, constitutes an eleventh species of this kind.

and to distribute the remaining species among three new genera, —*Dragmaxia*, *Dragmacidon*, and *Axidragma*. Forms capable of being referred to *Thrinacophora* in the previously understood sense would result from any of the genera *Biemna* (sens. ampl.), *Sigmaxinella* and *Sigmaxia* by the loss of sigmata, but with the possible exception of those I ascribe to *Dragmacidon* (which, if provided with sigmata, would perhaps require to be included in *Biemna*), none of the known species appear to have been thus derived.

Thrinacophora as here defined comprises, at present, five species, viz., *T. funiformis* Ridley & Dendy, *T. spinosa* Wilson,† *T. incrustans* Kieschnick(**23**), *T. cervicornis* Ridley & Dendy, and *T. rhaphidophora* Hentschel. Kieschnick's species—if its extremely meagre description is to be relied upon,—has essentially the same spiculation as that of the type-species, and, if such be the case, must of necessity be included in the genus, notwithstanding its being of encrusting habit; in the face of what has been disclosed by Thiele(**41**, p.935), however, it is questionable whether this species has any real existence. The remaining four species, in spite of their many points of agreement, are extremely well distinguished, and, indeed, might almost be regarded each as the type of a separate genus; since, however, their resemblances appear to be due to genetic relationship, their retention in a single genus has most to recommend it.

It is exceedingly doubtful if the species referable to *Thrinacophora*, in the restricted sense, belong properly to the Axinellidæ at all. In spiculation they present many striking points of analogy with the genera *Raspailia*, *Syringella*, *Axechina*(**15**), *Axiamon*(**13**), and *Trikentrion*,—the significance of which is greatly heightened, in the case of the last-mentioned two genera, by the fact that, in *Trikentrion*, microscleres are sometimes present in the form of trichodragmata and the peculiar acanthostylote megascleres characteristic of the genus are sometimes very scarce, and by the fact that, in *Axiamon*, the dermal megascleres are spined

† H. V. Wilson, Bulletin of the United States Fish Commission, Vol. xx., Pt.2, 1900, p.400.

at the apex, and thus exhibit a feature which might be looked upon as differing essentially only in degree of development from the furcation of the cladostrongyla of *T. funiformis*. Hence I am strongly inclined to think that *Thrinacophora* is of "Ectyonine" origin, and that its correct position is in the Desmacidonidæ.

Genus Dragmatyle Topsent.

Definition.—Axinellidæ(?) of encrusting habit, with a main skeleton consisting of long smooth tylostyli disposed vertically, with their heads based on the substratum, and a dermal skeleton formed of smooth diactinal megascleres disposed tangentially. Microscleres trichodragmata.

Type-species, *D. lictor* Topsent(**53**).

The systematic position of *Dragmatyle*, like that of *Thrinacophora*, is uncertain. The character of the skeleton (in the single known species) affords ground for the view that the genus is of "Ectyonine" derivation; and this view is further supported by the existence of two species of thinly encrusting habit—the so-called *Hymeraphia viridis* Topsent(**46**), and *Microciona fascispiculifera* Carter(**3**),—in which the spiculation consists of vertically directed long smooth tylostyli, trichodragmata and, in addition, acanthostyli. But this evidence is by no means conclusive, since the type of skeleton possessed by *Dragmatyle* is common to quite a number of encrusting genera of very diverse origin,—including, for example, (in addition to several genera provided with acanthostyli), *Timea* and *Halicnemia* (s.str.) in the Spirastrellidæ, and *Bubaris* in the Axinellidæ. On the whole, there is perhaps more to be said in favour of the inclusion of *Dragmatyle* in the Axinellidæ than can be advanced in the case of *Thrinacophora*.

Genus Axidragma, gen.nov.

Definition.—Axinellidæ typically of thin lamellar habit, stipitate, with even surface. Skeleton composed of primary lines of stylote megascleres, traversing the sponge in the direction of its growth, and of secondary lines (connecting fibres?) formed of oxea; there is no special dermal skeleton. The megascleres are of the two forms mentioned, which are quite distinct in kind. The microscleres are trichodragmata accompanied or not by single trichites.

Type-species, *A. padina* Topsent(**47**).

This genus is proposed for the reception of Topsent's *Axinella padina*, described from the Gulf of Lyons. At first I was inclined to include the species in the genus *Dragmaxia*, with the single species of which it presents some striking points of superficial similarity; but consideration of the decided differences between it and the latter in the matter of skeletal structure has confirmed me in the view that their generic separation is advisable. As regards the precise structure of the skeleton in *Axinella padina*, however, Topsent's description is not very explicit, and a quite exact definition of the genus cannot therefore be framed. In speaking of the outward features of the sponge, he mentions that the single specimen, in consequence of its having been somewhat damaged by the trawl, "se trouve en plusieurs endroits usé et percé à jour: de la sorte se trouve mise à nu par place l'espèce de nervation qui monte en éventail du pédicelle jusqu'au bord des lobes, en lignes spiculeuses, épaisses, nombreuses et, par suite, à peine divergentes." And further on, in describing the spiculation (which consists of slightly curved styli, 650 to 900μ in length by 8 to 10μ in diameter at the base, and of curved, sharp-pointed oxea with a maximal size of 275 by 6μ), he merely adds that the styli "forment les nervures et déterminent l'hispidation de la surface", and that the oxea "constituent les lignes secondaires, ordinairement unispiculées de la charpente". It is not clear whether the "nervures" are of the nature of funes, or whether they are formed by single fibres; nor is any mention made as to whether or not the fibres are plumose, nor regarding the extent to which spongin is developed in connection therewith. It is presumable, however, that the "lignes secondaires" are of the nature of connecting fibres, and that the styli producing the hispidation of the surface are the terminal spicules of fibres running outwards to the surface.

Genus Dragmacidon, gen.nov.

Definition.—Axinellidæ of more or less massive habit, sometimes provided with incipient conuli, but without surface-processes of other kind. The skeleton consists of irregular plumose columns loosely composed of mingled oxeote and stylote megascleres or of oxea alone, and of (sometimes relatively scarce) connecting fibres formed of the same spicules; typically, spongin is developed in connection with the fibres rather sparingly, and there is no dermal skeleton. In addition to the oxea and styli composing the skeletal columns,—which typically are of similar or nearly similar dimensions,—longer megascleres of a single kind (likewise either oxeote or stylote) may occur interstitially. The microscleres are trichodragmata, accompanied or not by single trichites.

Type-species, *D. agariciformis* Dendy(**8**).

Besides the type-species, the genus will include Dendy's *Thrinacophora durissima* (which likewise comes from Ceylon), and the species originally described by Lendenfeld, from Port Jackson, as *Halichondria clathriformis*.* The last-mentioned,—a redescription of the skeletal characters of which, based on a small piece of the type-specimen received from the British Museum, has recently been given by me(**13**),—is distinguished by the fact that its megascleres are almost exclusively oxea; and on that account the propriety of its association in a single genus with

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* Subsequently I have found that Whitelegge's *Ciocalypta incrustans*(**58**), from Funafuti, constitutes a fourth species of this genus. In this, as in *D. durissima*, special interstitial megascleres are wanting and the spiculation consists of styli and oxea in about equal number occurring in the skeleton promiscuously intermingled; but the styli are here larger than the oxea, ranging in length from less than 200 to upwards of 550μ and occasionally attaining to 13μ in stoutness, while the latter rarely if ever exceed a size of 400 by 10μ. The oxea are exactly similar in shape to those of the three species of *Allantophora* described above, and (as in the same species) are not connected with the styli by intermediate forms. The structure of the skeleton closely resembles that both of *D. agariciformis* and *D. clathriformis*. The trichodragmata, which are very scarce, have the form of stout compact bundles 12 to 14μ in length. Singly scattered trichites do not occur.

the other species might seem debatable. Owing to the kindness of Prof. Dendy, I have had the opportunity, however, of examining a section of his *Thrinacophora agariciformis;* and the close resemblance in skeletal pattern, which I find to exist between it and the species in question, leaves no doubt in my mind as to their very near relationship. In these two species, interstitial megascleres occur which are different from those composing the fibres; but whereas in *D. clathriformis* they are very scarce, and are connected with the fibre-forming megascleres by intermediate forms, such is not the case in the type-species. In *D. durissima*, apparently, special interstitial megascleres either have never been developed, or have become lost.

DRAGMATELLA, gen.nov.

Definition.—Axinellidæ of massive habit, provided with digitiform tapering processes. Internal structure cavernous. Main skeleton consisting of well-developed, non-plumose(?), multispicular fibres arranged more or less dendritically. A dermal skeleton is typically present, formed of tangentially-disposed megascleres crossing in every direction. The megascleres are styli of a single kind. The microscleres are trichodragmata alone, or accompanied by trichites singly scattered.

Type-species, *D. aberrans* Topsent(**46**).

To define the genus *Biemna* in such a way as to secure the inclusion in it of Topsent's *Desmacella aberrans*, and at the same time to exclude therefrom certain other species likewise possessing trichodragmata alone as microscleres,—such, for example, as those belonging to the genera *Dragmacidon* and *Rhaphoxya*,—is extremely difficult, if not impossible; and, on that account, the erection of a new genus for this species seems necessary. Even apart from any consideration of expediency, however, it is doubtful if the species could have been allowed to remain in *Biemna*, —since, in addition to being without sigmata, it differs from all strictly acceptable species of that genus in at least one other noteworthy respect, namely, the possession of a dermal skeleton composed of megascleres directed horizontally.

RHAPHOXYA, gen.nov.

Definition.—Axinellidæ(?) of massive habit, without surface-processes other than in the form of small, typically papilliform conuli; with a rather meagre main skeleton consisting of an irregular reticulation of slender, non-plumose, longitudinal and connecting fibres, somewhat scantily provided with spongin; and without a dermal skeleton. The megascleres are more or less curved to flexuous, slender cylindrical styli, oxea and strongyla, differing from one another only in the character of their extremities. The microscleres are trichites, in dragmata and scattered singly.

Type-species, *R. typica*, sp.n.

The two species which I ascribe to this genus, while scarcely distinguishable from one another in their skeletal structure and spiculation, nevertheless differ so markedly in some other respects as to render it questionable whether their resemblances may not merely be due to convergence. In one of them, for example,—described originally by Dendy as *Rhaphisia pallida*,—the main efferent canals are surrounded by a broad zone of gelatinous-looking collenchymatous tissue, precisely similar in appearance to that occurring in the same situation in most of the species of Tedaniinæ I have examined; whereas, in the other, the extra-choanosomal layer of tissue bordering the canal is, as usual, comparatively narrow, and appears to be histologically different in constitution. The arrangement of the dermal pores also is very dissimilar in the two species: and, furthermore, oscula are apparently absent in the one, while present in the other. I am strongly inclined to think that the feature in which *R. pallida* resembles the Tedaniinæ is evidence of its very close relationship to that group; but its microscleres, it must be confessed, afford no confirmation of this view, for they are perfectly smooth and quite symmetrically diactinal, whereas in all the species belonging indubitably to the Tedaniinæ that have so far been described, the rhaphides (onychetæ) are not only without exception more or less spinulous, but they are usually (perhaps invariably) also anisoactinal, and are very frequently provided with a bulbous dilation near one extremity. *R. typica* appears to me, on the other hand, not to depart in any important respect, except in the absence of spined microxea, from *Desmoxya* (formerly *Higginsia*) *lunata* Carter.

I hesitate, however, to refer the two species to separate genera, inasmuch as their only differences are such as are not yet recognised as possessing generic value.

With reference to the possible Tedaniine affinities of *R. pallida*, it is interesting to note that the only other two Australian species which have been ascribed to the genus *Rhaphisia*, actually do belong to the Tedaniinæ. This fact I have already made known regarding one of them—*Rhaphisia anonyma* Carter,—in a previous communication(**13**); and for the reception of the species I proposed a new genus, *Hemitedania*. The other, *Rhaphisia ramosa* Whitelegge(**59**), I now find to possess a somewhat similar spiculation,—consisting of oxea (of a single kind) and spinulous onychetæ (of three kinds); but in skeletal structure it differs from *H. anonyma* very considerably.* The species appears to me one which will necessitate the erection of a new genus for its accommodation, but provisionally it may be referred to *Hemitedania*.

Furthermore, of the seven specimens recorded by Dendy as examples of *R. pallida*, two are not correctly identified as such, but again are representatives of a Tedaniine species. In this latter, the microscleres are of three kinds,—nearly similar in form to those of *Hemitedania*(?) *anonyma* (excepting that the styliform ones are very much slenderer and somewhat differently shaped at their basal extremity); but the megascleres are cylin-

* The species is sorely in need of re-description, especially with respect to its skeletal structure; and the information regarding the spicular characters is also misleading. The oxea vary from 220 to 570μ in length and up to 14μ in stoutness; the onychetæ of two kinds are similar in form to those of *H. anonyma*(**13**. Text-fig.20), exhibiting a conspicuous bead-like dilatation close to the blunter extremity, and measuring respectively 150 to 185 by 1·5μ and 45 to 75 by 0·75μ in size; and the onychetæ of the third kind have the form of subfusiform styli with an abruptly truncated basal extremity provided with a central mucro and a circumferential whorl of minute spines, and measure 95 to 125μ in length by 3·5μ in maximum stoutness.

drical styli of a single kind (measuring 320 to 420μ in length by 6μ in stoutness), occasionally transforming into strongyla. This species also appears to me to constitute a new generic type.

Under the name *Chondropsis carteri*, Dendy(6) has described, from Port Phillip, a species in which the microscleres are "hair-like rhaphides," the megascleres are slender strongyla (and of a single kind), and the skeleton consists partly of "numerous stout sandy tracts or fibres running more or less parallel to one another towards the surface," and partly of spiculo-spongin fibres. From its description, therefore, the species is one which might appear as possibly admitting of inclusion in a single genus along with *Rhaphoxya typica* and *R. pallida*. On examination of its type-specimen, I find, however, that *Chondropsis carteri* also belongs to the Tedaniinæ; its rhaphides are spinulous, and of two kinds, measuring respectively 100μ and 55μ in length, the shorter ones styliform in shape, up to 1·5μ in stoutness, and relatively scarce, the longer (and slenderer) usually sharp-pointed at both extremities, and occasionally exhibiting a slight dilatation near one extremity. Since, in the case of this species, a new genus is unquestionably required, I propose, in designation thereof, the name *Strongylamma*.

RHAPHOXYA TYPICA, sp.nov.

(Pl. xxix., fig.3; Pl. xxxviii., figs.8, 9; Pl. xxxix., fig.5; Pl. xlii., figs.1, 2.)

Diagnosis.—Sponge massive, sessile, irregular. Surface rugose, but generally subglabrous; provided with scattered, small, papilliform elevations. Oscula situated chiefly on the uppermost parts. Dermal membrane easily separable; minutely reticulate to the naked eye, with many dermal pores in each mesh of the reticulation. Skeleton lax and rather scanty; consisting chiefly of ascending, slender, multispicular main fibres; connecting fibres more frequent towards the interior. Megascleres slender, cylindrical; comprising oxea, strongyla, and fewer styli; up to 700 by 9μ in size. Trichites 55 to 400μ long, occurring singly scattered and in dragmata, and also forming short fibres.

Loc.—Port Phillip.

External characters.—The single specimen (Pl. xxix., fig.3) is irregularly cake-shaped, with the upper surface deeply incised by several narrow, valley-like or sulciform grooves, and measures 65 mm. in length, 45 mm. in breadth, and 35 mm. in height in its most elevated, central portion; the grooves appear to be due merely to the more rapid upgrowth of the intervening portions of the sponge, and thus to be of accidental origin. The surface is further rendered uneven by many irregular shallow furrows and slight undulations, and by moderately numerous, irregularly scattered, small papilliform conuli; the latter are usually more or less appressed to the surface, and seldom exceed 1 mm. or so in height. The dermal membrane is distinct and easily separable (owing to the presence of subdermal spaces), and over most portions of the surface presents, to the naked eye, a minutely reticulate pattern (Pl. xxxviii., fig.8), due to the mode of arrangement of the dermal pores. Interiorly, the sponge is traversed more or less vertically by numerous, fairly wide, main efferent canals (up to 4 mm. in diameter), which terminate in relatively rather small oscula situated, for the most part, on the more elevated portions of the surface. For some distance before arriving at the oscula, many of the canals run close beneath the surface, separated from the exterior by scarcely more than the dermal membrane.

The consistency in alcohol is rather soft and compressible, imperfectly resilient, somewhat lacking in toughness, but not brittle; and the colour is brownish-grey on the surface, slightly paler in the interior.

The dermal reticulation (Pl. xliv., figs.1, 2) is made up of more or less polygonal meshes, varying in actual shape, in different portions of the surface, from nearly circular (with a diameter of from rarely less than 120 to occasionally 250μ) to almost oblong (measuring up to 350μ in length and often less than half as broad as long), and separated by usually relatively narrow boundaries varying from 25 to rarely more than 90μ in width. The largest meshes occur on those portions of the surface where the main efferent canals run immediately below the surface. Within the interstices of the meshes, the dermal membrane is perforated by numerous pores, the largest of which measure 60 or 70μ in diameter: each mesh is accordingly of the nature of a pore-sieve. The boundaries or sides of the meshes contain numerous, densely staining, coarsely granular pigment-cells, usually of more or less elongate shape and occasionally exceeding 20μ in length, and mostly with their long axes directed parallel to the sides of the meshes. No spicules are present in the dermal layer except a few scattered trichites.

Text-fig. 17.*

Skeleton.—Partly owing to the tenuity of the skeletal fibres, and partly to discontinuities due to the considerable number and size of the main efferent canals, the skeleton forms but a very inconsiderable portion of the total mass of the sponge. It consists throughout (Pl. xxxix., fig. 5; Pl. xlii., figs. 1, 2) chiefly of ascending multispicular main fibres, running upwards (often more or less sinuously) through the sponge in fairly close apposition with one another, increasing in number by bifurcation as they go. Excepting in the more peripheral region of the skeleton, however, fairly numerous, paucispicular connecting fibres also occur, which form among themselves and with the main fibres an extremely irregular reticulation. The fibres are composed of longitudinally directed, usually fairly closely packed spicules, united (and, in the case of the connecting fibres, also usually ensheathed) by a

* *Rhaphoxya typica.* Megascleres. Showing also the extremities of the same more highly magnified.

small amount of hyaline spongin, which is scarcely perceptible except when stained. The main fibres range from occasionally less than 30 to rarely above 80μ in stoutness: the connecting fibres are much slenderer. Scattered megascleres uncemented by spongin are few or absent. Trichites are plentiful through all parts of the interior, occurring chiefly in dragmata, but also scattered singly; in addition, the longest ones frequently form short fibres running parallel to the main skeletal fibres.

Mastichorions.—The flagellated chambers measure up to 45μ in diameter, and are arranged so closely together that the choanosome is generally reduced to a mere reticulum (Pl. xxxviii., fig.9).

Spicules.—(i.) The megascleres are variously (but seldom very much) curved, frequently more or less flexuous, slender cylindrical oxea, strongyla, and styli, differing from one another only in the character of their extremities, and varying in stoutness from about 2 to 9μ, and in length from rarely less than 100 up to 700μ; individuals less than 350μ long, however, are few. The majority are more or less sharply (and usually irregularly) pointed at both extremities (oxeote or tornote); but strongyla also are common, while stylote forms are somewhat less frequent.

(ii.) The trichites or rhaphides are mostly straight or nearly so, less than 1μ in stoutness, and apparently of all lengths from 55 to 400μ; individuals between 220 and 320μ in length, however, are exceedingly rare, and those between about 100 and 150μ are scarce.

RHAPHOXYA(?) PALLIDA Dendy.

(Pl. xxxiii., fig.6; Pl. xliii., figs.1, 2.)

1896. *Rhaphisia pallida* (partim); Dendy(**7**), p.257.

Diagnosis.—Sponge massive, sessile, irregular. Surface rugose, but subglabrous; irregularly beset with small papilliform elevations. Oscula absent. Dermal membrane closely adherent. Dermal pores singly scattered. Skeleton lax and rather scanty; consisting of slender, multispicular main fibres united in a very irregular fashion by a plexus of paucispicular connecting fibres. Spiculation almost identically similar to that of *R. typica.*

Loc.—Port Phillip.

Introductory.—The following description is based upon four of the original examples of the species (viz., those bearing the register-numbers 314, 621, 737, and 879), and an excellently preserved spirit-specimen which is in the collection of the Australian Museum; the type-examples also are in alcohol, but with one exception are imperfectly preserved. As already mentioned above, two of the original specimens, which Dendy somewhat doubtfully referred to this species, prove to belong to a genus closely related to *Tedania*.

External characters.—The sponge (Pl. xxxiii., fig.6) is irregularly cake-shaped, somewhat higher than broad, attaining in the case of the largest specimen a height of 65 mm. The surface is slightly uneven, more or less rugose; and is provided, especially in the upper parts, with irregularly scattered, mostly very small, somewhat conule-like elevations, rather variable, in size and shape, but usually more or less papilliform. The undamaged surface is subglabrous. The dermal membrane is moderately thin and fairly tough, without pores visible to the naked eye or even with the aid of a lens, and is everywhere closely adherent to the underlying tissues. The sponge is traversed in a generally upward direction by many main efferent canals, of inconsiderable size so far as regards the size of their lumina, but each surrounded (and thus rendered conspicuous) by a broad layer of somewhat gelatinous-looking collenchymatous tissue. These canals terminate in proximity to the surface; and there are no oscula.

In alcohol, the colour is pale greyish-yellow to dull white, and the consistency is compressible and resilient, fairly tough and compact, but moderately soft. The colour in life, according to the original description, is greyish, ranging from "very light grey-buff" to "smoke-grey."

The dermal membrane contains numerous finely and densely granular, deeply staining cells, generally more or less ovoidal in shape, averaging about 14μ in length by 9μ in breadth. Actual dermal pores were not observed; but (in the case of the one sufficiently well-preserved specimen) thin tangential stained sections of the dermal layer showed fairly numerous subcircular to oval areas,—up to 200μ in diameter and situated at an average distance apart of about 150μ,—distinguished from the intervening portions of the membrane by their relative transparency due to the fewness of the deeply-staining granular cells occurring within their limits (Pl. xliv., fig.3). In life, presumably, each such area is the site of a single pore (or possibly of several pores).

Text-fig. 18.*

Skeleton.—In most respects the skeleton closely resembles that of *R. typica*,—and, indeed, as seen in section, is scarcely distinguishable therefrom; the character of the skeletal fibres is exactly the same in both. The chief difference consists in the somewhat fewer main fibres in the present species, and the far greater number of the connecting fibres (except in the peripheral parts of the skeleton),—in consequence of which the pattern is more generally reticulate, and, except towards the surface, much more irregular (Pl. xliii., figs.1, 2). The difference in skeletal pattern of the two species is much more clearly marked in very thick sections of their skeleton, as will be seen from a comparison of figs. 3 and 5 in Pl. xxxix.; and from these figures it will be observed also that, in the present species, the skeleton is on the whole more scanty, and characterised by more extensive discontinuities due to the passage of main excurrent canals. As in *R. typica*, the trichites occur both in dragmata and scattered singly, and the longer ones (in part) give rise to fibres; the scattered

* *Rhaphoxya*(?) *pallida*. Megascleres. Showing also the extremities of the same more highly magnified.

trichites are mainly confined to the collenchyma, and the trichite-fibres, which are often of very considerable length, occur chiefly along and immediately within the boundaries of the same tissue, where it adjoins the choanosome.

Mastichorions.—The flagellated chambers are nearly spherical and of small size, rarely more than 20μ in diameter, and situated at an average distance of about 10μ apart.

Spicules.—Both megascleres and microscleres are precisely similar in form to those of *R. typica*. The former vary in maximum size, in different specimens, from 650 by 7μ to 720 by 9μ, and their minimum length in any specimen is less than 200μ; individuals below 300μ long, however, are scarce. The trichites are divisible into two groups, the shorter ones varying in length from about 50 to 220μ, the longer from about 320 to 450μ.

Genus DESMOXYA, gen.nov.

Definition.—Axinellidæ(?) of massive form, typically more or less dome-shaped, and provided with well-developed, papilliform processes. Skeleton consisting of an irregular, halichondroid reticulation traversed by ascending multispicular, non-plumose fibres. Spongin almost or quite absent. Megascleres of a single order,—oxea, strongyla and styli, differing only in the character of their extremities. Microscleres terminally-spined, arcuate or slightly sigmoidal microxea, and trichodragmata.

Type-species, *D. lunata* Carter.

The single species, for which this genus is proposed, has hitherto been referred to *Higginsia*. The number and importance of the characters distinguishing it from the remaining species of the latter genus, however, render obvious the necessity of its removal therefrom. The structure of the skeleton is essentially the same as in *Rhaphoxya*, only the main fibres are far fewer, the connecting fibres are reduced to a sparse reticulation of spicules, and spongin is almost completely wanting.

In the several specimens of *D. lunata* examined by me, the microxea are, without exception, simply bow-shaped, *i.e.*, curved in one plane. In the Australian Museum, however, there is a mounted slide of the spicules of a Port Phillip sponge in which (while otherwise closely agreeing in spiculation with *D. lunata*) the microxea for the most part are more or less curved in a distinctly sigmoidal manner.* There is evidence for supposing, therefore, that the microxea of *Desmoxya* are derivatives of sigmata.

DESMOXYA LUNATA Carter.

(Pl. xxix., fig.5; Pl. xxxviii., fig.5; Pl. xliv., fig.4.)

1885. *Higginsia lunata* Carter(**5**), p.358.

1897. *Higginsia lunata* Dendy(**7**), p.244.

Diagnosis.—Sponge massive, sessile, more or less dome-shaped, rising above into short digitiform processes, and provided also with irregularly scattered small conuli. Dermal membrane minutely reticulate; with many dermal pores in each mesh of the reticulation. Skeleton feebly developed, consisting of irregularly ascending, slender, multispicular main fibres, between which there extends a very sparse and irregular reticulation composed chiefly of single spicules. Megascleres slightly curved, cylindrical or nearly so; comprising oxea and styli in approximately equal numbers, and relatively few strongyla; maximum size about 800 by 12 to 15μ. Microxea crescent-shaped, minutely spinulous except in their central moiety, 30 to 45μ long and up to 3·5μ in stoutness. Trichites separable into two groups as regards size, the shorter varying from 60 to 220μ in length, the longer from 560 to 620μ; occurring in dragmata and scattered singly, the larger ones also forming short fibres.

Loc.—Port Phillip.

External features.—The sponge (which is known now from seven examples) appears always to be more or less dome-shaped (Pl. xxix., fig.5),—usually not far from (roughly) hemispherical, sometimes nearly as high as broad, occasionally, however, much depressed, almost flattened,—and is provided with moderately numerous mammiform, or short digitiform, processes; in addition,

* In this presumable second species of *Desmoxya*, the microxea (if they may correctly so be termed) are very small, rarely attaining to more than 25μ in length.

the surface, including that of the processes, is covered with small, usually blunt conuli. The largest specimen measures 95 mm. in length, 80 mm. in breadth, and 70 mm. in height; and the processes, which are generally slightly flattened and somewhat appressed to the surface, average about 4 mm. in diameter at the base, and vary in length up to about 10 mm. The dermal membrane is strongly developed and fairly easily separable, and usually presents to the naked eye a minutely reticulate pattern due to the mode of arrangement of the dermal pores (Pl. xxxviii., fig.5). Internally, the sponge is traversed vertically by rather numerous main efferent canals, measuring up to 3 mm. in diameter, which open into small, usually inconspicuous oscula situated on the upper parts of the surface. The oscula occur on and between the digitiform processes indifferently. The consistency in alcohol is soft and compressible, and lacking in toughness; the texture, however, is compact. The colour in life is some shade of brown, —usually a darkish or slaty-brown, sometimes with a greenish tinge; in alcohol, it is brownish-grey on the surface and pale grey within.

The dermal reticulation (Pl. xxxviii., fig.5) is formed of more ar less polygonal meshes of various size up to about 300 by 200μ, usually longer than broad, but varying in actual shape, in different parts of the surface, from subcircular to nearly oblong, and separated by usually narrow boundaries from 35 to (rarely) 150μ in width. Within each of the meshes, the dermal membrane is perforated by numerous pores. In consequence, no doubt, of their having become closed through contraction, the pores sometimes are apparently absent; and in one of the specimens examined, presumably owing to excessive contraction, even the dermal reticulation was indistinguishable. No megascleres are present in the dermal membrane, and only very few scattered trichites; but in the boundaries of the meshes of the reticulation, spined microxea occur more numerously than elsewhere in the sponge.

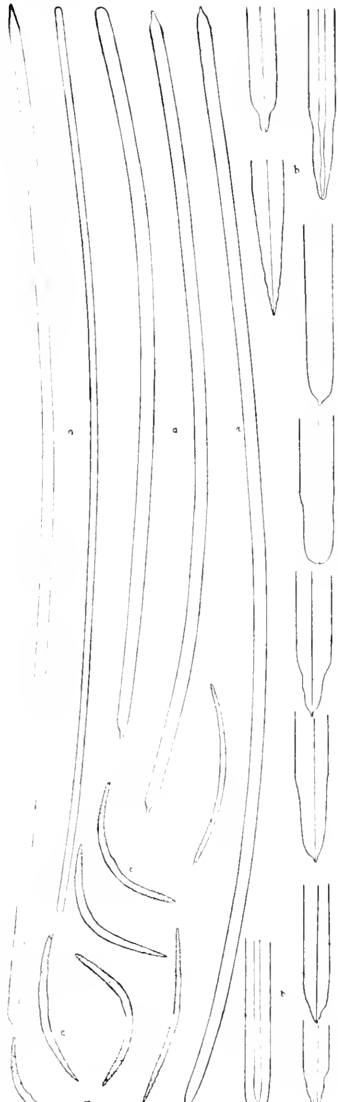
Skeleton.—When a piece of the sponge is treated with caustic potash, it usually decomposes entirely, yielding nothing but a flocculation (consisting mainly of separate spicules); occasionally, however, by the exercise of especial care, one succeeds in obtaining, as part of the residue, small masses of coherent skeleton. From examination of these, the skeleton, which is extremely scanty, is seen to consist partly of slender, multispicular (main) fibres running irregularly through the sponge, branching and occasionally anastomosing as they go, and partly of a very sparse and irregular reticulation of single spicules and short paucispicular fibres extending between the main fibres and partly serving to connect them (Pl. xliv., fig.4); the structure is much less dense than would appear from the figure, inasmuch as in the mounted preparation, from which the photograph was taken, the skeleton has been compressed under the cover-glass to less than half its original thickness. The main fibres are rarely as much as 40μ in stoutness, and are composed of fairly closely-packed spicules, directed longitudinally, and barely held together by an evanescently small amount of hyaline spongin, which becomes discernible only when stained. Outside the main fibres, spongin is generally wanting; but here and there, where several spicules cross one another at a point, a faint investment of cementing substance is sometimes detectable.

In ordinary sections of the sponge (*i.e.*, with the fleshy tissues intact) the precise pattern of the skeleton is usually not manifest: for, in thick sections, it is generally more or less obscured in consequence of an opacity due to great numbers of pigmented granules scattered everywhere through the tissues; while, in thinner sections, owing to the sparseness and irregularity of the skeleton, the main fibres are usually more than once cut across, and thus appear not to be continuous, and the intermediate skeleton appears to consist merely of a few scattered spicules. Trichodragmata occur rather abundantly through all parts of the interior, but are not very noticeable owing to the obscuring effect of the pigment-granules and the extreme slenderness of the individual trichites. Singly scattered trichites are scarce. The spined microxea likewise occur in all parts of the sponge, but are nowhere abundant; they are most numerous in the dermal membrane.

Spicules.—(i.) The megascleres are slightly curved cylindrical oxea, styli, strongyla and intermediate forms, differing from one another only in the character of their extremities, and the same in all parts of the sponge; the oxea and styli are present in about equal numbers, while the strongyla are notably fewer. They are of approximately the same dimensions in all the specimens examined, ranging in length from about 520μ to slightly above 800μ, rarely to 850μ, and varying in maximum stoutness (in different specimens) from 12 to 15μ.

(ii.) The trichites are straight or nearly so, almost immeasurably fine, and of all lengths between 560 and 620μ, and between 60 and 220μ; the shorter ones are again nearly separable into two groups, individuals between 100 and 150μ in length being very scarce.

(iii.) The acanthoxea are arcuately curved, crescentiform, often very slightly inflated centrally, 30 to 45μ in length by 2 to 4μ in stoutness, and densely covered with minute spinules for a distance of from 10 to 15μ from their extremities, the remaining portion of their length being smooth. The curvature is sym-



Text-fig. 19.*

* *Desmoxya lunata.* *a*, megascleres; *b*, extremities of the same, more highly magnified; *c*, spined microxea.

metrical, and rather variable in degree: when most considerable, it slightly exceeds that of two-fifths of the circumference of a circle.

Genus Holoxea Topsent.

Definition.—Axinellidæ(?) of massive or encrusting habit; with a more or less irregular, halichondroid, main skeleton, and with or without a dermal skeleton of horizontally-disposed megascleres. The megascleres are oxea of one or two kinds, and the characteristic microscleres are minute microxea, somewhat resembling sanidasters; in addition, trichodragmata are typically present.

Type-species, *H. furtiva* Topsent(**45**).

The considerable agreement which exists between this genus and *Desmoxya* in the matter of spiculation appears to me to justify the supposition of a relationship between them. It is true that, in *H. furtiva*, the type-species, so Topsent informs us in his second description thereof(**51**),—the ectosome is charged with more or less horizontally-disposed oxeote megascleres (differing from those of the main skeleton only in size), and is differentiated to form a cortex "peu epaisse, mais assez resistante"; but the importance to be attached to this feature is minimised by the fact that the other two species which have been ascribed to the genus,—viz., *H. collectrix* and *H. valida* Thiele(**39**),—a specially characterised cortex is, apparently, wanting; moreover, it is to be noted that, in *Desmoxya lunata*, the dermal layer is particularly well-developed, and if provided with a megascleric skeleton would probably constitute what might be termed a cortex. The information at our disposal regarding the structure of the main skeleton in the several species of *Holoxea* is extremely scanty: Topsent merely mentions, in the case of *H. furtiva*, that when the sponge is confined to narrow crevices the megascleres are constrained, owing to their great length, "s'orienter dans un sens déterminée, par faisceaux sur des longueurs variables", and that "il en résulte souvent un faux-semblant de charpente fibreuse"; while Thiele goes no farther than to state that the megascleres (of *H. collectrix*) "lassen keine bestimmte Anordnung erkennen." So far as one can judge, it seems probable that the skeleton, on the whole, is arranged irregularly, in a more or less halichondroid fashion; and this is the type of skeleton-pattern which would result if, in *Desmoxya lunata*, the reticulum of interstitial and connecting spicules merely increased in degree of development and complexity at the expense of the connecting fibres. The spined microscleres of *Holoxea furtiva* are looked upon by Topsent as sanidasters, and he has accordingly referred the genus to his proposed family Streptasteridæ; but these microscleres, it seems to me, might with equal propriety be regarded as microxea,—and, indeed, in Topsent's original description of the species were so designated: furthermore, in *H. furtiva* and *H. collectrix*, as in *Desmoxya*, the spined microscleres are accompanied by trichodragmata, which latter are unknown to occur in association with definitely astrose microscleres elsewhere in the Monaxonida. Whether certain genera with spined microxea, like *Desmoxya* and *Higginsia*, properly admit of inclusion in the family Axinellidæ is open to question; but *Holoxea* certainly appears to resemble *Desmoxya* much more closely than it does any other genus, and on that account, perhaps, ought to be placed in proximity thereto.

Genus Higginsia Higgin.

Definition.—Axinellidæ(?) of various external form; typically erect-lamellar, with entire or lobate margin, or sometimes tending to become palmo-digitate or frondose: seldom ramose; occasionally massive, with or without digitate processes. Skeleton usually more or less condensed axially; typically consisting (extra-axially) partly of more or less plumose main fibres or spicule-columns running to the surface, and partly of an irregular reticulation of spicules connecting the main fibres; either of these components, however, may be much reduced or absent. Or the extra-axial skeleton may consist (either throughout or only in its outer region) of bundles or bands of long styli radiating to the surface, and of sheaves of smaller and slenderer spicules surrounding these. Spongin present in small to moderate quantity. Megascleres: styli and (or) oxea, usually of two or three kinds. Megascleres of a single kind, in the form of centrangulate spined microxea.

Type-species, *H. coralloides* Higgin.

The genus *Higginsia* is here defined so as to include also Ridley and Dendy's *Dendropsis*, with its two species *D. bidentifera* and *D. mixta*,—the latter recently added to the genus by Hentschel(**15**). The reason for this is not that the differences between *Higginsia coralloides* and *Dendropsis bidentifera*, the respective type-species, are insufficient to warrant their generic separation, but that intermediate species exist between them, forming with them (in so far as skeletal characters are concerned) a gradational series incapable of subdivision into two groups except in an arbitrary way. This fact will be clear from the following synopsis of the chief distinguishing characters of the several species.

Dendropsis bidentifera Ridley & Dendy(**33**). Dichotomously ramose, with slightly compressed branches disposed in one plane. Skeleton consisting (i.) of a dense axial core of interlacing, comparatively short styli; (ii.) of bundles of much longer styli (up to 1100 by 44μ in size) radiating from the axis to the surface, beyond which the apices of many of them project; (iii.) of sheaves of slender oxeote spicules surrounding (ii.), which are peculiar in being double-pointed at one extremity, and also often project beyond the surface; and (iv.) of long slender styli (up to 1750 by 20μ in size), occasionally passing into strongyla.

Dendropsis mixta Hentschel(**15**). Thick, encrusting; with short digitiform processes. Skeleton consisting (i.) interiorly of irregularly arranged stout oxea (up to 750 by 31μ in size); (ii.) of long slender styli (up to 2240 by 31μ in size) projecting beyond the surface; (iii.) of bundles of slender oxea (up to 1175 by 5μ in size), forming dermal tufts around (ii.) as in the genus *Raspailia*, and also passing inwards towards the interior.

Higginsia papillosa Thiele(**42**). Massive, ovoidal; with papillose surface. Skeleton consisting (i.) of stout fibres, formed of styli, radiating to the surface and ending in the surface-papillæ,

—their terminal spicules (up to 1500 by 15μ in size) projecting beyond; (ii.) of shorter and relatively stouter styli, partly scattered irregularly between the main fibres, and partly forming lesser fibres running irregularly in various directions; and (iii.) of slender oxea (up to about 1000 by 6μ in size), which "pflegen in grösserer oder geringerer Anzahl die Style zu begleiten."

Higginsia natalensis Carter(**5**). Flabelliform, stipitate; with thin ridges on both surfaces, radiating from stalk to circumference. Skeleton-structure undescribed: megascleres of two kinds, viz., (i.) styli (up to about 1000 by 43μ in size), presumably arranged in fibres; and (ii.) slender oxea (up to 700 by 7μ in size) surrounding (i.) "in great numbers".

Higginsia coralloides Higgin(**17**), et varr. More or less lamellar, varying from submassive (*i.e.*, sessile and only slightly compressed) to stipitate-flabelliform, and then either entire or palmately subdivided; with longitudinal or radiating ridges on both surfaces. Skeleton consisting of more or less plumose main fibres or columns with an irregular reticulation of spicules between. Megascleres almost exclusively oxea, or oxea alone; usually of two kinds.

Higginsia thielei Topsent(**53**). Massive, with irregular surface. Skeleton consisting of "un réseau irrégulier, très solide, de styles robustes disposés par paquets épais et reliés aux entrecroisements par un lien très faible de spongine incolore." Megascleres styli, of a single kind.

In all the species, the microscleres are of the same characteristic form, and occur irregularly scattered through the choanosome and usually also in the dermal layer; they are symmetrically and rather sharply bent (*i.e.*, centrangulate or geniculate) acanthoxea with small spines scattered irregularly over their whole length, and are frequently provided with a bulbous dilatation situated slightly excentrally.

The exact similarity which exists between the microscleres of the present genus and those of *Halicnemia patera* has already been pointed out by Topsent(**49**), who accordingly refers *Halicnemia*, along with *Higginsia*, to the Axinellidæ. It seems to me extremely probable, however, that the acanthoxea of these genera, like those undoubtedly of the recently described genus *Acanthoxa* Hentschel(**16**), are homologous with the acanthoscleres of the Myxillinæ, and that the correct place of *Higginsia* and *Halicnemia* is, therefore, in the family Desmacidonidæ.

The genus is represented on the Australian coast by two varieties of *H. coralloides*,—viz., *massalis* Carter and *scabra* Whitelegge,—re-descriptions of which are given below. The other named varieties of this species (the typical form of which comes from the West Indies) are Higgin's(**17**) var. *liberiensis* from Cape Palmas and var. *arcuata* from Ireland; while the form recorded by Topsent(**48**) from Amboina as *H. coralloides* var. *massalis* probably constitutes a fifth variety. Carter's *H. coralloides* var. *natalensis*, although possessing the external habit characteristic of *H. coralloides*, is distinguished by having the skeletal fibres composed of stylote instead of oxeote megascleres, and may, therefore, conveniently be regarded as specifically distinct.

To supplement the brief diagnosis of *H. coralloides* given above, and at the same time to indicate the main points of difference distinguishing the varieties *massalis* and *scabra* from the remaining forms of the species, the chief characters of the latter (excepting Topsent's var. *massalis*, the description of which I have not seen), may be summarised as follows:—

H. massalis (typical form). Stipitate, flabelliform; "consisting of lobate compressed branches of irregular and luxuriant growth, united clathrously or continuously; surface deeply furrowed in a vertical direction, the ridges between the furrows being narrow and, in the young growths, serrated with tooth-like projections, passing in the older portions into rounded or tubercled prominences." The skeleton is "a spiculiferous network of lozenge-shaped reticulation," consisting (in part) of plumose fibres, the spicules of which are not enclosed in spongin, but merely cemented together by it where they touch or cross each other. The megascleres (oxea) appear to be of two kinds,—those of the fibres more or less curved and attaining a maximum size of 635 by 25μ, the others straight, very much slenderer (only 6μ in diameter), and relatively few in number. The spined microxea attain a size of 200 by 6μ.

H. coralloides var. *liberiensis* Higgin. Similar in outward form to the preceding. Structure of the skeleton undescribed. Megascleres of two kinds: stout curved oxea up to 660 by 32μ in size, and longer, straight, "hair-like" oxea. Spined microxea measuring 75 by 6μ.

H. coralloides var. *arcuata* Higgin. Only slightly compressed, submassive. Surface-features undescribed. Skeleton consisting of main lines of spicules extending vertically from the base, and of secondary lines connecting these at various angles, both being "echinated" with spicules (*i.e.*, more or less plumose). The megascleres (oxea) are not stated to be of two sizes; they are comparatively small, measuring only 300 by 6μ. The spined microxea measure 75 by 3·6μ.

Higginsia coralloides Higgin, var. massalis Carter.

(Pl. xxix., fig.6; Pl. xxxviii., figs.6, 7; Pl. xxxix., figs.1, 2; Pl. xl., figs.1-4.)

1885. *Higginsia coralloides* Carter(**5**), p.357.

1885. *Higginsia coralloides* var. *massalis* Carter(**5**), p.357.

1896. *Higginsia coralloides* var. *massalis* Dendy(**7**), p.243.

Diagnosis.—Sponge more or less compressed; varying in form from thickly flabellate and stipitate to submassive and sessile; the margin entire. Surface longitudinally ridged and furrowed; the ridges generally more or less discontinuous, appearing as a succession of crenations or knobs; distance apart of the ridges, 2 to 3 mm. Oscula small, marginal. Dermal membrane distinct, finely porous. The "skeleton-sponge" consists of a series of transverse, thin lamellæ, each only about a millimetre in thickness, which are nearly quite separate from each other in their uppermost portions, but become more and more intimately united in the median plane of the sponge proceeding towards its base. The skeleton of each lamella is a dense and intricate reticulation of paucispicular main and connecting fibres and single spicules.

Spongin is present in relatively small quantity. The megascleres are imperfectly differentiated into three kinds: (i.) curved oxea forming the skeleton-reticulation, attaining a maximum size of from 560×14 to $700 \times 18\mu$; (ii.) longer and slenderer, scarce styli, strongyla, and (very rare) oxea, occurring interstitially, ranging in length to upwards of 900μ; and (iii.) smaller interstitial and dermal oxea, commonly between 250 and 350μ in length and 4 or 5μ in diameter, but frequently slenderer, and connected by spicules of intermediate size apparently both with (i.) and (ii.). The acanthoxea are from 40 to 130μ in length and up to 4 or 5μ in diameter exclusive of the spines, and rather seldom exhibit a bulbous dilatation.

Loc.—Port Phillip.

External characters.—The general shape and habit of growth of the sponge are sufficiently indicated in the diagnosis; and the characteristic rugose surface-appearance produced by crenated longitudinal ridges and intervening furrows is well shown by the figure (Pl. xxix., fig.6),—which also illustrates the most frequent form of the sponge, viz., one intermediate between flabellate and submassive. Apparently it is only in its younger stages that the sponge is massive, subsequent growth taking place chiefly in height and breadth, with only slight increase in thickness; occasionally the plate thus formed, instead of remaining simply flabellate, becomes somewhat irregular through formation of perpendicular lateral outgrowths similar to itself. The largest specimen at my disposal measures about 75 mm. in height, 110 mm. in breadth, and 25 mm. in maximum thickness of the plate. The surface-ridges (and furrows) pass without discontinuity across the margin of the sponge from one side of it to the other, and, as necessarily follows, are oppositely situated on the two surfaces. The oscula are situated marginally, and are numerous and of small size, the largest seldom exceeding 1 mm. in diameter. The dermal membrane, which is well-developed, is most distinct within the surface-grooves, where it is underlain by extensive subdermal spaces; it is closely perforated with minute pores, which in some places are sufficiently large to be discerned with the naked eye (Pl. xxxviii., figs.6, 7). Well-preserved spirit-specimens are of firm, compressible, and resilient consistency, and of compact texture, and vary in colour from pale greyish-yellow to light brown, occasionally with a faintly pinkish tinge. The colour in life, according to previous descriptions, varies from "hair-brown" to dull shades of purple.

The dermal pores (Pl. xl., figs.3, 4) are distributed singly in very close order, are circular or oval in shape, and vary from about 100 to occasionally upwards of 300μ in diameter. In the dermal membrane, spined microxea occur scattered in great abundance.

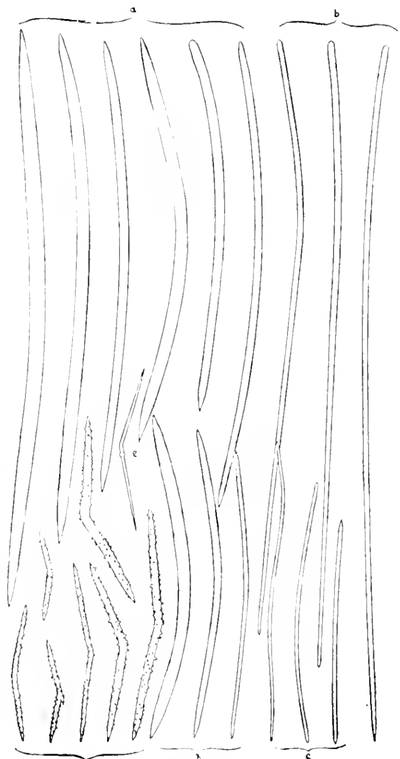
The "skeleton-sponge",—meaning by that the entire coherent skeleton which remains after complete removal of all the fleshy substance of a specimen by maceration with caustic potash,—is of very characteristic gross structure. Its general superficial contour is nearly similar to that of the original entire sponge; but the shallow surface-furrows of the latter are replaced by deep vertical fissures (Pl. xxxix., fig.2) penetrating it (except its older portions) almost or quite to the mid-plane, and thus reducing it (since the furrows on the one side are situated exactly oppositely to those on the other) to a series of nearly separate, transverse lamellæ. A single such lamella, photographed by transmitted light, is shown in Pl. xxxix., fig.1. The lamellæ are each about 1 mm. in thickness, and their distance apart, at their periphery, varies from about 2 to 3 mm.; their edges, which correspond to the discontinuous, crenated surface-ridges of the internal sponge, are irregularly lobed or toothed. Distally (*i.e.*, in the upper parts of the skeleton-sponge) the lamellæ are either quite separate from one another or are barely united together by a thin septiform connection in the mid-plane of the sponge; but proceeding towards the base of the sponge, this connection gradually increases in breadth, and in addition an increasing number of independent, synapticula-like connections arise between them, so that in places a honeycombed appearance sometimes results.

The skeleton-sponge is fine-textured, and (being composed to a greater extent of spicules than of spongin) is, when dry, whitish in colour and somewhat harsh to the feel, and remains slightly crushed when much compressed by squeezing.

Skeleton.—In each constituent lamella the skeleton consists of numerous, closely arranged, pauciserial main lines of spicules running in the plane of the lamella upwards and outwards to its periphery, and of numerous short secondary lines and single spicules connecting these in irregular manner, the whole forming an exceedingly dense and intricate reticulation (Pl. xl., figs. 1, 2). The spicules of the fibres are arranged in a somewhat loose, irregular, and slightly plumose fashion, and are held together and more or less ensheathed by a rather small amount of spongin, which, being of a pale colour, is inconspicuous unless stained; the interfibral spicules, for the most part, are invested with spongin only at their extremities or lie quite free. The skeleton-reticulation is so dense, especially towards the central region of the lamella (*i.e.*, towards the mid-plane of the sponge), that, in sections of the ordinary thickness for studying the skeleton-pattern, it appears as if consisting of a confused mass of spicules without definite arrangement. In the interlamellar regions of the sponge, except where junctions between the lamellæ occur, the skeleton consists solely of spined microxea scattered in great profusion, and of very scarce scattered megascleres. The interlamellar regions are traversed by numerous main canals, the largest of which are about 1 mm. in diameter.

The previous description of the skeleton, given by Dendy, which differs rather considerably from the above, was evidently based upon an insufficiently thin (and "undesarcodised") section cut across the thickness of the sponge obliquely to the mid-plane (and, therefore, intersecting several lamellæ). The description is as follows: "The skeleton is very confused and irregular, without any definite fibre, composed of densely intermingled oxeote spicules, especially aggregated in wide tracts which trend towards the surface and end in the conuli. The presence of these ill-defined tracts of spicules, with intervening spaces almost free from megascleres, gives a somewhat columnar character to the vertical sections. Internally, all the tracts unite into one dense, irregular agglomeration of spicules." It is obvious that the "tracts of spicules" correspond to vertical transections of the lamellæ.

Where the main skeleton abuts on the surface of the sponge (*i.e.*, along the surface-ridges), the terminal spicules of the skeletal fibres project slightly beyond the dermal membrane, and along with these projecting fibral spicules are occasional small clusters of much shorter and slenderer diactinal spicules which are perhaps to be regarded as special dermal megascleres. Elsewhere (*i.e.*, within the surface-grooves) the dermal membrane overlies extensive subdermal spaces, and is generally free from megascleres.



Text-fig. 20.—*Higginsia coralloides* var. *massalis*. *a*, megascleres of the fibres; *b*, interstitial megascleres; *c*, dermal megascleres; *d*, spined microxea; *e*, immature microxea.

Megascleres.—(i.) The spicules of the skeleton-reticulation are somewhat angulately curved oxea (and occasional styli), which in some specimens are of nearly uniform diameter to within a comparatively short distance of their extremities and generally are more or less irregularly pointed (often somewhat blunt-pointed, and occasionally approximating in form to strongyla), while in other specimens they taper very gradually to the extremities (*i.e.*, are more or less fusiform) and with rare exception are regularly sharp-pointed. The full-grown ones (comprising all those ensheathed in spongin as well as the vast majority of the remainder) vary in maximum size in different specimens from $560 \times 14\mu$ to $700 \times 18\mu$, and rarely fall below 350μ in length or below 8μ in diameter; interstitially-occurring immature individuals of all sizes down to about $250 \times 2\mu$, however, are to be met with.

(ii.) Also occurring interstitially, but very scarce (in some specimens exceedingly rare), are longer and generally less curved, mostly stylote spicules, very frequently more or less blunted or rounded off at the apex and not seldom passing into strongyla, and attaining a maximum size of about $900 \times 9\mu$. Between these and the slenderer forms of the preceding, however, there appears to be a complete series of spicules of intermediate forms and sizes.

(iii.) The short slender megascleres occurring in loose bundles and also scattered singly in the dermal layer,—which appear to be special dermal spicules,—are slightly curved oxea, frequently blunt-pointed and more or less resembling strongyla, and usually 4 or 5μ in diameter and between 250 and 350μ (but ranging from about 200 to upwards of 400μ) in length. They are not distinguishable either in form or size from many of the interstitially occurring spicules which appear to be immature forms of (i.) and (ii.).

Microscleres.—With the exception of a few, which are straight, the acanthoxea are invariably sharply bent at the centre,—the maximum angle of inclination of the actines (which are gradually tapered and sharp-pointed) being about 30°. About 5% of the spicules exhibit a peculiarity in the form of a small bulbous dilatation situated at a short distance (10μ or less) from their mid-point. They range from about 40 to 130μ in length and up to 4 or (rarely) 5μ in diameter exclusive of the spines. The spines are perpendicularly-directed, conical, sharp-pointed, usually very numerous, and scattered irregularly over the whole length of the spicule, gradually decreasing in size towards its extremities; the largest of them are $2 \cdot 5\mu$ in length. The spicules in their earliest stage of development are quite smooth. As an occasional abnormality, one actine is prolonged beyond its point of union with the other, as shown in the text-figure; and very rarely both actines are thus prolonged.

HIGGINSIA CORALLOIDES Carter, var. SCABRA Whitelegge.
(Pl. xxxix., fig.3; Pl. xli., figs.1-3.)

1907. *Higginsia scabra* Whitelegge(60), p.511, Pl. xlvi., fig.44.

Diagnosis.—Sponge erect, lamellar, perhaps sometimes simply flabelliform, but more usually subdivided into lobes or separate fronds. Surface closely covered with small conuli arranged somewhat indistinctly in longitudinal parallel series about 1 mm. apart. Oscula small, marginal. Dermal membrane very distinct. Internal structure and skeleton-pattern not essentially different from that of the preceding variety Megascleres: (i.) curved oxea in the main skeleton, $770 \times 35\mu$ in maximum size; (ii.) exceedingly rare styli occurring interstitially, up to $1100 \times 25\mu$ in size. Special dermal megascleres apparently absent. Acanthoxea 60 to 130μ in length and up to 5μ in diameter exclusive of the spines; very frequently exhibiting a bulbous dilatation.

Loc. Off Port Jackson, N.S.W.

This variety is so far known only from the two original specimens – obtained from the same locality – one of which (figured by Whitelegge) is in a dried condition, while the other (smaller and incomplete) is imperfectly preserved in alcohol.

External characters.—Both specimens are erect, substipitate, lamellar,– the smaller one apparently flabellate, divided above into several lobes, the other consisting of much more completely separated (though in part secondarily coalescent) lobes or frond-like branches, from some of which, also, secondary sessile lobes or fronds arise laterally; in both, the thickness of the lamina is about the same, viz, from 6 to 10 mm. The larger specimen measures 110 mm. in height. In the dried condition of the sponge, with the dermal membrane shrunken closely in upon the underlying skeleton, the surface is densely and conspicuously conulose,— the conuli attaining in places a height of as much as

2·5 mm., and exhibiting an indistinct arrangement in longitudinal rows; but in the case of the spirit-specimen, except where the dermal membrane has been destroyed, it is scarcely more then minutely pustulose. On complete removal of the sarcode by maceration, the skeleton-sponge is found to be composed, just as in the case of var. *massalis*, of conjoined, parallel, thin lamellæ perpendicular in direction to the plane of the sponge; and it is to a serration of the edges of these lamellæ that the surface-prominences are due. The only oscula observed were marginally situated and of very small size, the largest not exceeding 0·5 mm. in diameter. The dermal membrane is well-developed and very distinct, and is underlain (between the surface-prominences) by extensive subdermal spaces; owing to its imperfect preservation in the present specimens, dermal pores were not observable. The unmacerated dried sponge is somewhat hard and with difficulty compressible, brittle rather than elastic, and pale greyish or almost whitish in colour. In alcohol, the consistency is dense and firm, moderately flexible, compressible and resilient; and the colour is yellowish pale grey.

The structure of the "skeleton-sponge" is essentially the same as in the case of var. *massalis;* but the lamellæ are much thinner (only about 0·5 mm. in thickness), more closely approximated (at most 1·75 mm. apart), and, in proportion to their width (*i.e.*, in proportion to the thickness of the sponge-lamina), more completely united with one another. In the present variety, accordingly, the structure is notably denser, and the texture also is much more coarse.

Skeleton.– In each lamella the skeleton consists, again as in the case of var. *massalis*, of a dense and intricate reticulation of paucispicular main and connecting fibres, and numerous connecting spicules; but the fibres are here less clearly defined, the skeleton-pattern accordingly is somewhat more irregular, the megascleres are larger, and there is a relatively great scarcity of slenderer megascleres occurring interstitially and dermally. In other respects, apart from differences depending upon the greater thinness of the lamellæ and the much lesser width of the interlamellar in the present case, the skeletal characters of the two varieties are practically the same. As seen in a vertical median section of the sponge, cut in a direction perpendicular to the lamellæ, the skeleton appears as if consisting of parallelly-arranged, stout plumose columns of spicules, which in the marginal region of the sponge are nearly or quite separate from one another (Pl. xli., figs. 1, 2); these columns represent, of course, transverse sections of the lamellæ. The appearance of the skeleton (of a lamella) in a direction at right angles to the preceding is shown in Pl. xli., fig. 3.

Megascleres.—(i.) The oxea of the skeleton-reticulation are curved, fusiform, regularly sharp-pointed spicules, ranging from 550 to 770μ in length and up to 35μ in stoutness; individuals less than 8μ in diameter are very rare, and those forming the fibres very seldom are much less than 20μ. Occasional spicules are styli or substrongyla.

(ii.) Long interstitial megascleres are exceedingly rare, and appear to be invariably styli. The few observed measured from 950 to 1100μ in length and from 15 to 25μ in stoutness.

(iii.) Megascleres corresponding to the slender dermal spicules of the preceding variety are apparently wanting.

Microscleres.—The acanthoxea are exactly similar in form and size to those of the preceding variety, excepting that their minimal length is somewhat greater (about 60μ) and a considerable proportion of them (amounting to about 50%) exhibit a bulbous dilatation.

For Postscript, see p.673.

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EXPLANATION OF PLATES.

Plate xxix.

Fig.3.—*Rhaphoxya typica*, sp.nov.; ($\times \frac{2}{3}$).
Fig.5.—*Desmoxya lunata* Carter; ($\times \frac{2}{3}$).
Fig.6.—*Higginsia coralloides* var. *massalis* Carter; ($\times \frac{5}{12}$).

Plate xxxiii.

Fig.6.—*Rhaphoxya*(?) *pallida* Dendy; ($\times \frac{2}{3}$).

Plate xxxviii.

Fig.5.—*Desmoxya lunata* Carter; photograph of portion of the surface to show the dermal pores.

Figs.6, 7.—*Higginsia coralloides* var. *massalis* Carter; photograph of different portions of the surface, showing the dermal pores.

Rhaphoxya typica, sp.nov.

Fig.8.—Photograph of portion of the surface, showing the dermal pores.

Fig.9.—Photograph of part of a section through the choanosome, showing canals and flagellated chambers. (The outlines of the canals and chambers have been retraced with pen and ink to render them more distinct).

Plate xxxix.

Higginsia coralloides var. *massalis* Carter.

Fig.1.—An entire lamellar component of the skeleton; (nat. size).

Fig.2.—Portion of a desarcodised specimen, showing the crenated surface-ridges and the intervening deep grooves, the latter partially obliterated (in the lower portion of the figure) by synapticula-like connections between the former; (nat. size).

Fig. 3.—*Higginsia coralloides* var. *scabra* Whitelegge; extremity of a frond-like lobe of the sponge, desarcodised, showing the discontinuous surface-ridges and the deep intervening grooves, the latter almost obliterated (in the lower portion of the figure) by synapticula-like connections between the former; (nat. size).

Fig. 4.—*Rhaphoxya*(?) *pallida* Dendy; skeleton remaining after desarcodisation of a (3 mm. thick) vertical slice of an entire specimen by means of caustic potash; (nat. size).

Fig. 5.—*Rhaphoxya typica*, sp.nov.; the skeleton remaining after desarcodisation of a (3 mm. thick) vertical slice of an entire specimen; (nat. size).

Plate xl.

Higginsia coralloides var. *massalis* Carter.

Fig. 1.—Showing pattern of the skeleton as seen in a thin section in the mid-plane of one of the component lamellæ near its upper margin; (× 15).

Fig. 2.—Showing pattern of the skeleton as seen in a thin section parallel to, but at some distance from, the mid-plane of a component lamella near its upper margin; (× 15). (This figure and the preceding one are from sections of two different specimens).

Figs. 3-4.—Surface-sections, showing the arrangement of the dermal pores; (× 40).

Plate xli.

Higginsia coralloides var. *scabra* Whitelegge.

Fig. 1.—Section of the skeleton (at the extremity of a frond-like lobe), cut in a direction perpendicular to the planes of the component lamellæ; (× $3\frac{3}{4}$).

Fig. 2.—Portion of the preceding figure enlarged; (× 12).

Fig. 3.—Portion of a single lamellar component of the skeleton; (× 4).

Plate xlii.

Rhaphoxya typica, sp.nov.

Fig. 1.—Longitudinal section of the skeleton in proximity to the surface; (× 12).

Fig. 2.—Longitudinal section of the skeleton remote from the surface of the sponge; (× 12).

Plate xliii.

Rhaphoxya(?) *pallida* Dendy.

Fig. 1.—Longitudinal section of the skeleton in proximity to the surface; (× 12).

Fig. 2.—Longitudinal section of the skeleton remote from the surface of the sponge; (× 12).

Plate xliv.

Figs.1, 2.—*Rhaphoxya typica*, sp.nov.; surface-sections, showing the reticulate pattern of the surface and the arrangement of the dermal pores; (× 85).

Fig.3.—*Rhaphoxya*(?) *pallida* Dendy; surface-section, showing dermal pores; (× 85).

Fig.4.—*Desmoxya lunata* Carter; longitudinal section of the skeleton; (× 12).

Postscript *(added 15th December, 1916).*

In Part ii. (*antea*, p.500), in my remarks on the distinction between the genera *Biemna* and *Tylodesma*, I expressed the opinion that, if *Desmacella fragilis* Kieschnick, is correctly described as possessing a spiculation consisting of styli, sigmata, trichodragmata, and *toxa*, it would be advisable to establish a new genus for its accommodation (rather than adopt the only seemingly possible alternative, namely, that of merging the two genera *Biemna* and *Tylodesma* in one). Since then I have received a copy of Prof. Dendy's recent "Report on the Non-Calcareous Sponges collected by Mr. James Hornell at Okhamandal,"* in which is contained the information that toxa, in addition to styli, sigmata, and trichodragmata, likewise occur in *Desmacella tubulata*. For the reception of these two species, therefore, and for such others as may be found to possess toxa together with trichodragmata, irrespective of whether the megascleres be styli or tylostyli, or of the presence or absence of sigmata, I propose the new genus *Toxemna*, with *D. tubulata* as the type-species.

The family Axinellidæ, as at present constituted, admits of subdivision into four groups, which I think might conveniently be raised to the rank of subfamilies, with the designations Axinellinæ, Desmoxyinæ, Trachycladinæ, and Desmacellinæ. The first would comprise all the genera without microscleres; the second, *Desmoxya*(g.n.), *Higginsia*, *Halicnemia*, *Heloxea*, and (?)*Laonænia*(g.n.); the third, *Trachycladus* alone; and the fourth, the remaining genera with microscleres, viz., *Tylodesma*, *Toxemna*

* Dendy, A., in "Report to the Government of Baroda on the Marine Zoology of Okhamandal in Kattiawar," Part ii. London, 1916.

(g.n.), *Biemna* (including *Allantophora*), *Sigmaxinella*, *Sigmaxia* (g.n.), *Ceratopsis*, *Dragmaxia* (g.n.), *Dragmacidon* (g.n.), *Axidragma* (g.n.), *Dragmatella* (g.n.), *Thrinacophora*, *Dragmatyle*, and *Rhaphoxya* (g.n.).

The occurrence of trichodragmata in *Rhizaxinella pyrifera*,—which, according to Topsent(**51**), is identical with *R. clavigera* Keller, the type-species of *Rhizaxinella*,—and in *Spinularia spinularia* (=*Rhaphidorus setosus* Topsent*), renders it possible that these species are more nearly related to the Desmacellinæ than to the Suberitidæ and Polymastiidæ respectively.

The two species described by Row(**34**) under the names *Ophlitaspongia(?) arbuscula* and *O.(?) horrida*, which certainly do not belong to *Ophlitaspongia*, are perhaps representative of a new genus related to *Tylodesma*. Another species which it may be necessary to include in the Desmacellinæ, under a new genus, is that described by Kirkpatrick(**22**) as *Ophlitaspongia nidificata*.

The genus *Sigmaxinyssa* Kirkpatrick(**22**) I regard as belonging to the Gelliinæ.

The genera *Trachygellius* and *Spirasigma*, established respectively by Topsent† and myself (**12**, p.131, footnote) for *Trachya globosa* Carter, and for *Gellius aculeatus* Whitelegge, are obviously related to the Tetillidæ, and must, I now think, in spite of their apparent non-possession of tetracts, be included in that family. The chief distinction between the two genera is the presence of small, spinulous oxea in the latter (cf. *Tetilla australiensis*) and their absence in the former. In both genera, the sigmata (sigmaspires) are very finely spinulous. The genus *Spirasigma* is identical with that indicated by Lendenfeld‡ by the name *Suberamata*.

At the last moment, after having corrected the proof-sheets of Part iii., I find that two species, which apparently must be added to the Desmoxyinæ, have been described by Keller(**18**, **19**) under the names *Axinella pumila* and *Trachytedania arborea*. The former of these may be referred, provisionally at least, to

* *Vide* Stephens, "Fisheries, Ireland, Sci. Invest., 1914, iv.(1915)," p.30.

† Topsent, E., Mém. Soc. Zool. France, vii., 1894, p.8.

‡ Lendenfeld, R., Zool. Jahrb., ii., 1887, p.564.

the genus *Higginsia*; but the latter, in which the microscleres are spined microstrongyla, evidently requires a new genus for its reception, and for this I propose the name *Allantella*.

The new genera proposed in this Paper, in addition to those already indicated in this Postscript, are *Rhabdosigma* (p.520), *Echinaxia*(p.543), *Strongylamma*(p.643), and *Paratimea*(p.675).

Genus HALICNEMIA Bowerbank.

Definition.—Axinellidæ(?) typically of encrusting habit, sometimes disc-shaped, with a main skeleton consisting of smooth skeletal tylostyli disposed (in part, at least) vertically, with their heads based upon the substratum, and with dermal megascleres in the form of smooth, typically centrotylote tornota. The microscleres are centrangulate, spined microxea similar to those of the genus *Higginsia*.

Type-species, *H. patera* Bowerbank(**1**).

Topsent(**49**) would include in this genus, in addition to *H. patera*, Bowerbank's *Hymeraphia verticillata*, and the species originally described by him as *Bubaris constellata*,—both of which agree with *H. patera* in the possession of skeletal tylostyli and centrotylote, diactinal dermal megascleres. The very decided differences between these three species in certain other respects, however, appear to me to render necessary the allocation of each to a separate genus.

In *Hymeraphia verticillata*, the acanthoxea are of slightly curved form and verticillately spined, and the smooth, diactinal megascleres are trifid at both extremities; and, furthermore, the species is sometimes of massive habit. To replace the (preoccupied) generic names *Laothoë* and *Nænia* already proposed by Gray(**11**) for this species, I propose the name *Laonænia*.

The third species referred to has euasters for microscleres, and, but for its possession of special dermal megascleres, would probably require to be referred to the genus *Timea*. For its reception, I propose the new genus *Paratimea*, which I would include in the family Spirastrellidæ.

AN EFFLORESCENCE ON SOME NEW ZEALAND KELPS.

By A. H. S. Lucas, M.A., B.Sc.

In December, 1910, I received a parcel of Algæ from Wellington, N.Z. After washing with fresh water and drying in the open air, I deposited specimens of some of the larger kelps, *Lessonia variegata* J. Ag., *Marginaria Boryana* (Rich.) Mont., and *M. Urvilleana* Rich., in a large cardboard box, and thus preserved them in a dry room. On looking over these specimens in June, 1915, I found them covered with a beautiful efflorescence of delicate needle-shaped crystals, some of them nearly a centimetre in length. They were singly colourless and flexible. The crystals had formed in such quantities that, by shaking the algæ, I was able to collect several grams of them. They were entirely soluble in water.

I made a large number of preliminary tests with them in the laboratory of the Sydney Grammar School. The flame was as pure a potassium flame as I could obtain from crystals of potassium chloride taken from the laboratory stock. I could not obtain any evidence of the presence of any other metal. The abundant precipitate with silver nitrate indicated that the potassium was mainly present as chloride. I could find no trace of sulphates or any other inorganic salts. There were no signs at all of iodine or bromine. That organic substances were present was soon discovered; and, notably, the reduction of copper sulphate in the presence of sugars showed the presence of OH radicals. The solution behaved just as would a solution of a tartrate or a citrate, while Fehling's solution gave no evidence of sugars. I could not obtain, however, independent evidence of the presence of tartrates or citrates.

I then made an exact determination of the amount of KCl. The samples selected were free from sand. In one sample, the percentage of KCl was 60·55, and in a second it was 61·24.

Speaking of the analysis to my friend, Mr. T. Steel, who has great laboratory experience in organic analyses, he evinced great interest in the matter, and offered to make a complete and exhaustive analysis of the efflorescence.

Mr. Steel's analysis gave:-

KCl	58·20
$CaSO_4$	trace
Mannitol	36·70
Sand	4·90
Water	0·30
	100·10

He estimated the potassium and the chlorine separately, and thus definitely proved the complete absence of sodium.

If we deduct the sand, the percentage of KCl in the efflorescence is 61·3 and that of the mannitol 38·6. These percentages agree well with the formula of an exact chemical compound, $C_6H_8(OH)_6$, 4 KCl, as was pointed out by my colleague, Mr. Carpenter.

I then tried if this compound could be formed artificially in the laboratory. The chloride and mannitol were dissolved in the above proportions in a small quantity of water and evaporated down (1) rather quickly, and (2) very slowly in a desiccator. In the former case, the two substances crystallised out separately in their characteristically different crystalline forms. In the second case, crystals of one form only were obtained, needles arranged in beautiful feathery groups, crystals apparently identical with the crystals of the efflorescence.

I tried mixtures of alkaline chlorides with mannitol corresponding to the formula $C_6H_8(OH)_6$, 2KCl: $C_6H_8(OH)_6$, 4NaCl; $C_6H_8(OH)_6$, 2NaCl. In all cases, the substances crystallised out independently. No compound was formed.

The compound $C_6H_8(OH)_6$, 4KCl is unstable in the presence of water, which dissolves more of the mannitol, and of alcohol, which dissolves more of the chloride. On boiling with absolute alcohol, all the mannitol is precipitated.

Similar compounds of the alkaline chlorides with some of the sugars are already known.

It is, of course, well known that many of the kelps, or larger *Fucoideæ*, contain abundance of KCl in their ash. Efflorescence of salts on the dry weed is a common phenomenon in hot, dry climates. Whilst most published accounts of such efflorescences mention large quantities of KCl, they do not in general give anything else except NaCl. On the other hand, so long ago as July 31, 1894, in the Journ. Soc. Chem. Industry, Vol.34, p.608, C. Stanford writes, "Mannite is often seen on the frond of the *Laminaria* as an efflorescence, and is probably the result of fermentation.'" He does not mention the KCl.

A great deal of attention has been paid in the last few years to the constituents of kelps by American workers, and it is of interest to compare the results in the case of American kelps with those obtained from the New Zealand forms mentioned.

Mr. Frank K. Cameron, in Report No.100, United States Department of Agriculture, Washington, 1915, writes, p.21, "The salts contained in kelp are mainly potassium and sodium chlorides. To a small extent, calcium and magnesium salts and iodides are present, and probably unimportant amounts of other salts. While the ratio of potassium chloride to sodium chloride varies more or less, for general argument it may be assumed as approximately 3 to 2." And on p.27, "When kelp is dried slowly, there appears on the surface an efflorescence which can more or less readily be shaken off. This efflorescence is a mixture of potassium and sodium chlorides, the former predominating, together with smaller and generally negligible quantities of other salts." It will be noticed that there is no mention of a preliminary washing in fresh water, and the question arises— Is the sodium chloride actually derived from the kelp itself, or is it simply due to the evaporation of the adherent sea-water? No mention is made of the presence of mannitol in the efflorescence.

Mr. D. R. Hongland, writing in the Journal of Agricultural Research, U.S.A., Vol. iv., p.52, April, 1915, says, "The selective action for potash is of course almost equally striking" [as that for iodine] "but the difference is of interest: much of the potassium chloride effloresces out as the plant dries, while no iodine is demonstrated in the effloresced salt."

In view of the above, Mr. Steel's complete analysis of an efflorescence undoubtedly derived solely from the algæ themselves, is of great value.

Mr. Hongland does not speak of mannitol, or of any other organic substance in the efflorescence, but, *l.c.*, p.47, speaking of the non-nitrogenous organic substances present in the kelp, he says, 'Very little information is obtainable for these groups, and there are no satisfactory chemical methods available for their study. In general, complex mucilaginous polysaccharines are characteristic of marine algæ, replacing the starch, cellulose, and simple sugars of most land-plants." I do not know whether mannitol has been found in the dried weed. Stanford regarded it as an after-product produced by fermentation. In the case of the New Zealand plants, the efflorescence is still forming (May, 1916), quite a large fresh crop of crystals having appeared in the interval from June, 19'5. It seems improbable that a fermentation could continue for five years and a half under dry conditions. I imagine that the efflorescence is a purely physico-chemical phenomenon.

It would be premature to discuss the bearing of the result of the analysis of this efflorescence upon the subject of the metabolism of kelps.

STUDIES ON AUSTRALIAN MOLLUSCA. PART XIII.

By C. HEDLEY, F.L.S.

(Plates xlvi.-lii.)

(Continued from Vol. xxxix., p.755.)

ARCA ADAMSIANA Dunker.

Arca adamsiana Dunker, Novit. Conch. 1866, p.88, Pl. xxix., figs.4-6. *Arca signata* Dunker, *op. cit.*, 1868, p.112, Pl. xxxviii., figs.3-5: *Id.*, Lamy, Journ. de Conch , lv., 1907, p.78, Pl. i., figs. 1, 2.

This species has not hitherto been recorded for Australia I dredged several specimens in ten fathoms in Port Curtis, Queensland. Submitting these to Dr. Lamy, he approved of my identification of them as *A. adamsiana*, and added that they confirmed him in considering that species identical with *A. signata*. For while the larger of my series corresponded well to *A. signata*, the smaller agreed exactly with *A. adamsiana*.

ARCA BOTANICA, sp.nov.

(Pl. li., figs.33, 34, 35.)

Barbatia pusilla Angas, Proc. Zool. Soc., 1867, p.931, not *Byssoarca pusilla* Sowerby.

Shell small, very solid, pointed-oblong, inflated, flattened on the anterior-superior face, angled where this face meets the disk, constricted slightly abreast of the byssal gape, truncate posteriorly and attenuate anteriorly. Colour dull white or uniform clay-colour. Umbo at three-fifths of total length, enrolled, closely approaching. Area narrow-lanceolate, sunk under the high arched beaks. Sculpture: small, conical scales set in imbricating flounces, the scales in about forty-four radials, the concentric lines about forty. The radials on the anterior face of each valve are twelve. The scales are suppressed near the byssus-exit. Teeth eighteen, of which seven are posterior, increasing in size and inclination as they recede from the centre. Length, 15; height, 7; breadth of conjoined valves, 7 mm.

This species is common under stones at low tide-level in the Hormosira-zone, all along the coast of New South Wales. It has hitherto lacked a name through misidentification with a Peruvian species. A member of the subgenus *Acar*, it nearest approaches the tropical *A. plicata* Dillwyn (founded on Chemnitz, Conch. Cab., xi., Pl. 204, fig.2008). From that, it is distinguishable by finer sculpture, especially by the smaller and more numerous radials of the antero-superior face, by shorter broader form, and by far smaller size. Compared with the Adelaidean *Arca laminata* Angas,* it is smaller, more compact, and delicately sculptured.

Arca metella, sp.nov.

(Plate li., figs.36, 37.)

Shell small, rather thin, inflated, oblique, medially constricted, especially in the young, and in the left valve. Colour dull white. Anterior margin obliquely truncate, projecting past the hinge-line. Ventral margin insinuate, ascending posteriorly till it meets the hinge-line at a right angle. Umbo at one-third of the total length from the posterior end, low and slightly projecting over the area. Fine, close, radial threads, about seventy in number, are crossed by similar threads about thirty in number, and develop a bead at the point of intersection. Ligamental area narrow-lanceolate, from the umbo a few oblique furrows cross the area anteriorly. The hinge has seven posterior and ten anterior teeth; those remote from the centre are inclined. Length, 10; height, 5·5; depth of single valve, 3 mm.

Numerous separate valves, associated with *Arca strabo*, were dredged by myself in 100 fathoms off Wollongong, and in 80 fathoms off Narrabeen, N. S. Wales.

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* *Barbatia laminata* Angas, Proc. Zool. Soc., 1865, p.655. ? = *Arca irudina* Lamarck, An. s. vert., vi., 1819, p.41; Lamy, Journ. de Conch., lv., p.80.

As Dr. Lamy kindly points out to me, this shell has a general resemblance to *Arca nodulosa* Müller, from the North Atlantic. The Australian shell is, however, sharply cancellated, while the radial lines of *A. nodulosa* are broken before reaching the concentric. Our shells are also much smaller and rather more inflated.

CHAMA FIBULA Reeve.

Chama fibula Reeve, Conch. Icon., iv., 1846, Pl. v., fig.27; *Id.*, Melvill & Standen, Journ. Linn. Soc. Zool., xxvii., 1899, p.193. *Chama jukesii* Reeve, Proc. Zool. Soc., 1846 (1847), p.120; *Id.*, Conch. Icon., iv., 1847, Pl. vii., fig.39; *Id.*, Schmeltz, Cat. Mus. Godeff., v., 1874, p.172; *Id.*, Smith, Chall. Rep. Zool., xiii., 1885, p.172. *Chama pellis-phocæ* Reeve, Proc. Zool. Soc., 1846 (1847), p.118; *Id.*, Reeve, Conch. Icon., iv., 1847, Pl. ix., fig.54; *Id.*, Melvill & Standen, *op. cit.*, p.193. *C. bellisphocæ* Clessin, Conch. Cab., 1889, p.37, Pl.17, fig.1. *Chama spinosa* Angas, Proc. Zool. Soc., 1867, p.925 (not Broderip). *Chama reflexa* Angas, Proc. Zool. Soc., 1871, p.100 (not Reeve).

A small *Chama* is not uncommon on stones between tide-marks in the sheltered parts of Sydney Harbour. It is firmly attached by the greater part of the left valve, the opercular valve usually pitched at a high inclination to the base; it is orbicular, with a sculpture of small, crowded, erect, subtubular scales, and attains a diameter of 45 mm. I have dredged this species also in Port Curtis and off Cape York, Queensland. No other species of this genus comes as far south as Sydney.

The first mention of *Chama* from this State is Lamarck's note that the variety (b) of *C. ruderalis* comes from Port Jackson. Both Delessert and Chenu* illustrate *C. ruderalis* as attached by the apex of the right valve. In size and general appearance, it is conformable to the Sydney shell. In South and West Australia, there is a species which is usually sinistral, and exceptionally dextral, and may, therefore, be Lamarck's species. If Chenu's figs.2b, 2c represent Lamarck's var. (b), then the locality ascribed to it is erroneous.

* Delessert, Recueil, 1841, Pl. xiii., figs.5, a, b. Chenu, Illustr. Conch., 1846, Pl.5, figs.2, 2a, 2b, 2c.

The next records of *Chama* were by Angas, who, in his catalogue of Port Jackson shells, included *C. spinosa* Broderip, in 1867, and *C. reflexa* Reeve, in 1871. *C. spinosa* was described from Lord Hood's Island, or Marutea, in the Paumotus, and its appearance here is improbable. It seems to be based on a shell too young to display specific characters. *C. reflexa* is from Darnley Island or Erub, Torres Strait. The figure of it does not well agree with the Sydney shell. From Cape York, Smith identified *C. jukesii* as taken by the "Challenger," and unites to these, as synonyms, *C. fibula* Reeve, and *C. pellis-phocæ* Reeve. The two latter are again recorded from this area by Melvill & Standen.

Of these three, *C. fibula* was published in December, 1846, and must, therefore, take precedence over *C. jukesii* and *C. pellis-phocæ*. "Preliminary" descriptions of the two latter were issued 27th January, 1847, in the Proceedings of the Zoological Society, but perhaps subsequent to their appearance in the Iconica in January, 1847.

In the case of another Queensland species, *Chama pulchella*, Reeve seems to have intruded not only on the prior *C. lobata* Broderip, and the Lamarckian *C. damæcornis*, but on the original Linnean *Chama lazarus*.

There is yet another species described by Reeve as *C. nivalis*, which Jukes procured in Queensland, and which seems to me likely to be preoccupied by Lamarck's *Chama limbula*.*

Such items as these support Cooke's contention that, in *Chama*, "Reeve has made fifty-five species out of material probably better represented by ten."†

Lucinida hilaira, sp.nov.

(Plate li., figs.38, 39.)

Shell rather thin, inflated, truncate-circular. Colour dull white. The lunule-side is straight, cutting off a segment from the circle which the margin of the valve otherwise describes.

* Lamarck, An. s. vert., vi., 1819, p.95; Chenu, Illustr. Conch., 1846, Pl.7, figs.5, 5a. 5b.

† Cooke, Ann. Mag. Nat. Hist., (5), xviii., 1886, p.96.

Umbo small, incurved. Lunule rather broad, margined by a shallow groove, beyond which is a low broad fold. Sculpture: irregular, weak, concentric growth-lines, across which runs a series of delicate and superficial radial scratches. Edge of valve smooth and thin. Height, 18; length, 19; depth of single valve, 6 mm.

Hab.—Off Montagu Island, 7-10 fathoms, February, 1916, (type), self. Also separate valves from the ocean-beaches round Sydney.

In general appearance, *L. hilaira* is like *Lucina perobliqua* Tate, but that is larger, more solid, more inflated, with more regular, concentric sculpture.

SOLECARDIA CRYPTOZOICA, n.sp.

(Plate xlvi., fig.1; Pl. li., fig.40.)

Scintilla anomala Angas, Proc. Zool. Soc., 1867 (1868), p.928; not *S. anomala* Deshayes, Proc. Zool. Soc., 1855 (1856), p.181; nor *S. anomala* Deshayes, Explan. Pl. xlix., figs.13-15, Anim. s. vert. Bassin de Paris, i., 1860.

Shell thin, translucent, of a milky colour, subequilateral, oblong in outline when young but becoming ovate when aged. When in contact ventrally, the valves are slightly apart dorsally. Ventral margins slightly curved, anterior end rounded, posterior produced. In the centre, the valve is tumid, but, dorsally, the margins are compressed and elevated in an arched crest on either side of the umbo, which projects prominently. Surface glossy, under the lens a few faint concentric threads appear, and the dorsal margins are slightly vermiculate. Length, 11; height, 8 mm.

The animal is of a milky translucency, in pale examples tipped with lemon, in darker specimens the mantle-margin and the longer tentacles are orange, sometimes the most prominent tentacles are tipped with scarlet. The foot is long and narrow, and is thrust far out, thus enabling the animal to progress rapidly. A thin transparent membrane, an outgrowth of the mantle, is spread over most, if not all, of the shell. On it are numerous papillæ which, round the margin, develop into tentacles. At each dorsal angle is a particularly long, slender horn. Similar processes on the mantle are shown in a sketch of *Scintilla chilkaensis* Preston.* Posteriorly, the mantle develops into two voluminous flaps. This gregarious species shelters under stones at low water in the mud-zone in Middle Harbour, Sydney, in companies of a dozen or so.

Following the identification of G. F. Angas, this species has locally been received as *Scintilla anomala.* But it does not agree with the figure of that species in the Thesaurus: and Mr. H. B. Preston, who compared the type in the British Museum with Sydney specimens, assures me that they are distinct.

CARDIUM RACKETTII Donovan.

Cardium rackettii Donovan, Naturalist's Repository, iv., 1826. Pl.124. *Cardium radiatum* Reeve, and *Cardium pallidum* Reeve, Conch. Icon., ii., 1845, Pl. xviii., figs.89, 92. *Cardium tenuicostatum* of authors, but not of Lamarck and Delessert.

No mention is made of *Cardium rackettii* in any of the monographs or catalogues dealing with the genus *Cardium.* Yet it was excellently figured, described, and localised, as being the size of the ordinary European *Cardium echinatum*, having 47 ribs, and obtained by Humphrey in New South Wales. It is obviously a species common round Sydney, a particularly fine example of which before me, from the Harbour, is 48 mm. in height and in breadth, and has 49 ribs. By Forbes, it was reported from Sydney as *C. radiatum*, and, by both Angas and Smith, as *C. tenuicostatum.*†

But *Cardium tenuicostatum* was described by Lamarck from Timor and New Holland as a shell 56 mm. in diameter, with 48 ribs. The figure which Delessert gave (Pl. xi., fig.6) from a Lamarckian specimen exhibits a shell of a quite different contour from *C. rackettii*, and disagrees with the figures which Sowerby, Hanley, Reeve, and Roemer have produced as of *C. tenuicostatum.* It is now suggested that the real *C. tenuicostatum* has been lost

* Annandale and Kemp, Mem. Indian Museum. v., 1910, p.351.

† Forbes, Voy. Rattlesnake, ii., 1852, p.366. Angas, Proc. Zool. Soc., 1867, p.925. Smith, Chall. Rep. Zool., xii., 1885, p.159.

to view, and that the later Australian references to it should be transferred to *C. rackettii* Donovan.

CARDIUM CYGNORUM Deshayes.

(Plate lii., fig.41.)

Cardium cygnorum Deshayes, Proc. Zool. Soc., 1854 (May, 1855), p.331; *Id.*, Angas, *op. cit.*, 1865, p.651; *Id.*, Tryon, Am. Journ. Conch., vii., 1872, Suppl., p.261; *Id.*, Tenison-Woods, Proc. Roy Soc. Tasm., 1877, p.53; *Id.*, Tate, Trans. Roy. Soc. S.A., ix., 1887, p.95; *Id.*, Tate & May, Proc. Linn. Soc. N. S. Wales, xxvi., 1901, p.430; *Id.*, Pritchard & Gatliff, Proc. Roy. Soc. Vict., xvi., 1903, p.135.

Though this species has been frequently cited in literature, it has not yet been figured. A specimen 50 mm. high and 42 mm. long, from St. Vincent's Gulf, S. Australia, identified by Mr. E. A. Smith, is, therefore, here illustrated. The range of this species is now announced to extend into New South Wales. I have dredged a living specimen, 26 x 28 mm., in 7-10 fathoms, on sandy ground, under Montagu Island.

TRIDACNA GIGANTEA Perry.

Chama gigas Linné (in part only) Syst. Nat., x., 1758, p.691 (*fide* Hanley, Ips. Linn. Conch., 1855, p.85); *Id.*, Born, Test. Mus. Cæs., 1780, p.80; *Id.*, Chemnitz, Conch. Cab., vii., 1784, p.111, Pl.49, figs.492-4. "*La Faitière*," Cubières, Histoire Abrégé des Coquillages de Mer, 1798, p.148. *Chama gigantea* Perry, Conchology, 1811, p.2. *Chama gigas* Flinders, Voy. Terr. Austr., ii., 1814, p.114. *Tridacna gigas* Lamarck, An. s. vert., vi., 1819, p.105; *Id.*, Ten.-Woods, these Proceedings, v., 1880, p.125; *Id.*, Kobelt, Nachr. deut. Malak. Gesell., xv., 1883, p.189; *Id.*, Kent, Great Barrier Reef, 1893, p.44, Pl. xxix.; *Id.*, Smith, Proc. Malac. Soc. iii., 1898, p.112; *Id.*, Hedley, Nautilus, xv., 1902, p.98; *Id.*, Banfield, "Confessions of a Beachcomber," 1908, p.138. *Tridacna lamarcki* Hidalgo, Mem. Real Acad. Cienc. Madrid, xxi., 1903, p.385.

Under the name of *Chama gigas*, the Father of Natural History seems to have embraced the whole of the modern genus

Tridacna. For the name *gigas*, as restricted to a single species, the candidates are the shell subsequently named *squamosa* by Lamarck, and a huge species whose valves, in the Ulrica Museum, together weighed 498 lbs.

After careful examination, Hanley decided that the furbelowed clam, such as Reeve has figured (Conch Icon., xiv., 1862, Tridacna, Pl. iii.) for *T. squamosa*, ought rightly to bear the name of *gigas*. He based his verdict on the ground that the actual shell owned by Linné as representing *gigas*, is the Lamarckian *squamosa*, and that to this apply most of the literary references. Linnean contemporaries, such as Born, Regenfuss, and Chemnitz, while making casual reference to the giant, all agree in figuring and describing *squamosa* as the Linnean *gigas*.

Discriminating in 1819 between the species his predecessors had confused, Lamarck unlawfully used the name *gigas* for the largest form, while for the Linnean *gigas* he proposed *squamosa*. Attentive to the remarks of Hanley, Hidalgo, in 1903, renamed the biggest species *T. lamarcki*. But in 1811, Perry had already used the name *Chama gigantea* for "The largest shell at present known . . . . . a Bivalve about three feet in length, one foot and a half in breadth, the shell itself being four or five inches thick."

As the young of the giant has not yet been traced to the adult, it is still possible that *squamosa* is a juvenile deeper-water form of the large intertidal and abraded *gigantea*.

The size to which this species ultimately attains is, as Kent and Banfield remark, a favourite subject for romance among travellers. After some inquiries, Smith concluded that the largest authentic record was that by Dillwyn of a Sumatran pair which weighed 507 lbs., and of which the largest valve was four feet six inches long, two feet five and a half inches high, and one foot deep. The heaviest known are a pair weighing 550lbs., which, Cubières and Lamarck relate, were presented by the Venetian Republic to Francis I. These still exist, their edges bound with brass, as holy-water basins in the cathedral of St. Sulpice, in Paris.

The photographs of Saville Kent show the giant clams in their natural position on the Great Barrier Reef, where they occur free and exposed at low tide, standing on their umbones, and showing their brightly coloured mantle and so-called eyes* as they gape. They were reported by Capt. Cook as "cockles of so enormous a size that one of them was more than two men could eat."†

Kobelt has noticed that Javan specimens were infested by *Pinnotheres*, a commensal crustacean.

Flinders described how the valves of this giant cockle were used as tanks on Half-way Island or Parima, a waterless cay in Torres Strait. To each shell, the rain-water was led from Pandanus trees by gutters, long slips of bark, so that a shower would pour two or three pints into each for the use of native canoe-voyagers.

Dosinia crocea Deshayes.

Dosinia crocea Deshayes, Brit. Mus. Cat., 1853, p.8; *Id.*, Roemer, Monogr., 1862, p.71, Pl. xiii., fig.4: *Id.*, Tate, Trans. Roy. Soc. S.A., ix., 1887, p.94; *Id.*, Pritchard & Gatliff, Proc. Roy. Soc. Vict., xvi., 1903, p.133; *Id.*, May, Proc. Roy. Soc. Tasm., 1915, p.80.

This species is now added to the fauna of New South Wales on the strength of specimens I dredged in 7-10 fathoms under Montagu Island.

Gafrarium quoyi Hanley.

Cytherea scripta var. *quoyi* Hanley, Recent Shells, 1844, p.11 *bis*, Pl. xv., fig.25. *Circe quoyi* Sowerby, Thes. Conch., ii., 1853, p.758. *Circe lenticularis* Deshayes, Cat. Conchif. Brit. Mus., June, 1853, p.85; *Id.*, Proc. Zool. Soc., 1853 (June 27, 1854), p.7; *Id.*, Reeve, Conch. Icon., xiv., 1863, Pl. ii., fig.7; *Id.*, Roemer, Monog. Venus, 1869, p.200, Pl. lv., fig.1; *Id.*, von Martens, Zool. Forsch. Semon, 1894, p.94. *Circe trigona* Reeve, Conch. Icon., xiv., 1863, Pl. iii., fig.12. *Circe rivularis* Sowerby, Thes. Conch., ii., 1853, p.652, Pl.139, figs.46-48; *Id.*, Hanley,

* Brock, Ann. Mag. Nat. Hist. (6), i., 1888, p.435.

† Cook's First Voyage, iii., 1783, p.566.

Recent Shells, 1856, p.355; *Id.*, Reeve, Conch. Icon., xiv., 1864, Pl. i., fig.3 (not *Venus rivularis* Born, Index Mus. Cæs. Vind., 1778, p.59. and Test. ect., 1780, p.72, Pl. v., fig.7). *Circe undatina* Angas, Proc. Zool. Soc., 1867, p.922 (? *Venus undatina* Lamarck, An. s. vert., v., 1818, p.575; ? Reeve, Conch. Icon., xiv., 1864, Pl. i., fig.1c). *Circe personata* Reeve, Conch. Icon., xiv., 1864, Pl.2, fig.6; *Id.*, Roemer, Monog. Venus, 1869, Pl. liv., figs.1a, 1b, not 1c; *Id.*, Schmeltz, Cat. Godeff. Mus., v., 1875, p.169 (not *C. personata* Desh., Cat. Conch. Brit. Mus., 1853, p.84). *Circe sugillata* Reeve, Conch. Icon., xiv., 1864, Pl. iii., fig.11. *Circe scripta* Chenu, Illustr. Conch., 1847, Pl. xi., figs.8, 8a, 8b only; *Id.*, Smith, Chall. Exped. Zool., xiii., 1885, p.140; *Id.*, Roth, N. Qld. Ethn. Bull., iii., 1901, p 18; *Id*, Hedley, these Proceedings, xxxi., 1906, p.466 (not *Venus scripta* Linné, Syst. Nat., x., 1758, p.680).

The "Challenger" Expedition reported *Circe scripta* Linn., as taken in 4-18 fathoms in Port Jackson. It is difficult to decide what shell ought to bear this name. For none of the figures cited by Linné in the original account of 1758 harmonise with any shell known in modern times as *Circe scripta*. He quoted first the *Chama litterata rotunda* of Rumphius,* which is a rounder, smoother shell than a *Circe*, and might pass as well for *Lioconcha fastigiata*. Hanley stated† that a specimen in the Linnean cabinet corresponds to Sowerby's illustration of *C. scripta*, Thes. Conch., ii., 1844, Pl.139, fig.38. This form (= *albida* Deshayes) occurs, I believe, in Queensland; it differs from the Sydney shell in shape and colour.

Thus, whether *C. scripta* is to be identified from the figures to which Linné referred, or whether the shell owned by Linné, and noted by Hanley, is to be taken for the foundation of the species, we must equally exclude *C. scripta* from the local fauna. Having arrived at the conclusion that "this shell (usually termed the Scripta of Australia) is completely distinct from the true scripta of Linnæus," Hanley suggested for it "the name of Quoyi, in

* Rumphius, Amboin. Rariteitkamer, 1741, p.139.

† Hanley, Ips. Linn. Conch., 1855, p.78.

honour of the naturalist who has so successfully investigated the invertebrata of that portion of the globe." But he again described this species on p.355 under the name of *Cytherea rivularis* Born. The Sydney shell, which has a smooth ventral margin, and so belongs to the section *Circe*, as restricted by Jukes Browne,* appears to have been figured by Sowerby and Reeve as *Circe rivularis* Born. But Brauer† has determined Born's type of *rivularis* to be *Circe crocea* Gray, as figured by Roemer, Pl. lvi., fig 2c. This is different from *C. quoyi*, being more inflated, with coarser, umbonal, oblique folds.

Schmeltz has identified the Sydney shell as *C. personata* Deshayes, 1853, but that was founded on a Nicobar species figured by Chemnitz (Vol. vii., figs.420-426), and was already named *Circe violacea* by Schumacher in 1817. This, and not *scripta* Linn., was the type of the genus *Circe*. Perhaps the figures of *personata* supplied by later authors were derived from Australian shells. Angas referred the Sydney shell to *Cytherea undatina* Lamk. This may be correct, and, if so, would take precedence over *quoyi* or other names. But the literary history of this is too meagre and contradictory for adoption. For Roemer's figure of it agrees neither with Lamarck's description of the colour-pattern, nor with Deshayes' determination of it as *scripta*. Possibly Lamarck's species might be the neglected *Venus Wauaria* Gmelin, 1791.

Adams has figured‡ *C. quoyi* as the host of *Myochama stutchburyi*.

As the best expression of typical New South Wales *G. quoyi*, Roemer's fig.1, Plate liv., may be selected. A variety from N. W. Australia is shown by Reeve's Pl. i., fig.3a. A well marked related form is *C. trigona* Reeve, 1863, not yet reported as Australian, but here noted as from Stradbroke and Facing Islands, Queensland. It is shown by Roemer's Pl.53, fig.2, as *Circe plicatina*.

* Jukes Browne, Proc. Mal. Soc., xi., 1914, p.66.
† Brauer, S. B. Akad. Wien, lxxvii., 1878, p.132.
‡ Adams, Proc. Zool. Soc., 1852, Pl. xv., fig.4.

MARCIA NITIDA Quoy & Gaimard.
(Plate xlvi., figs.2, 3)

Chione nitida Hedley, these Proceedings, xxix., 1904, p.194.

This species attains a larger size than is usually recognised. One specimen I gathered is 56 mm. long, and 37 high, the conjoined valves being 27 mm. deep. It occurs alive at low tide in sand on the margin of a Zostera-flat by the Middle Harbour Sand-Spit. The animal has a long, tongue-shaped, orange-coloured foot. The siphons are buff streaked and spotted with black; they are of equal length and deeply divided, their apertures fringed with digitate papillæ. The exhalant has, besides, a lobe which acts as a lid. The mantle-margin is finely fringed with papillæ. In his review of the family, this species was, under the synonym of *fumigata*, included in *Marcia* by Jukes Browne.*

TELLINA ASTULA, sp.nov.
(Plate lii., figs.42, 43.)

Tellina nitida Perry, Conchology, 1811, Pl. lv., fig.1. Not *Tellina nitida* Poli, 1791. *Tellina perna* Brazier,(not Spengler), these Proceedings, ii., 1877 (1878), p.142; *Id.*, Whitelegge, Proc. Roy. Soc., N. S. Wales, xxiii., 1889, p.238.

Shell oblong acuminate, polished, convex, rose-pink, with broad radiating bands of cream, smooth except on the rostrum. Dorsal margin straight, anterior end semicircular, ventral margin arcuate. Rostrum tongue-shaped, concave above, protuberant posteriorly, end truncate, lower margin straight, horizontal, sharply bent to continue the ventral margin. The valves differ by the rostrum being bent to the right and having, in the right valve, a fold at its base, absent in the left. From the umbo to the extremity runs a shallow furrow. Spaced and sharply engraved concentric grooves extend in the right valve over the whole rostral area past the fold and notch, but, on the left, only from the radial furrow to the edge. The anterior side is rather longer than the posterior. Length, 155; height, 25; depth, 11 mm.

Hab.—Sow and Pigs Reef, Sydney (Brazier), Broken Bay (Hargraves), and Trial Bay (C. Laseron), N.S.W.

* J. Browne, Proc. Malac. Soc., viii., 1909, p.233; and xi., 1914, p.87.

This has a general likeness to *T. perna*, for which it has been mistaken, but *T. astula* has a much narrower rostrum, and an abrupt notch where the rostrum leaves the body. *T. pharaonis* has the rostrum grooved, but both the rostrum and the rest of the valve are longer and narrower than in *T. astula*. *T. consanguinea* Sowerby,* is more compressed, and the rostrum has a more upward direction.

SPISULA TRIGONELLA Lamarck.

Mactra trigonella Lamarck, An. s. vert., v., 1818, p.479; *Id.*, Lamy, Bull Mus. Hist. Nat., 1914, p.245. *Gnathodon parvum* Petit, Journ. de Conch., iv., 1853, p.358, Pl. xiii., figs. 9, 10. *Spisula parva* Dall, Proc. U. S. Nat. Mus., xvii., 1894, p.106; *Id.*, Hedley, Proc. Linn. Soc. N. S. Wales, xxvi., 1902, p 707, Pl. xxxiv., figs.2, 3 (hinge); *Id.*, Smith, Proc. Malac. Soc., xi., 1914, p.146.

Mactra trigonella was gathered by Péron at Shark's Bay, W.A., and was named by Lamarck. For nearly a century, his unfigured type has lain unobserved in the Paris Museum. Dr. Lamy has lately disinterred it, and declares it identical with *Spisula parva*, which younger name must now be superseded.

AMPHIDESMA ANGUSTA Reeve.

(Plate xlvi., fig.4.)

Mesodesma angusta Reeve, Conch. Icon., viii., July 1854, Pl. i., fig.3; *Id.*, Deshayes, Proc. Zool. Soc., 1854 (May, 1855), p.338: *Id.*, Tate, Trans. Roy. Soc. S.A., xxi., 1897, p.46; *Id.*, Lamy, Journ. de Conch., lxii., 1914, pp.37, 38, fig.2. *Mesodesma elongata* Reeve, Conch. Icon., viii., 1854, Pl. i., fig.5; *Id.*, Deshayes, Proc. Zool. Soc., 1854 (1855), p.337; *Id.*, Tate, Trans. Roy. Soc. S.A., ix., 1887, p.85; *Id.*, Tate & May, these Proceedings, xxvi., 1901, p.424; *Id.*, Pritchard & Gatliff, Proc. Roy. Soc. Vict., xvi., 1903, p.110. *Donacilla elongata* Angas, Proc. Zool. Soc., 1865, p.647, and 1867, p.220; *Id.*, Tryon, Am. Journ. Conch., iv., Suppl., 1868, p.126; *Id.*, Ten.-Woods, Proc Roy. Soc. Tasm., 1877, p.50.

* Sowerby, Ann. Mag. Nat. Hist., (7), xii., 1903, p.500.

It has already been reported by Prof. Tate that *M. angusta* and *M. elongata* are synonyms, an observation which, from examination of their respective types, I can confirm. As the notices in the Conchologica Iconica were published a year before those in the Zoological Proceedings, it follows that *angusta* must be credited to Reeve, and must also take precedence over *elongata*. To the list of Tasmanian species wrongly credited to Raine Island (*antea*, xxxviii., p.268), *A. elongata* can now be added.

This species is common round Sydney. Its habit is to lie in the sand in the wash of the sea. When the drag of the waves uncovers it, there is a sparkle of yellow, a scramble, two or three quick stabs of the foot, and the bivalve is again buried. The foot protrudes to a length equal to that of the shell: it is flat, cordate-acuminate, buff with a pink tinge. The exhalant siphon seems to be always exserted further than its fellow: the orifice is beset with a few, small, digitate papillæ. The inhalant siphon issues at the angle of the shell; as far as I could observe it in captivity, it extends only a third of the length of the other siphon, and has the expanded orifice fringed with fine, pinnatifid processes.

Mr. T. Dick sends me a specimen of *A. angusta* from Port Macquarie, which he found in process of being bored by *Polinices incei*.

AMPHIDESMA CUNEATA Lamarck.

Crassatella cuneata Lamarck, An. s. vert., v., 1818, p.483; *Id.*, Lamy, Bull. Mus. Hist. Nat., 1912, p.248, text fig. (not of Sowerby, Reeve, Hanley, or Tate). *Amphidesma glabrella* Lamarck, *op. cit.*, p.493; *Id.*, Lamy, *op. cit*, p.253; *Id.*, Lamy, Journ. de Conch., lxi., 1913, p.322; *Id.*, Blainville, Man. de Malac., 1827, Pl.78, fig.6; *Id.*, Tate Trans. Roy. Soc. S.A., xxi., 1897, p.46. *Mesodesma gaymardi* Deshayes, Encycl. Méth., vers, ii., 1835, p.444(*fide* Lamy). *Mesodesma præcisa* Reeve, Conch. Icon., vii., 1854, Pl.4, fig.31; *Id.*, Deshayes, Proc. Zool. Soc., 1854 (May, 1855), p.338. *Mesodesma obtusa* Crosse & Fischer, Journ. de Conch., xii., 1864, p.350, and xiii., 1865, p.428, Pl. xi., fig.4; *Id.*, Angas, Proc. Zool. Soc, 1867, p.920.

This is another case in which Australian conchologists have benefited by the examination of Lamarck's types by Dr. Ed. Lamy, of Paris. This southern species is dwarfed, and scarce in this latitude, which makes it improbable that Melvill & Standen were correct in identifying *M. præcisa* from Albany Pass. The first record of this from our State was a note by Angas that he had found *Donacilla obtusa* at The Spit, Middle Harbour. Tate ascertained that this name was a synonym of *M. præcisa* and *M. glabrella*. The unfigured *C. cuneata* had been generally ascribed, as in Reeve's Iconica, to *Anapella cycladea* (= *Spisula adelaidæ* Angas), but the figure of the type, lately published by Dr. Lamy, has corrected this error. This species varies a good deal in outline.

Lingula rostrum Shaw.

Mytilus rostrum Shaw, Nat. Miscell., ix., 1797, Pl.315, two upper figures. *Pharetra monoculoides* Bolten, Mus. Bolt., (2), 1798, p.159, for Chemn. Conch. Cab., x., 1788, p 360, Pl. 172, figs.1675-77. *Ligula unguis* Cuvier, Tab. Elem., 1798, p.435.

Lingula anatina Lamarck, Syst. An. s. vert., 1801, p.141, for *Lingula* sp. Bruguière, Encycl. Méth. vers, 1797, Pl.250, fig.1,a, b, c: *Id.*, Davidson, Trans. Linn. Soc. Zool , iv., 1888, p.206, Pl. xxix., figs.1-8; *Id.*, von Martens, Forsch. Gazelle, iii., 1889, p.263. *Lingula hians* Angas, Proc. Zool. Soc., 1867, p.935; *Id.*, Whitelegge, Proc Roy. Soc. N. S. Wales, xxiii., 1889, p.294.

The type of the brachiopod genus *Lingula* is usually known by Lamarck's name of *anatina*. There are, however, other names whose claims deserve consideration. Linné included, under "*Patella unguis*," references both to a *Scutus* and to a *Lingula*. According to Hanley,* it is the former, based on a figure of Rumphius, which should carry the Linnean name.

From the Museum Gerversianum, there is cited by Dillwyn for this species *Anatifera luzona* of Meuschen.

A Philippine form was well figured and legitimately named *Mytilus rostrum* by Shaw in 1797, a name which, though left for

* Hanley, Ips. Linn. Conch., 1854, p.425.

a century in obscurity, appears the rightful heir to the title. In the following year, Bolten proposed a binomial for some excellent figures published polynomially by Chemnitz. The generally accepted name by Lamarck was not advanced till 1801.

The genus-name *Lingula* appeared rather irregularly as a heading for a single species on a plate in the Encyclopédie Méthodique. If this is ruled out, then we shall have to fall back on Bolten's *Pharetra*.

The species have been discriminated usually from dry and probably distorted material. Little attention has been given to change in appearance in different stages of growth. It may be, therefore, still a matter for investigation whether the names assigned to Australian forms, *L. tumidula* Reeve, *L. murphiana* Reeve, *L. exusta* Reeve, and *L. hirundo* Reeve, represent distinct species, geographical races, or growth-forms of a single species.

L. anatina was recognised from Moreton Bay by Dr. E. von Martens. Some fifty years ago, Angas gathered, in Middle Harbour, a species of *Lingula* which he determined as *L hians*. Brazier has noted, in Whitelegge's List, additional localities for this.

A Revision of Australasian Tugalia.

Of *Tugalia*, there are two species in New Zealand, and two others in Australia. Confusion has enveloped this small group; for under the name of *T. parmophoidea*, or its various renderings, each of the other species has in turn been included. The identity of the genotype has thus been obscured. Monographs in the Thesaurus and Conchologica Iconica, by transfer of names to wrong genera, species, and localities, by omission, and disunion, constructed a labyrinth of error which has entangled conchologists for half a century. Thus, in 1867, *Emarginula ossea* Gould, from Fiji, was substituted for the totally different *T. parmophoidea* from Sydney by Angas. In 1883, Brazier re-distributed the names of three species incorrectly. As late as 1903, Pritchard & Gatliff reflected current opinion by presenting, under the head of *T. parmophoidea*, a tangled, heterogenous mass of *intermedia*, *elegans*, *tasmanica*, and *australis*.

It is hoped that the figures of the four species concerned, now placed side by side for comparison, will relieve the misunderstanding that has hitherto prevailed.

TUGALIA INTERMEDIA Reeve.

(Plate lii., fig.44.)

Parmophorus intermedius Reeve, Conch. Syst., ii. 1842, p.22, Pl. cxxxix., figs.5, 6; *Id.*, Reeve, Proc. Zool. Soc., 1842, p.50; *Id.*, Hutton, Proc. Linn. Soc. N. S. Wales, ix., 1884, p.371. *Subemarginula intermedia* Suter, Man. N.Z. Moll., 1913, p.102, Pl.8, fig.6. *Tugalia cinerea* Sowerby, Thes. Conch., iii., 1863, p.221, Pl.249, fig.15. *Tugalia parmophoridea* Sowerby, Thes. Conch., iii., 1863, p.221, Pl.249, fig.16; *Id.*, Sowerby, Conch. Icon., xvii., 1870, Pl.i., fig.4a, not 4b; *Id.*, Hutton, Man. N.Z. Moll., 1880, p.106. *Subemarginula parmophoidea* Harris, Cat. Tert. Moll. Brit. Mus., i., 1897, p.290. *Tugali elegans* Gray, in Dieffenbach, Travels in N.Z., ii., 1843, p.240; *Id.*, Revue Zool., 1844, p.355; *Id.*, von Martens, Crit. List N.Z. Mollusca, 1873, p.35. Not *Parmophorus elegans* Gray, Annals of Philos., ix., 1825, p.140(= *Scutus unguis* Linn.).

Hitherto, this species has not been clearly differentiated from *T. parmophoidea.* The New Zealand form is readily distinguishable by having the apex considerably nearer to the margin than has the Australian shell. In *T. intermedia*, the sculpture is finer, the shell is not so tall, and has a more marked sinus at the anterior margin. Otherwise the two are much alike in size, shape, and general appearance. The pair represent one another on each side of the Tasman Sea, which neither crosses.

In *T. elegans*, the concentric sculpture is described as forming arched ribs across the radial striæ, a point which, supported by an exact locality, Great Barrier Island, fixes the identity of the species. On the Barrier Island shell, Gray founded a new genus, which he spelt *Tugali*, apparently a misprint later corrected by himself to *Tugalia.**

* Gray, Guide to the Systematic Distribution of Mollusca in the British Museum, Part i., 1857, p.163.

By A. Adams,* *T. elegans* was wrongly referred to North Africa, and subsequent authors have mostly lost sight of the name.

The specimen figured is 29 mm. long, and was collected by Mr. H. Hill, at Wellington, New Zealand.

TUGALIA PARMOPHOIDEA Quoy & Gaimard.

(Plate lii., fig.45.)

Emarginula parmophoidea Q. & G., Zool. Astrolabe, iii., 1835, p.325, Pl.68, figs.15, 16. *Clypidina parmophoroidea* Chenu, Man. Conch., i., 1859, p.373, figs.2798-99. *Tugalia parmophoridea* Sowerby, Conch. Icon., xvii., 1871, Pl. i., fig.4b, not 4a. *Emarginula parmophoidea* Watson, Chall. Rep. Zool., xv., 1886, p.35. *Tugalia parmophoidea* (in part) Pritchard & Gatliff, Proc. Roy. Soc. Vict., xv., 1903, p.190. *Subemarginula parmophoroides* Shirley, Proc. Roy. Soc. Q'land, xxiii., 1911, p.96. *Tugalia ossea* Sowerby, Thes. Conch., iii., 1863, p.221, Pl.249, fig.18; *Id.*, Angas, Proc. Zool. Soc., 1867, p.219. *Tugalia australis* Ten.-Woods, Proc. Roy. Soc. Tasm., 1876 (1877), p.44; *Id.*, Hardy, Proc. Roy. Soc. Tasm., 1915, p.63. *Tugalia intermedia* Brazier, Proc. Linn. Soc. N. S. Wales, viii., 1883, p.227.

This shell was, by Quoy & Gaimard, reported from New Holland. Their account suits a species from New South Wales, with which their name has been generally associated. But the name has also been applied to other members of the genus.

Angas misidentified the Sydney *Tugalia* as *T. ossea* Gould, a species of another genus. Detecting this error, and probably associating *T. parmophoidea* with the New Zealand form, Tenison-Woods proceeded to rename the Sydney shell as *T. australis*.

T. parmophoidea inhabits the coast of South Queensland and New South Wales, but fails, so Mr. W. L. May tells me, to reach Tasmania. A statement by Angas, that it occurs in South Australia, seems to need confirmation. The specimen figured is 27 mm. long, and was collected by myself at Cape Byron, N. S. Wales.

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* A. Adams, Ann. Mag. Nat. Hist. (3), vi., 1860, p.112.

TUGALIA CICATRICOSA A. Adams.

(Plate lii., fig.46.)

Tugali cicatricosa A. Adams, Proc. Zool. Soc., 1851(1852)p.89; *Id.*, Angas, *op. cit.*, 1865, p.185. *Tugalia cicatrosa* Sowerby, Thes. Conch., iii., 1863, p.222, Pl.249, fig.14; *Id.*, Conch. Icon., xvii., 1870, Pl i., fig.7. *Tugalia tasmanica* Ten.-Woods, Proc. Roy. Soc. Tasm., 1876 (1877), p.156.

Like *T. intermedia*, this species was first erroneously ascribed to the Philippine Islands. Angas recognised it from Port Lincoln. I have seen it from Ulverstone, Tasmania; Neptune Islands, South Australia; and Geographe Bay, West Australia. This distribution suggests that it will prove to be the Adelaidean representative of the Peronian *T. parmophoidea*. Compared with that, *T. cicatricosa* is more depressed, with the sides more parallel; the apex nearer to the margin, is more notched anteriorly, and has a much coarser sculpture. A scar on the summit, which suggested the name, was an individual and accidental feature of the type-shell. It is by chance repeated in a specimen before me, and was probably caused by adherence of a *Capulus* or some such associate. The specimen figured is 18 mm. long, and was collected in North Tasmania, by Miss M. Lodder.

TUGALIA BASCAUDA, sp.nov.

(Plate lii., fig.47.)

Shell small, solid, oblong. Colour milk-white. Surface glossy. Sculpture: about 50 radial cords are crossed by 25 similar concentric cords, beaded at the points of intersection, and enclosing deep, square pits as meshes. From the apex, a radial of double breadth and height runs anteriorly along the median line. The edge of the aperture is crenulated by the radials. Length, 12 breadth, 8; height, 3 mm.

The specimen drawn (type) was collected by the late Mr, R. Helms, under stones, near Wellington, New Zealand. I have also seen specimens from the Chatham Islands, labelled *Tugalia elegans* by Capt. F. W. Hutton. It is apparently the species cited by Mr. Suter in the Manual of New Zealand Mollusca as

Subemarginula parmophoidea, now shown to be a different Australian species.

HEMITOMA ASPERA Gould.

(Plate xlvi., fig.6.)

In the last Part of these Studies (*antea*, xxxix, p.707), it was stated that, though in ordinary use, *Subemarginula* was untenable Relying on a defective entry in Scudder, *Montfortia* was selected to replace it. Messrs. W. C. Clapp and T. Iredale have kindly written to say that the name Rafinesque proposed was not *Hemitoma*, as Scudder quotes, but *Hemiloma*. Therefore the *Hemitoma* of Swainson, not *Montfortia* of Récluz, must take the place of *Subemarginula*. For the group of *H. rugosa*, Mr. Iredale has introduced *Montfortula*.*

H. aspera inhabits the crevices among the compacted tubes of *Galeolaria*,† where it is common near Sydney. When warned, it can cling tenaciously to its foothold. Its movements are deliberate; both head and tail can be protruded beyond the shell. Such parts as are exposed, the back of the head, tentacles, siphonal pipe, and upper surface of hind foot, are black; the rest is buff, which, on the mouth and muzzle, brightens to lemon-yellow. The muzzle is rather long, with broadly expanding lip, notched beneath. The tentacles are long and tapering; they search actively in various directions; at the outer base of each is a short, digitate, ocular tentacle with a large, black eye. On the right side of this, there is, in the male, a curved, cephalic appendage. Along the epipodial line, but interrupted between the tentacles, runs a series of small, short filaments. When the animal leans forward, the ctenidia are exposed; these are worn folded, the edges donbled together on the inside and the stem outside. Beyond the gill-tips, the mantle is slit, its edges coalescing in a short tube external to the shell. The thickened fringe of the mantle-margin is produced into an inner and an outer series of tufts of compound papillæ, the outer ones lying in the crenulations of the shell-rim.

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* Iredale, Trans. N.Z, Inst., xlvii., 1915, p.433.

† Hedley, Journ. Roy. Soc. N. S. Wales, xlix., 1915, p.66, Pl.5.

CLANCULUS ALOYSII Tenison-Woods.

Clanculus aloysii Ten.-Woods, Proc. Roy. Soc. Tasm., 1875 (1876), p.155; *Id.*, Hardy, *op. cit.*, 1915, p.62; *Id*, Pilsbry, Man. Conch., xi., 1889, p.59, Pl. xiv., figs.20-23; *Id.*, Tate & May, these Proceedings, xxvi., 1901, p.400; *Id.*, Pritchard & Gatliff, Proc. Roy. Soc. Vict., xiv., 1902, p.121; *Id.*, Chapman & Gabriel, Proc. Roy. Soc. Vict., xxvi., 1914, p.316.

This Tasmanian species is now found to extend north into New South Wales. I dredged specimens in 7-10 fathoms near Montagu Island. Also unrecorded for the State is *Clanculus plebeius* Philippi, which I have collected in Twofold Bay.

MONODONTA OBTUSA Dillwyn.

(Plate xlvii., fig.12.)

Trochus obtusus Dillwyn, Descrip. Cat., ii., 1817, p.809, for Chemnitz, Conch. Cab., xi., 1795, p.167, Pl.196, figs.1894, 1895. *Monodonta zebra* Menke, Verch. Conch. Malsb., 1829, p.17; *Id*, Mörch, Malak. Blatt., xviii., 1871, p.125; *Id.*, Maplestone, Month. Micros. Journ., viii., 1872, p.50, Pl. xxvi., fig.2; *Id.*, Troschel, Gebiss Schnecken, ii., 1879, p,232, Pl. xxiii., fig.7; *Id.*, Smith, Zool. Coll. Alert, 1884, p.74; *Id.*, Pilsbry, Man. Conch., xi., 1889, p.91, Pl.20, fig.20; *Id.*, Shirley, Proc. Roy. Soc. Q'land, xxiii., 1911, p.96. *Trochus tæniatus* Quoy & Gaimard, Zool. Astrolabe, iii., 1834, p.249, Pl.63, figs.15-17; *Id.*, Angas, Proc. Zool Soc., 1867, p.216; *Id.*, Ten.-Woods, Proc. Roy. Soc. Tasm., 1877, p.43; *Id.*, Ten.-Woods, Proc. Roy. Soc. N. S. Wales, 1888, p.119. *Trochocochlea multicarinata* Chenu, Man. Conch., i., 1859, p.360, fig. 2676; *Id.*, Angas, Proc. Zool. Soc., 1867, p.216. *Labio porcatus* A. Adams, Proc. Zool. Soc., 1851 (1853), p.177; *Id.*, A. Adams, Ann. Mag. Nat. Hist. (2), xii., 1853, p.207; *Id.*, Angas, Proc. Zool. Soc., 1867, p.216. *Trochus extenuatus* Fischer, Coq. Viv., 1878, p.330, Pl.103, fig.1.

The above summary of literature shows how superfluous names may accumulate round a well known species. As one of the most common and conspicuous shells on the Sydney beach, this was naturally among the first to be sent to Europe, and described. Yet, for more than a century, the coloured figures given by

Chemnitz remained unrecognised. Lamarck seems not to have distinguished between this and its Tasmanian representative, which he called *Monodonta constricta.* Under his influence, Quoy & Gaimard figured for *constricta* in the zoology of the Astrolabe, both the Sydney "zebra" (Plate 63, figs.23-24), and the Hobart "trochlea" (figs.26, 27). This error had a long existence, for these two were still united in 1902 by Pritchard & Gatliff. But Quoy & Gaimard, in partial recognition of their mistake, submitted *Trochus tæniatus* as a name for the Port Jackson species. This name is not to be confused with *Turbo tæniatus* Sowerby (Tankerv. Cat., 1825, Append., p.xiii.). Chenu twenty-five years afterwards, added another name, *Trochocochlea multicarinata.* Mörch then pointed out that the names of these Parisian conchologists were anticipated by *Monodonta zebra* of Menke: a name not to be confused with *Trochus zebra* Wood (Index Test., 1828, Suppl., Pl. v., fig.18). For this already over-burdened species, Arthur Adams proposed *Labio porcatus*, and Fischer, to avoid clashing with *Trochus porcatus* Philippi, (Zeit f. Malak., 1849, p.187) gave the final name of *Trochus extenuatus.*

Guided by a suggestion in Pilsbry's Monograph, I forwarded a series from this coast, and requested Dr. H. Lynge to compare them with the type of *T. obtusus* still preserved in the Zoological Museum of Copenhagen. That conchologist kindly replied (30/4/16) that the worn and injured shell, which Chemnitz figured in 1795, is absolutely identical with the specimens I sent from Montagu Island.

The species has a great range in colour, development of spiral keels, form and size. Typical *M. obtusa* is a rather depressed form, with 30-40 close, narrow lines; this intergrades with a more abundant, broadly-banded form, *zebra*, with about ten stripes, and with a dwarfed variety from the border of the mangrove-swamps which can be called *porcata.* The species ranges from Moreton Bay to Twofold Bay; its southern limit is not known to me.

Another *Monodonta* occurring in this State is *M. concamerata* Wood, 1828 (= *Trochus striolatus* Quoy & Gaimard, 1834, = *Labio fuliginea* A. Adams, 1853). I have not myself gathered this species, but it was found at Clontarf Bay, N.S.W., by Mr. R. Helms, and was dredged by the "Challenger" Expedition. To complete the genus as developed in this State, it is now proposed to insert *Gibbula picturata* Adams & Angas. Neither that nor any other Australian species seems congeneric with *magus*, the type of *Gibbula*.

Those who consider that *Monodonta* Lamarck, 1799, is preoccupied by *Monodon* Linné, 1758, will employ *Labio* Oken, 1815, as the generic name.

The animal of *M. obtusa* is splendidly arrayed in black and gold. The edge of the muzzle is buff, followed by, first, a band of black and then one of orange, the forehead-flaps are edged with orange, the ocular tentacles are orange below and black above, and the cervical epipodium is orange, the rest of the upper surface being black. The epipodium is differentiated into an anterior, median, and posterior portions. The latter begins just above the tail and continues a little past the operculum; it has a simple expanded margin, from beneath which spring four pairs of lash-tentacles, three of which are beside the operculum, and the fourth is planted where the cervical meets the posterior epipodium. At the base of each lash is set a stump-tentacle, forming an uneven pair like the ocular and cephalic tentacles; the three hinder tentacles are each adnate to their associate stumps, but the anterior lash is parted from its stump, while a stump without a lash stands in the median line behind the operculum. Another lonely stump is the cervical papilla, which occurs on both left and right sides. The medium epipodium or cervical lobe extends from the ocular tentacle to the anterior lash. On the right, it has a plain edge and during locomotion is curled into a makeshift siphon and extruded beyond the lip of the shell. On the left, the edge is cut up into about twenty filaments. The ocular tentacles are compressed from above to below and keeled laterally, thus indicating that they are overrun by the epipodium, which finds its anterior expression in a pair of forehead-flaps on the snout. Even when the animal has withdrawn into the shell, the epipodial lashes steal out from behind the operculum and softly search.

A similar arrangement of the epipodium, entire on the right, slashed in tatters on the left, is shown by *Trochus pica** and *T. lineatus.*†

GENA STRIGOSA A. Adams.
(Plate xlvii., fig.11.)

Gena strigosa A. Adams, Proc. Zool. Soc., 1850, p.37; *Id.*, Sowerby, Thes. Conch., ii., 1854, p.830, Pl.173, figs.11, 12; *Id.*, Angas, Proc. Zool. Soc., 1867, p.218. *Gena nigra* Brazier, Journ. of Conch., vi., 1889, p.72 (not of Quoy & Gaimard).

Mr. T. Iredale was kind enough to compare critically a series of specimens from Sydney with the unlocalised types, three specimens, of *G. strigosa* in the South Kensington Museum. He reports that my set agreed with types in size, shape, and general colouration; and concludes that *Gena strigosa* is the correct name for the Sydney species. He also considers that it does not, as has been indicated, extend to the tropical Indian Ocean.

The favourite haunt of this animal is under rather large boulders in the Hormosira-zone. It crawls rapidly, seeking always to escape from the light. Behind the shell, the large muscular foot extends for more than half the total length of the animal. It is liable to break off by self-mutilation just behind the shell, if the animal is annoyed. It is covered with small, large, and sometimes compound tubercles. The shell is wholly, or partly, overspread by the large mantle, also bearing small and branched processes. Thin, smooth lobes of the mantle protrude on the right and on the left as a scoop or pipe, acting as siphons. Posterior to these are epipodial lobes, three on each side, retracted and exserted from pockets. Beside each lash arises a conspicuous branched process, apparently the homologue of the stump of *Monodonta*. As is usual when the foot is so tubercular, the epipodial line is indistinct. In addition to the three lateral filaments, the epipodium is displayed above the muzzle as a slashed fringe, sometimes separate, sometimes united. Cephalic tentacles long and slender, each with an external ocular stump. Muzzle broad and produced, fringed towards the neck.

* Fischer, Coq. Viv., 1880, Pl. i.

† Randles, Quart. Journ. Micro. Sci., xlviii., 1904, Pl. iv., fig.7.

I suppose that in forming *Plocamotis*, Fischer was misled by a defective sketch of Arthur Adams, and that it is an absolute synonym of *Gena*.

Scutus astrolabeus, nom.mut.

Parmophorus australis Quoy & Gaimard, Zool. Astrolabe, iii., 1834, p.321, Pl.69, figs.1-4; *Id.*, Menke, Moll. Nov. Holl., 1834, p.33 (not *P. australis* Lamarck, An. s. vert., vi., (2), 1822, p.5; nor *P. australis* Rüppell, Reis. N. Afrika Moll., 1828, p.37). *Scutus elongatus* Sowerby, Thes. Conch., iii., 1863, p.226, Pl.249, fig.10. *S. anatinus* var. "b" Smith, Journ. of Conch., ii., 1879, p.237.

From King George's Sound, West Australia, the zoologists of the Astrolabe Expedition described a large species of *Scutus*, the shell of which is broader and flatter than the others. The name they used had previously been employed by Lamarck for a compound of the East Australian "antipodes" and the New Zealand "breviculus." This was reduced to the rank of a variety by Smith in 1879, and by Pilsbry in 1890. Now estimated as the Adelaidean representative of the Peronian *antipodes*, and restored to specific rank, it needs this fresh name.

Scutus antipodes Montfort.

(Plate xlvii., figs.7, 8, 9.)

Scutus antipodes Montfort, Conch. Syst., ii , 1810, p.59, Pl. xv. *Patella ambigua* Dillwyn, Cat. Recent Shells, ii., 1817, p.1053 (not *P. ambigua* Gmelin, Syst. Nat., xiii., 1791, p.3255). *Scutus anatinus* Smith, Journ. of Conch., ii., 1879, p.258; *Id.*, Tate, Journ. Roy. Soc. N.S.W., xxvii., 1893, p.185; *Id.*, Shirley, Proc. Roy. Soc. Q'land, xxiii., 1911, p.96. *Parmophorus elongatus* Blainville, Bull. Soc. Philom., 1817, p.25, and Malacol., 1827, Pl.48, fig.2; *Id.*, Angas, Proc. Zool. Soc., 1867, p.219; *Id.*, Ten.-Woods, Proc. Roy. Soc. Tasm., 1877, p.44 (not *P. elongatus* Lamarck, 1801). *Parmophorus convexus* Quoy & Gaim., Zool. Astrolabe, iii., 1834, p.322, Pl.69, figs.5-16; *Id.*, Forbes, Voy. Rattlesnake, ii., 1852, p.362. *Parmophorus tumidus* A. Adams Proc. Zool. Soc., 1851 (1853), p.222. *Parmophorus australis*

Hogg, Trans. Roy. Micr. Soc., xvi., Pl. xii., fig.57 ; *Id.*, von Martens, Forsch. Gazelle, iii., 1889, p.263.

As *Patella ambigua* was already occupied by Gmelin in 1791, it is of no consequence whether the *Patella ambigua* of Chemnitz or of Dillwyn meant a species of *Scutus* from New Zealand or another Australian form. But the sketch of Montfort, inartistic though it be, exactly represents that *Scutus* with a narrow shell, inhabiting Tasmania and New South Wales, as distinguished from *S. breviculus* of New Zealand, or *S. astrolabeus* from West Australia. Therefore, *S. antipodes* of Montfort must replace the younger name of *anatinus* now in ordinary use.

The animal of this species lives beneath large stones in rock-pools in clear water. Quoy & Gaimard mention that it was eaten by the aboriginals of Jervis Bay. The attitude of an allied species, so frequently copied in textbooks from the Zoology of the Astrolabe, is that of a moribund or preserved individual. An endeavour is here made to offer more life-like figures.

Except the sole of the foot, which is buff, the animal is entirely coal-black. The mantle is very voluminous; two lateral lobes, like those of Cypræa, meet over the shell and quite conceal it. Only when handled or sick, do the lobes part and disclose the shell. The mantle also extends on each side behind the shell for a space the breadth of the foot. In front, over the head or each tentacle, an insinuation may temporarily appear. At rest (Fig.8) the animal assumes the shape of an inverted saucer, only the tips of the tentacles protruding beyond the cover of the mantle. The head is elongate, with a long and cylindrical muzzle usually expanded at the distal extremity. The tactile tentacles are long and stout, with a very short ocular tentacle at the outer base of each. From the base of each tentacle, along the epipodial line, runs a series of small, close-set, short lappets. The young differ considerably from the adult. They have a comparatively narrower shell with the apex more excentric; of a white colour, the mantle-lobes, instead of folding across the shell, merely curl over its edge. In a specimen half an inch long (Fig.9), the mantle was deeply notched above the head, and its lobes failed to meet across the shell. It was uniform buff except the black eyes, which showed through the transparent mantle.

LUCAPINELLA NIGRITA Sowerby.

(Plate xlvii., fig.10.)

Lucapinella nigrita Hedley, Proc. Roy. Soc. Vict., xi., 1894, p.24.

The above sketch was taken from a living specimen at Narooma, N.S.W. The animal has already been described in the reference above cited.

NERITA MELANOTRAGUS Smith.

(Plate xlviii., figs.13, 14.)

The nomenclature of this species has already been discussed in these Studies (*antea*, xxv., p.500).

The animal has narrow black stripes on a buff ground, along the muzzle and upper surface of the foot, the rest being buff. The muzzle is produced into a long and broad lip, fimbriated at the margin. When crawling, which is done with deliberation, the muzzle, expanded to the breadth of the foot, brushes along the ground in front. The ocular tentacle is a flat, triangular lobe grooved on the inner side for the reception of the long, slender, tactile tentacle. It is produced into a spur on the outer base, and is connected by an epipodial fringe with the opercular lobe. The mantle has two lobes, one above the operculum, the other spread below the base of the columella. The margin of it is plain, though in other species it is said to be festooned. In a considerable number of individuals examined, no intromittent organ was observed. The foot is rather small, rounded in front and behind. Sometimes, as in the figure, the gill-plume is protruded from the dorsal cavity till its tip reaches the aperture of the shell. The eggs are separate, white, oblong capsules with a continuous, tough membrane. Frequently, these are deposited on the shells of other individuals of the same species. The operculum (Fig.14) has a smooth, median, falcate area, on each side of which are small, crowded pustules; the convex margin has a membranous edge.

The radula has been illustrated by Maplestone,* from a Williamstown specimen.

PHENACOLEPAS CINNAMOMEA Gould.

(Plate xlviii., figs.17, 18, 19.)

Patella cinnamomea Gould, Proc. Boston Soc. Nat. Hist., ii., 1846, p.151. *Scutellina cinnamomea* Brazier, these Proceedings, iv., 1879(1880), p.389. *Phenacolepas cinnamomea* Thiele, Conch. Cab. Abth. xi.a, 1909, p.35, Pl.6, fig.5. *Scutellina ferruginea* A. Adams, Gen. Rec. Moll., 1854, Pl.52, figs.6, 6a.

This species was described originally as a *Patella*, and was transferred by Adams to *Scutellina*. Remarking that this name of Gray was preoccupied, Pilsbry† substituted *Phenacolepas* for it. I have a grave suspicion that *Plesiothyreus*, Cossmann‡ proposed for a French Tertiary fossil and applied by Sowerby§ to a recent Hong Kong shell, should be employed in its place.

Important remarks by Dr. Dall,‖ referring this group to the vicinity of *Nerita*, seem to have been overlooked by subsequent writers.

Dr. Thiele¶ has published some notes on the anatomy of this species.

P. cinnamomea is rather rare; it occurs in Sydney Harbour under large stones in the mud-zone, in communities of a dozen or so under the same rock. The animal is uniform crimson. The shell is carried with the apex turned to the posterior end. A large, open chamber is exposed behind the head, whence the broad, bipectinate ctenidium may be stretched beyond the shell margin or be withdrawn out of sight. The neck is long and flexible; the muzzle terminates in a bilobed upper lip, projecting as an immense hood over and beyond the small mouth. The

* Maplestone, Month. Micros. Journ., viii., 1872, p.14, Pl. xxvi., No.14.

† Pilsbry, The Nautilus, v., 1891, p.89.

‡ Cossmann, Ann. Soc. Malac. Belg., xxiii., 1889, p.191, Pl. vii., figs.13-15.

§ Sowerby, Proc. Malac. Soc., i., 1894, p.191.

‖ Dall, Bull. Mus. Comp. Zool., xviii., 1889, p.342.

¶ Thiele, Zeits. wiss. Zool., lxxii., 1902, p.349, Pl. xxvi., figs.133-134, text-fig.11.

tentacles are long and slender, having an ocular bulb at their outer base. From the eye, a crest of muscle runs backward to the shell. In the female(Fig.19), there is a small lobe and sinus on the right side of this crest. But the male has a large, intromittent organ rooted on the median side of the right tentacle, and carried round below the eye to the back of the neck(Fig.18). There is no epipodium. Outside the mantle-margin there is a peripheral row of longer and shorter papillæ, corresponding to the radials of the shell; on further magnification, these papillæ are seen to be beaded.

Since writing the above, I have gathered *P. cinnamomea* under stones at the mouth of the Annam River, near Cooktown, Queensland.

The other Australian members of this genus are:—*P. senta* Hedley, 1899, March (= *P. lingua-viverræ* Melvill & Standen, 1899, July); *P. reticulata* Thiele, 1909; *P. mirabilis* Sowerby, 1910; *P. calva* Verco, 1906; *P. alboradiata* Verco, 1906; *P. crenulata* Broderip, 1834; and *P. galathea* Lamk., 1819.

Patelloida nigrosulcata Reeve.

Patella nigrosulcata Reeve, Conch. Icon., viii,, 1855, Pl. xxx., fig.84. *Acmæa patellavecta* Verco, Trans. Roy. Soc. S.A., xxxvi., 1912, p.195, Pl. xv., figs.5-7; Pl. xvi., fig.5.

At the conclusion of an excellent description of this species, Dr. Verco noted that the West Australian material dealt with, resembled *P. nigrosulcata*, and might eventually prove to be that species. Mr. T. Iredale, under date 13/9/15, writes, "Specimens of Verco's shell have been received at the British Museum, and I compared them, with Mr. Edgar A. Smith's assistance; we agree that the identity is absolute."

Cerithium mysterium, nom.mut.

Cerithium tomlini Hedley, Proc. Linn. Soc. N.S. Wales, xxxix , 1914, p.717, Pl. lxxxv., fig.89; not *Cerithium tomlini* Preston, Journ of Malacology, xii., 1905, p.3, Pl. i., figs.11, 11a.

Mr. J. R. le B. Tomlin, to whom this species was dedicated, has reminded me that, in this compliment, I have been anticipated by Mr. H. B. Preston. A new name, therefore, becomes necessary, and is here bestowed. I have lately found the species to be plentiful as dead shells on the beach of Lizard Island, North Queensland.

Ancilla edithæ Pritchard & Gatliff.

Ancilla edithæ Pritchard & Gatliff, Proc. Roy. Soc. Vict., xi., 1899, p.181, Pl.29, fig.5.

This is a new record for this State. On 2nd February, 1916, I dredged several specimens in 7-19 fathoms, off the north end of Montagu Island, on sandy ground.

Marginella mustelina Angas.

(Plate l., fig.31.)

Marginella fasciata Sowerby, Thes. Conch., i., 1846, p.389, Pl.76, fig.142; *Id.*, Chenu, Man. i., 1859, p.197, fig.1041; *Id.*, Tomlin, The Nautilus, xxix., 1916, p.138 (not *Persicula fasciata* Schumacher, Essai nouv., 1817, p.235). *Hyalina mustelina* Angas, Proc. Zool. Soc., 1871, p.90, Pl. i., fig.5: *Id.*, Oliver, Trans N. Z. Inst., xlvii., 1915, p.537. *Volvarina rubrifasciata* Jousseaume, Rev. et Mag. Zool., (3), iii., 1875, p.221.

This species lives under rocks on the ocean-beach. The animal is very active, coloured orange variegated with buff. There is no operculum. A papillate mantle closes over the shell. Foot in front notched, sometimes produced into lobes, behind pointed and projecting past the shell. Tentacles wide-spread, rather short and blunt, eyes sessile at the outer bases of the tentacles. Rostrum exserted more than half the length of the tentacles. The specimens drawn were obtained at Narooma, N.S.W., whence I have traced it north to Mast Head Island.

Conus coronatus Gmelin.

Conus coronatus Gmelin, Syst. Nat., xiii, 1791, p.3389; *Id.*, Dillwyn., Descrip. Cat, i., 1817, p.403; *Id.*, Hedley, these Proceedings, xxxii., 1907, p.484. *Conus minimus* Hwass, Encycl. Méth., vers (2), 1792, p.618; *Id.*, Reeve, Conch. Icon., i., 1843, Pl. xxvi., fig. 143; *Id.*, Sowerby, Thes. Conch., iii., 1853, p.9, Pl. 189, figs-54, 55, Pl.191, figs.99, 111; *Id.*, Angas, Proc. Zool. Soc., 1877, p.184; *Id.*, Brazier, Journ. of Conch., ii., 1879, p.190; *Id.*, Smith, Proc. Zool. Soc., 1891, p.402; *Id.*, Melvill & Standen, Journ. Linn. Soc. Zool., xxvii., 1899, p.156 (not *Conus minimus* Linné, Syst. Nat., x., 1758, p.714—sole citation, Argenville t.15, f.A = *Conus figulinus* Linné, —*fide* Hanley, Linn. Ips. Conch., 1855, p.169). *Conus tæniatus* Hwass, *op. cit.*, p.628, Pl.319, fig.5. *Conus miliaris* Hwass, *op. cit.*, p.629, Pl.319, fig.6. *Conus barbadensis* Hwass, *op. cit.*, p 632, Pl.322, fig.8 (not *C. barbadensis* of Reeve or of Sowerby, *fide* Kiener). *Conus bandatus* Perry, Conchology, 1811, Pl. xxv., fig.4. *Conus tiaratus* Broderip, Proc. Zool. Soc., 1833, p.52. *Conus abbreviatus* Reeve, Conch. Icon., i., 1843, Pl. xvi., fig.86. *Conus aristophanes* Sowerby Thes. Conch., iii., 1853, p.9, Pl.190, figs.81, 82.

Hanley pointed out that the original *Conus minimus* was clearly based on that shell which modern authors know as *C. figulinus.* From the figures of Valentyn and Gualtier, a shell hitherto unnamed was correctly introduced by Gmelin as *Conus coronatus.* He also included other species, such as *C. nobilis* Linné. This synonymy was purified by Dillwyn. Appreciating the error of Hwass, Smith referred to the species, in 1891, as *C. minimus* Auctorum. The natural inference that *minimus* meant "least," whereas it was a latinised form of "La Minime," meaning the monkish, perhaps countenanced the error of Hwass, mostly adopted by modern authors. It follows that *C. figulinus,* reported from Torres Strait by Melvill & Standen (and recently taken by myself at Lucinda Point, Queensland) must now assume the name of *minimus.*

This tropical species descends into New South Wales. It was recorded from the Bellenger and Redbank Rivers by Angas and Brazier, and was recently taken at Woolgoolga by Mr. C. Laseron. Melvill, Standen, and Shirley have reported it from Murray Island, Smith from Port Essington, Brazier from Fitzroy Island, and the writer from Mast Head Island. It is one of the commonest and most widely dispersed shells in the tropical Pacific. It grows to a length of 45 mm., and may combine the broken, dark spirals of *aristophanes* with the dot-pattern of *miliaris*, with the smooth crown of *tæniatus* or the tubercular summit of the type. The ground-colour may be in bands or clouds, the articulated dark and white spirals may be developed as broken lines or reduced to dots.

MITRA RHODIA Reeve.

(Plate xlviii., figs.15, 16.)

Notes on the nomenclature of this species have already appeared in these Studies (*antea*, Vol. xxxviii., p.313). It inhabits the sand and broken shells that litter the floor of the rock-pools. The long proboscis is probably used for sounding in the sand for its prey. Its movements are slow. There is no operculum. The colour of the animal is uniform cream, against which the small, black eyes are conspicuous. Foot long and narrow, pointed behind, squarely truncate in front. Head rhomboidal, broader anteriorly; tentacles rather short, apparently only partly contractile, widely spaced. When the proboscis is completely retracted, as in the specimen drawn, the head has somewhat the aspect from above of a cow's head and horns. The siphon is rather long. In the radula, the rachidian has four cusps, the outer smaller and divergent. The lateral has a long, oblong base slightly sinuate posteriorly, with about fifteen cusps. the inner directed towards the rachidian, the second and third largest, the rest gradually diminishing to minute exterior denticles.

MACULOTRITON AUSTRALIS Pease.

(Plate l., figs.28, 29, 30.)

The local members of this genus were discussed *antea*, Vol xxxix, p.733. *M. australis* haunts the shaded sides of boulders at low-water level on the ocean-beach. The animals creep about with moderate activity; they are marbled with black and buff The head is narrow, forking into divergent tentacles which support eyes at half their length, above which point the tentacles contract to half their former thickness. Siphon rather short, only protruded for a length equal to three or four diameters. Foot long and slender. Operculum (Fig.29) with the nucleus apical, situated about its own length from the tip of the tail.

The radula (Fig.30) has a rachidian with arched base, three median pointed cusps and a small external one; laterals bicuspid, the inner cusp half the size of its fellow, with two small denticles on its inner blade, the outer cusp slender and falcate.

ARCULARIA PARTICEPS Hedley.

(Plate xlix., fig.20.)

This species was named, *antea*, Vol. xxxix., p.738. The animal lives sunk beneath the surface of the sand. Into a pool where no *Arcularia* were visible, a few crushed shellfish were thrown; a few minutes afterwards a number of individuals, including the subject of my sketch, appeared in various directions, all steadily crawling towards the bait. The animal of *A. particeps* is particularly bold and active. When lifted out of the water by the shell, the animal twists and kicks about with much vigour. The colour of it is cream irregularly splashed with black.

XYMENE HANLEYI Angas.

(Plate xlix., figs.21, 22, 23, 24.)

Trophon hanleyi Angas, Proc. Zool. Soc., 1867, p.110, Pl.xiii., fig.1.

In previous papers, I have figured the young shell of this, under the title of *Trophon paivæ* (*antea*, Vol. xxxiii., p.456), and later noted that Tryon made a mistake in subordinating *T. hanleyi* to *T. paivæ* (*antea*, Vol. xxxviii., p.329). For this group, Hutton introduced the genus *Kalydon*, but Iredale, on the ground that *Kalydon* was preoccupied, has substituted *Xymene*.*

The animal (Fig.21) is very common under stones in the mud-zone in Sydney Harbour, where it is notorious as an oyster-pest.† The eggs (Figs.23, 24) are laid in separate packets, each packet round. about 5mm. in diameter, rather flatter than hemispherical, with a central circular orifice about 1·5 mm. across. The ova are visible both through the orifice and through the semitransparent membrane. These eggs are deposited on the under surface of shells and stones. So crowded are they, that Mr. T.

* Iredale, Trans. N.Z. Inst., xlvii, 1915, p.471.

† Saville Kent, Parliamentary Report on Oysters and Oyster-Fisheries of Queensland, 1891, p.10, Pl. i., figs.1, 10, 11.

Dick, who kindly furnished me with the material drawn, writes, under date 13th July, 1915, that, in an infested area in Port Macquarie, the stones were then almost white with the ova of this borer.

PLANISPIRA STRANGULATA Hombron & Jacquinot.

Helix strangulata Hombron & Jacquinot, Ann. Sci. Nat., (2), xvi., 1841, p.64. *Planispira cyclostomata* Hedley, Rec. Austr. Mus., viii., 1912, p.155, Pl xlv., figs.51-54.

A preliminary paper by Hombron & Jacquinot, describing the new shells obtained by the Astrolabe and Zélée Expedition, was lately discovered by that active bibliophile, Mr. Tom Iredale. In the official account of that expedition by Rousseau, and in unofficial work by Le Guillou, a member of it, this memoir is ignored. It has also been overlooked by Pfeiffer, Reeve, Tryon, von Martens, Smith, and every writer on the subject.

Examining the nomenclature of this species, in 1912, I concluded that the name to be adopted for this shell from Warrior Island was *Helix cyclostomata*, published by Le Guillou in 1842. It now appears that the name of *strangulata* was published a year earlier, instead of many years later, than *cyclostomata*.

Another consequence of the establishment of *H. strangulata* as dating from 1841, is that *H. strangulata*, proposed by C. B. Adams in 1849, becomes invalid.

PLANISPIRA TORRESIANA Hombron & Jacquinot.

Helix torresiana Hombron & Jacquinot, Ann. Sci. Nat., (2), xvi., 1841, p.63. *Helix delessertiana* Le Guillou, Rev. Zool., v., 1842, p.138; *Id.*, Pilsbry, Man. Conch., 2nd ser., ix., 1894, p.114.

Here it again becomes necessary to restore the older but forgotten name. In his independent publication of the new species obtained by the expedition, Dr. Le Guillou seems to have been either careless or disloyal.

XANTHOMELON DURVILLII Hombron & Jacquinot.

Helix Durvillii Hombron & Jacquinot, Ann. Sci. Nat., (2), xvi., 1841, p.62. *Helix pomum* Pfeiffer, Symbolæ hist. Heliceorum, ii., 1842, p.37.; *Id.*, Pilsbry, Man. Conch., 2nd ser., vi., 1890, p.178, Pl.38, figs.73, 74.

Here again, the name first proposed by the circumnavigators precedes that in current use. It is a pleasure to reinstate in Australian zoological nomenclature the name of this unfortunate and gallant explorer.

MARSENIOPSIS WILSONI Smith.

Lamellaria wilsoni Smith, Ann. Mag. Nat. Hist, (5), xviii, 1886, p.270, text-fig.; *Id.*, Wilson, Vict. Nat., iv., 1887, p.117; *Id.*, Pritchard & Gatliff, Proc. Roy. Soc. Vict., xii., 1900, p.196. *Marseniopsis wilsoni* Vayssière, Exped. Antarct. Franc. Charcot, 1907, Moll., p.35.

Typically southern is the genus *Marseniopsis*, first introduced by Bergh for two subantarctic species taken by the Challenger Expedition, *M. pacifica*, from Kerguelen, and *M. murrayi*, from Marion Island. A pair of Antarctic forms, *M. conica* and *M. mollis*, were discovered near Cape Adare, Adélie Land, while a fifth, *M. antarctica*, was dredged by Dr. Charcot off Wandel Island.

Discussing the distribution of the group in relation to the latter species, Prof. Vayssière points out that the Australian *Lamellaria wilsoni* should be here included. In the British Museum, there is a single specimen of *L. wilsoni*, presented by Mr. J. B. Wilson, and marked "type.'

I now suggest that a second Australian member is *Caledoniella contusiformis* Basedow.*

PHYTIA ORNATA Férussac.

(Plate l., figs.26, 27.)

The nomenclature of this species was discussed (*antea*, xxxviii., p.334) under the heading of *Ophicardelus ornatus.*

Its habits are to associate with *Rhodostoma*, *Salinator*, and *Assemania* in the Salicornia-zone, that is, just below high-water level in sheltered estuarine swamps, either in the open or under the shade of the Avicennia-mangrove. At low tide, the *Phytia*

* Basedow, Trans. Roy. Soc. S.A., xxix., 1905, p.183, Pls. xxvii., xxix.

crawls over the mud at a fair pace; if placed in a vessel of sea-water, it soon creeps out, and always moves steadily away from the light.

The foot is small and narrow for the size of the shell; there is no operculum. The facial area is darker in colour, and covered with finer tubercles than the rest of the animal; it is marked off from the foot by a groove on each side. When the animal is extended, the tentacles are planted well apart, but seem to spring from contiguous bases when it is contracted. They are sub-cylindrical, slightly tapering, blunt at the tips, contractile, not evaginate. The eyes are sunk within the substance of the tentacle. Near the tip of the muzzle are two, white, oblong marks that may represent the smaller tentacles of the Helicidæ.

The muzzle is unusually broad, being as wide as the foot. Sometimes it is emarginate in front, and usually recurved at the margins. The mouth is in the centre of a large, labial disc. Between this disc and the fore-part of the foot is a shallow pouch.

Siphonaria scabra Reeve.

(Plate l., fig.32.)

Siphonaria scabra Reeve, Conch. Icon., ix., 1856, Pl. i., fig.2.

This species occurs on sheltered rocks at low water. It does not cling as firmly to the rock as a limpet does, and, when upset on its back, finds more difficulty in turning over. On the right is a free lobe of the mantle, sometimes rolled in a funnel or spread in a flap, and reaching to the edge of the shell. The head is devoid of any trace of tentacles; the eyes are small, and sunk under the surface. The muzzle is spotted with black; it projects a little past the foot, and terminates in a broad, mobile, upper lip, which may assume a notch in front and recurved corners at the side. Beneath it is the mouth. The foot is spotted on the side and is of the ordinary limpet-shape.

Rhizorus.

Rhizorus Montfort, Conch. Syst., ii., 1810, p.339, Pl. lxxxv., for *R. adelaidis* Montfort, = *Bulla acuminata* Bruguière, 1792. *Volvula* A. Adams, in Sowerby, Thes. Conch., ii, 1850, pp.558, 596, for *B. acuminata*, etc. *Volvulella* Newton, Syst. List. Brit. Oligocene, Eocene Moll., 1891, pp. xii., 268, for *Volvula* Adams, not Oken, 1815.

Some discussion has occurred over the validity of the name *Volvula*. On the ground that *Volvulus* Oken, 1815, preoccupied *Volvula* Adams, 1850, Mr. R. Bullen Newton replaced it, in 1891, with a new name, *Volvulella*. But, as Dr. H. A. Pilsbry considered that it was not thus invalidated, he employed *Volvula* in his monograph of the genus in the Manual of Conchology, in 1893.

Neither of these authorities seems to have seriously considered the claim of *Rhizorus*. As early as 1810. *Rhizorus adelaidis* was legitimately proposed by Montfort, for a shell the size of a grain of millet, found on a sandy beach at Porto Ferrajo, in the island of Elba, Italy. From a rough, reversed, but recognisable woodcut, it seems clear that *R. adelaidis* is *Bulla acuminata* Bruguière, 1792,* because that is the only Mediterranean shell which corresponds in size and contour. This is itself the type, both of *Volvula* and of *Volvulella* so, as was indicated sixty years ago by Menke,† *Rhizorus* must be given precedence. The Australian species concerned in this change of nomenclature are *Volvula rostrata* A. Adams, *V. sulcata* Watson, and *V. tragula* Hedley.

ODOSTOMIA PASCOEI Angas.

(Plate xlvi., fig.5.)

Odostomia pascoei Angas, Proc Zool. Soc., 1867, p.112, Pl. xii., fig.12.

In the Natural History Museum at South Kensington, I examined a single specimen, marked as the type of *O. pascoei*, and seven specimens marked as types of *O. kreffti* Angas. These two agree in all particulars, except that *O. pascoei* has an additional whorl, and a corresponding increase in length and breadth. Since it is the adult which *O. pascoei* represents, and since that

* Jeffreys, Brit. Conch., iv., 1867, p.412.

† Menke, Malak. Blatt., i., 1854, p.46.

name also happens to have page-precedence, it is recommended that *O. kreffti* be reduced to synonymy.

The species haunts crevices on the under surface of loose rocks between tide-marks. When kept in an aquarium, it endeavours to creep from the light to the darkest corner available. The colour is uniform cream, the foot truncate or emarginate. The rhinophores are folded, narrow, pointed and divaricate; beneath and between these are two falcate processes. The eyes are black, close together in the median line, just behind the junction of the rhinophores. The external appearance suggests that a natural classification would group the family Pyramidellidæ in Opisthobranchiata near the Actæonidæ.

Dolabrifera brazieri Sowerby.

(Plate xlix., fig.25.)

Dolabrifera brazieri Sowerby, Proc. Zool. Soc., 1870, p.250; *Id.*, Angas, *op. cit.*, 1871, p.98. *Dolabrifera jacksoniensis* Pilsbry, Man of Conch., 1896, p.120, Pl.44, figs.38, 39, 40, 41.

The haunt of this species is the coralline zone of the ocean-rocks, where form and colour tend to conceal it against its native background. In extension, the animal is about four inches long, and one and a half broad. The colour is olive-brown, variegated with buff, and tinged, at the margin and on the tentacles and rhinophores, with green. Upon the back are about a score of warty protuberances, which rise or subside at the will of the animal, and from the summit of which a white filament may project for two or three millimeters, or be withdrawn.

The tentacles are comparatively short and broad, bell-shaped, split nearly to the base, with ragged margin. The rhinophores are narrow, more cylindrical, less deeply notched, set farther back on the neck. Just in front of these are the sessile, inconspicuous, black eyes.

The posterior orifice is set far back, is ovate, about 6 mm. long, with erect margins and an inner lobe rising at the anterior end. In front of this, the right side of the mantle overlaps the left. The gill is never exserted.

Only one species of this genus is known locally. Mr. Brazier, who collected the type-specimens, agrees with me that *D. jacksoniensis* probably represents the young of the unfigured *D. brazieri*. The specimen drawn, I gathered at Long Reef. I have also seen the species at Maroubra.

EXPLANATION OF PLATES XLVI.-LII.

Plate xlvi.

Fig. 1.—*Solecardia cryptozoica* Hedley; animal expanded.
Fig. 2.—*Marcia nitida* Quoy & Gaimard.
Fig. 3.—Orifice of inhalant siphon of same.
Fig. 4.—*Amphidesma angusta* Reeve.
Fig. 5.—*Odostomia pascoei* Angas.
Fig. 6.—*Hemitoma aspera* Gould.

Plate xlvii.

Fig. 7.—*Scutus antipodes* Montfort, crawling.
Fig. 8.—The same at rest.
Fig. 9.—Young stage of same.
Fig. 10.—*Lucapinella nigrita* Sowerby.
Fig. 11.—*Gena strigosa* A. Adams.
Fig. 12.—*Monodonta obtusa* Dillwyn.

Plate xlviii.

Fig. 13.—*Nerita melanotragus* Smith.
Fig. 14.—Operculum of same.
Fig. 15.—*Mitra rhodia* Reeve.
Fig. 16.—Radula of same.
Fig. 17.—*Phenacolepas cinnamomea* Gould.
Fig. 18.—Intromittent organ of same individual.
Fig. 19.—Head of female *P. cinnamomea*, the lip expanded above the pedal mucous gland.

Plate xlix.

Fig. 20.—*Arcularia particeps* Hedley.
Fig. 21.—*Xymene hanleyi* Angas.
Fig. 22.—Operculum of young *X. hanleyi*, the muscle-scars visible through its substance.
Fig. 23.—Cluster of ova of *X. hanleyi*.
Fig. 24.—A single egg-capsule further enlarged.
Fig. 25.—*Dolabrifera brazieri* Sowerby, also detail sketch of tubercle and exserted filament.

Plate l.

Fig.26.—*Phytia ornata* Férussac.
Fig.27.—The same from below.
Fig.28.—*Maculotriton australis* Pease.
Fig.29.—Operculum of same.
Fig.30.—Radula of same.
Fig.31.—*Marginella mustelina* Angas.
Fig.32.—*Siphonaria scabra* Reeve.

Plate li.

Figs.33, 34, 35.—*Arca botanica* Hedley.
Figs.36, 37.—*Arca metella* Hedley.
Figs.38, 39.—*Lucinda hilaira* Hedley.
Fig.40.—*Solecardia cryptozoica* Hedley.

Plate lii.

Fig.41.—*Cardium cygnorum* Deshayes.
Figs.42, 43.—*Tellina astula* Hedley.
Fig.44.—*Tugalia intermedia* Reeve.
Fig.45.—*Tugalia parmophoidea* Quoy & Gaimard.
Fig.46.—*Tugalia cicatricosa* A. Adams.
Fig.47.—*Tugalia bascauda* Hedley.

DESCRIPTIONS OF NEW SPECIES OF AUSTRALIAN COLEOPTERA. Part xii.

By Arthur M. Lea, F.E.S.

Family CURCULIONIDÆ.

Rhinoscapha* darnleyensis, n.sp.

♂. Black. Clothed with scales mostly more or less bluish; the elytra with conspicuous markings.

Head with minute punctures; interocular fovea rather deep and marking the end of the median groove of rostrum Rostrum about as long as prothorax; with rather large, irregularly distributed punctures. Antennæ rather thin; second joint of funicle slightly longer than first, the others all distinctly longer than wide. *Prothorax* apparently slightly longer than wide, but (by measurement) really slightly transverse: with rather small scattered punctures, the sides with numerous small irregular elevations, a small medio-apical impression. *Elytra* not much wider than prothorax at base, sides slightly dilated to beyond the middle, with regular rows of large, sharply defined punctures, becoming smaller posteriorly. *Legs* long and thin. Length(♂♀), 15-19 mm.

♀. Differs in being larger, prothorax somewhat shorter, elytra conspicuously wider, abdomen more convex, and legs shorter.

Hab.—Darnley Island (H. Elgner).

The discovery of a species on Darnley Island brings this fine genus into the Australian region, although it has yet to be recorded from the mainland;† it is structurally close to *R. biundulata*, *R. tricolor*, *R. egregria*, and *R. consueta*, but readily distinguished by the blue scales; these are rather sparse on the

* Montr., Ann. Soc. Agr. Lyon, 1857, vii., p.47.

† I have had for many years a specimen (probably of an undescribed species) supposed to be from Queensland, but have been unable to get the locality confirmed.

head and mixed with setæ; on the prothorax, they form four wide but feeble longitudinal vittæ: on the legs, they are dense; on parts of the undersurface they are dense, but vary to green and to a bluish-white. The elytra, to the naked eye, appear to have most of the derm glabrous, but really have very fine setæ; the markings on each consist of an irregular patch near the scutellum of more or less rusty-red scales, becoming whitish or bluish at the edges, and connected with a smaller patch on the side; an irregular, postmedian fascia, with a short extension (on the fourth interstice) from same to near the basal patch, the scales whitish-green and purple, with a few rusty ones; and a small pale spot on the fifth interstice midway between the post-median fascia and the apex; the suture on the apical slope and the side (except near base) are rather densely clothed with bluish or greenish scales.

CATASARCUS SPINIPENNIS Fhs.(?), var. INSIGNIS, n.var.

C spinipennis is such a variable species, that it does not appear to be desirable to describe, as more than a variety of it, two specimens (from Shark's Bay) that differ from the ordinary forms in being much larger (12-15 mm.), spines at summit of apical slope much longer than usual (about as long as the prothorax is wide), and with very different clothing. The prothorax has, within a narrow median groove, a conspicuous stripe of pale metallic-green, opalescent scales, continued to apex of elytra along suture; on each elytron there are also several conspicuous patches of similar scales; a small one immediately in front of each of the discal tubercles, a conspicuous oblique patch behind the two, and another oblique patch between the median tubercle and base; at the corner of each puncture in the first six rows, from base to tubercles, there are four conspicuous granules (except at the green patches, where the punctures are smaller and granules absent); on the pronotum there are numerous small tubercles, and the eyes are more conspicuous than usual; the inner side of the hind femora are armed with numerous minute conical granules (but these are present also on the typical form, and on several other species).

A specimen (without locality-label) in the British Museum, differs in having the conspicuous patches and stripe of scales more of a golden-green, and the large tubercles somewhat smaller.

LEPTOPS FUMATUS, n.sp.

Black. Very densely clothed with scales varying from almost snowy-white to smoky-brown; in addition with numerous long setæ.

Rostrum moderately long; median carina distinct but densely clothed throughout; sublateral sulci rather narrow and closed at both ends; scrobes not very deep, slightly directed upwards posteriorly. Antennæ not very long but rather thin; none of the joints of funicle transverse. *Prothorax* rather strongly transverse, with rough vermiculate elevations, leaving a rather wide irregular median excavation; near apex with a conspicuous, impressed, irregular line, not quite meeting on upper surface, but meeting on lower surface. *Scutellum* round and distinct. *Elytra* not much longer than wide, strongly convex, sides strongly rounded and at widest fully twice the width of prothorax; with numerous tubercles, mostly acutely conical and of moderate size; suture with seven pairs of tubercles, the largest acutely conical and near summit of apical slope, the others mostly rounded; third, fifth, and seventh interstices with acute tubercles; ninth with a *Catasarcus*-like posthumeral tubercle. *Prosternum* unarmed. *Legs* rather long; tibiæ very feebly denticulate. Length, $11\frac{1}{2}$ mm.

Hab.—New South Wales: Broken Hill (Dr. Pulleine).

In the 1906 table of the genus, would be placed in C, *j*; it is about the size of *L. niveus*, but the spines are much more acute, the clothing is very different, prothoracic excavation larger and of different shape, rostrum stouter and very differently sculptured; the other species of C, *j* are all very different; *L. spiniger* is more acutely spined, and has the rostrum longer and otherwise different. The scales are small and round, and so dense as to almost everywhere conceal the derm; on the rostrum, antennæ, and legs they are nearly all white, but on the prothorax and elytra they have a curious rusty-brown appearance as of having been irregularly smoked, the colour being more intense about the base of elytra than elsewhere, but on the scutellum the scales are almost white. The setæ are denser on the tibiæ, tarsi, muzzle, and apex of abdomen than elsewhere, but they are nowhere sparse; those on the upper surface are more or less golden. The only sign of the interocular fovea is a slight depression in the scales at its position. Seen directly from in front, the base of the elytra appears to be conspicuously margined by six strong tubercles; these are almost the largest, but the most acute ones are those on and about the summit of the apical slope.

Leptops mucidus, n.sp.

Black. Densely clothed with small, soft scales, varying from ashen-white to pale muddy-brown; in addition with numerous stiff setæ, becoming denser and thinner on tibiæ, tarsi, and abdomen.

Head flat between eyes, interocular fovea scarcely traceable. Rostrum moderately long; median carina distinct in middle, but not traceable to interocular fovea or apical plate; sublateral sulci long, narrow, and deep, but almost open posteriorly; scrobes very shallow posteriorly. Antennæ not very stout; two basal joints of funicle comparatively long, none of the others transverse. *Prothorax* almost as long as wide, sides rather strongly rounded; with numerous small tubercles or large granules; with a small medio-apical impression. *Elytra* elliptic-ovate, at widest fully twice the width of prothorax, with numerous small tubercles or nodes, mostly rounded, but a few subconical; with fairly regular punctures about sides, but the derm elsewhere mostly vermiculate-rugose. *Prosternum* unarmed. *Legs* rather long; tibiæ feebly denticulate. Length, 17-18 mm.

Hab.—Western Australia: Killerberrin (H. J. Carter), Swan River (British Museum).

The two specimens before me are probably females; in the 1906 table of the genus, they would be referred to C, *j*, but their general appearance is very different from those of any species of that group, and at a glance they seem near *L. cacozelus*, from which, however, they differ in many details. The scales are of almost even density throughout; on the elytra, the setæ are more numerous on the tubercles and the apical slope than elsewhere; on the pronotum, many of the granules are supplied with two or more setæ; the granules themselves are seldom conjoined, so that the surface does not appear to be vermiculate; on the elytra, the suture has two irregular rows of small tubercles, of which the largest (but still small) are a conjoined pair near summit of apical slope; there are fairly numerous tubercles on the third, fifth, and seventh interstices, but the intervening ones are also supplied with a few, and there is an obtuse *Catasarcus*-like posthumeral tubercle on the ninth; altogether there are about thirty tubercles on each elytron.

LEPTOPS GRANIVENTRIS, n.sp.

Black. Densely clothed with small, round, muddy-brown or chocolate-brown scales; in addition, with numerous short, dark setæ.

Head with interocular fovea distinct. Rostrum not very long, sides rather strongly incurved to middle. Antennæ comparatively short and stout, but no joint of funicle transverse. *Prothorax* strongly transverse, sides irregularly rounded, base gently incurved at middle; surface vermiculate. *Scutellum* small and subtriangular. *Elytra* subovate, much wider than prothorax; with rows of large punctures; each elytron with three conspicuously elevated lines, of which one commences on the shoulder as a distinct tubercle. *Abdomen* with numerous small, shining, setiferous granules on all segments; a few also on metasternum. *Legs* not very long, tibiæ not visibly denticulate. Length, $8\frac{1}{2}$-$11\frac{1}{2}$ mm.

Hab.—Queensland: Cunnamulla (H. Hardcastle).

On account of the humeral tubercles, the elytra cannot be regarded as non-tuberculate; consequently, in the 1906 table, the species would be associated with those referred to L, from all of which it is very different On the elytra, the setæ are rather dense on the suture and on the elevated interstices, but sparse in between; on the tibiæ, they are considerably denser than elsewhere, but not particularly long. The clothing is so dense on the rostrum as to partially conceal its sculpture; the median carina is distinct in the middle, but does not appear to extend to the interocular fovea or the apical plate; the sublateral sulci appear to be short and rather shallow; the scrobes are dilated and shallowed posteriorly, and appear to touch the lower half of the eyes. The head, on each side near the eye, appears to have a feeble, oblique ridge, but this is perhaps due more to a line of stiff setæ than to any actual elevation of the derm; there are certainly no distinct tubercles present as on *L. baileyi* and some other species, although the species is obviously allied to *L. frontalis*. There is a shallow medio-apical impression on the prothorax. The elytral punctures are large, but not in geminate rows, and a few are transversely confluent; about the base and apex the rows are constricted and irregular, but across the middle there are. on the female, between the suture and the first elevated line, three rows; between the first and second, four or five rows; between the second and third, four or five rows; and between the third and margin, five or six rows; on the male, the rows are three, three, three, and five in number. The female differs from the male also in being larger and wider, elytra fully twice the width of prothorax (as against about once and one-half in the male), and the legs are somewhat shorter.

LEPTOPS INTRICATUS, n.sp.

Black. Densely clothed with muddy-brown scales; with stout setæ, rather numerous but somewhat irregularly distributed on upper surface, but becoming denser and longer on muzzle, abdomen, and legs.

Rostrum moderately long, sculpture partially concealed. Antennæ moderately long and thin; second joint of funicle longer than first. *Prothorax* moderately transverse, sides irregularly rounded; coarsely vermiculate, with an irregular medio-frontal depression. *Elytra* suddenly wider than prothorax, not much wider at middle than across shoulders; surface very irregular. *Legs* moderately long; tibiæ not visibly denticulate. Length, 11-13½ mm.

Hab.—Queensland: Cunnamulla (H. Hardcastle).

In the 1906 table of the genus, would be referred to KK, from all the species of which its elytral sculpture will readily distinguish it. At first glance, it appears close to *L. globicollis*, but the scape is considerably longer than in that species, and the prothorax and elytra are really very differently sculptured. In some respects, it is close to the preceding species, but the rostrum is longer and differently sculptured, the antennæ thinner, elytra differently sculptured, and abdomen without granules. The median carina of the rostrum is hardly more than traceable on the smallest specimen, but on the others it appears to start from a small interocular fovea, and to terminate before the apical plate; the sublateral sulci are narrow and apparently open posteriorly; the scrobes become so shallow posteriorly as to practically vanish. The sculpture of the elytra is very peculiar, and appears to consist of irregularly elevated interstices connected with others by short nodes, giving the general surface a somewhat roughly vermiculate appearance; thus, although the suture has no distinctly elevated tubercles, it appears to be connected with the second interstice by about eight small nodes, each being placed at the distance of about three punctures; the third and fifth interstices have many such transverse nodes, the seventh has a few, but a few distinctly elevated tubercles as well; in consequence, there appear to be numerous narrow, suboblong depressions of undulating depths, between irregular transverse and longitudinal elevations, the punctures themselves are large but mostly shallow, but they become deep and regular on the sides and on part of the apical slope.

Leptops murinus, n.sp.

Black. Densely covered with smoky or mouse-coloured scales, in places lightly mixed with white; in addition, with numerous stout, more or less decumbent, whitish setæ.

Head somewhat flattened between eyes; interocular fovea concealed. Rostrum stout, sides dilated from base to near apex, median carina distinct. Scape short, rather strongly increasing in width to apex; second joint of funicle longer than first, some of the following ones lightly transverse. *Prothorax* lightly transverse, sides rather strongly and evenly rounded, median line narrow and distinct, towards sides somewhat vermiculate. *Scutellum* very small. *Elytra* not very much wider than prothorax, sides almost parallel from behind shoulders (which are oblique) to beyond the middle; with geminate rows of large, but not closely adjacent, punctures; third, fifth, and seventh interstices lightly elevated, and in places obtusely tuberculate. *Legs* rather stout; front tibiæ rather strongly curved and moderately denticulate. Length, 10 mm.

Hab.—Queensland: Dalby (Mrs. F. H. Hobler).

The type being unique and in perfect condition, it has not been abraded. In the 1906 table of the genus, it would be referred to L. From *L. globicollis*, it differs in the elytra not much wider than the prothorax at its widest, alternate interstices much less conspicuously elevated, prothorax smaller, with sides less strongly rounded, and rostrum shorter and differently sculptured; *L. corrugatus* and *L. argillaceus* have very different elytra. The setæ are mostly depressed, but on account of their colour being paler than the scales, they are rather conspicuous; on the tibiæ, they are denser than elsewhere, not very long on the upper surface of same, but decidedly longer on their undersurface, where they are almost as long as on the muzzle. The sublateral sulci and the scrobes are greatly obscured by the clothing, but the former appear to be subtriangular, and to be open posteriorly; the latter appear to be very shallow posteriorly and to be directed below the lower edge of the eyes. There is a fairly distinct, but obtuse, tubercle on each shoulder, and another on the fifth interstice near summit of apical slope, but the elytra might almost fairly be regarded as non-tuberculate.

Leptops scaber, n.sp.

Black. Densely clothed with dark brown scales; with short, stout setæ, not very dense on prothorax and elytra, but becoming denser on rostrum and femora, and much denser and longer on tibiæ.

Head with a fairly large interocular fovea. Rostrum long, parallel-sided to near apex, and then rather strongly inflated; median carina distinct, except near base and apex; sublateral sulci narrow, at base suddenly directed inwards so as almost to touch the interocular fovea; scrobes deep, directed on to lower surface, where they almost meet. Antennæ moderately stout; scape not quite touching the eye; two basal joints of funicle of equal length, but second apparently the longer (from above), some of the following ones feebly transverse. *Prothorax* not much wider than long, sides irregularly rounded, with an irregular medio-frontal excavation; with numerous rounded tubercles or large granules, a few of which are irregularly conjoined. *Elytra* subelliptic, at base scarcely wider than prothorax, but much wider across middle; with irregular rows of large punctures, becoming regular on sides; third, fifth, and seventh interstices tuberculate. *Legs* rather stout; tibiæ not visibly denticulate. Length, 15 mm.

Hab.—Queensland: Coen (J. A. Anderson); unique.

In the 1906 table of the genus, would be associated with *L. superciliaris*, whieh is a much smaller and otherwise very different species. The combination, in fact, of sublateral sulci almost meeting on the upper surface, and scrobes almost meeting on the undersurface, is without parallel in the genus. It is a rough-looking species, at first glance like some females of *L. multinodosus* and *L. cicatricosus*. A few of the scales have a faint golden lustre; each of the femora has an obscure dark ring. The elytral tubercles are mostly obtuse, although a few are subconical; the largest is on the third interstice at summit of apical slope, the next largest is on the fifth; on the seventh, they are few in number and small.

Leptops concinnus, n.sp.

Black. Very densely clothed with glistening white scales, with a silvery or rosy gloss; setæ mostly confined to rostrum, legs, and undersurface.

Head somewhat flattened between eyes; interocular fovea not traceable. Rostrum moderately long; median carina apparently absent, intermediate ones obtuse; sublateral sulci rather deep, subcrescentic in shape, and closed at both ends; scrobes deep, directed below lower edge of eyes. Antennæ comparatively long and thin; second joint of funicle distinctly longer than first. *Prothorax* moderately transverse, sides irregularly rounded and widest slightly in advance of the middle; surface vermiculate-tuberculate, with a rather small medio-frontal impression. *Elytra* separately rounded at base and increasing in width to beyond the middle; with rows of fairly large, conspicuously black punctures; third interstice with a large tubercle at summit of apical slope, and numerous shining black nodes between same and base, fifth with a somewhat smaller tubercle and less numerous nodes, seventh with somewhat larger nodes and an obtuse humeral tubercle. *Legs* rather long; tibiæ not visibly denticulate. Length, 17 mm.

Hab.—Queensland : Coen (J. A. Anderson); unique.

With the general shape of *L. iliacus*, *L. nodicollis*, and *L. maleficus*, but with very peculiar clothing; the curious satiny lustre of the scales is almost the same (although varying in shades) throughout, but on the rostrum and legs the lustre is interrupted by the setæ. The setæ on the elytra are almost confined to the suture and apical slope, elsewhere being either absent or traceable with difficulty; from the prothorax at first they appear to be entirely absent, but a few small ones may be traced by their slightly darker colour than the scales; between the eyes, on the rostrum and legs, they are dense, stiff, and brownish: on the undersurface of the tibiæ, and on the abdomen, they are pale. The deep, black punctures and the conspicuously shining black nodes give the elytra a rather curious appearance. The rostrum appears to be non-carinate along the middle, but the type was not abraded to make certain of this.

Leptops minor, n.sp.

Black, some parts obscurely diluted with red. Densely clothed with fawn-coloured scales, mixed with stout setæ.

Head with interocular fovea narrow. Eyes rather convex, scarcely once and one-half as deep as wide. Rostrum rather long; median and intermediate carinæ very distinct through clothing: sublateral sulci narrow; scrobes deep only in front, directed towards middle of eyes. Antennæ comparatively long and thin. *Prothorax* almost as long as wide, sides evenly rounded; with numerous small tubercular elevations, and with a small medio-frontal impression. *Scutellum* absent. *Elytra* strongly convex, elliptic-ovate, across base no wider than prothorax, but almost twice as wide across middle, with rows of large, partially concealed punctures; third interstice with an obtuse tubercle at summit of apical slope, and a still more obtuse one near base, fifth with two obtuse ones slightly closer together than those on third. *Legs* moderately long but rather stout; tibiæ feebly denticulate. Length, 7-8 mm.

Hab.—Queensland: Brisbane (H. W. Cox).

The absence of a scutellum associates this species with *L. tetraphysodes*, but the tubercles are differently placed; on that species, the four nearer the suture are placed, as it were, at the corners of a square; on the present species, the two nearer the base are fully twice as distant as those from summit of the apical slope, as the two on the third interstice on the left elytron are to their fellows on the right; the punctures and clothing are also different. On the elytra, the setæ are fairly dense on the suture and elevated parts, but rather sparse elsewhere; on the prothorax, they are fairly numerous, and, on the front margin, are condensed into two feeble fascicles.

ONESORUS HOPLOCNEMUS, n.sp.

Black, appendages in parts obscurely diluted with red. Moderately densely clothed with greyish-white scales.

Head wide and gently convex between eyes, these very prominent. Rostrum short, wide, and rather flat, median carina very feeble; sublateral sulci apparently absent. Scape about as long as four following joints combined; first joint of funicle slightly shorter than second, the four apical ones subglobular. *Prothorax* almost twice as wide as the median length; with large, irregular punctures, and subreticulate elevations. *Scutellum* small. *Elytra* rather briefly ovate, sides strongly rounded; with rows of large, deep punctures, close together, but partially concealed by scales; no interstices conspicuously elevated. Hind *tibiæ* with a few conspicuous teeth; claw-joint elongate, the claws separated throughout. Length, 6½ mm.

Hab.—N.W. Australia: Wyndham (Inspector Stephens).

In some respects close to *O. ocularis* but smaller, eyes not subangulate, and no elytral interstices elevated. There are a few granules on the two basal segments of abdomen. The clothing is of an almost uniform dingy-white throughout, and nowhere condensed into markings, but the type appears to be somewhat abraded.

AMISALLUS TUBERCULIFRONS, n.sp.

Black, antennæ and tarsi feebly diluted with red. Densely clothed with muddy-brown scales, interspersed with setæ.

Head with two large, obtuse tubercles between eyes; these very narrow. Rostrum moderately long, dilated towards apex, median carina traceable through clothing; apical triangle conspicuously elevated and shining. Scape rather lightly curved, rather rapidly increasing in width to apex; two basal joints of funicle moderately long, second slightly longer than first, all the others transverse. *Prothorax* moderately transverse, rather widely depressed along middle, each side of depression conspicuously bituberculate towards apex, with numerous small tubercles or nodes elsewhere. *Elytra* briefly subovate, strongly convex, much wider than prothorax; with rows of very large punctures, regular only on sides: with numerous round, conspicuous tubercles. Length, 7-8 mm.

Hab.—N.S.W.: Sydney (A. J. Coates), Kurrajong (Macleay Museum)

In general appearance like *A. nodosus*, but elytra without small tubercles on suture at summit of apical slope, and median channel of prothorax deeper, with the tubercles at its sides considerably larger; seen directly from in front, the apex of the prothorax is very conspicuously bituberculate. There are a few inconspicuous tubercles at the extreme base of elytra, but the larger ones are in two rows on each elytron, and so placed that the end ones, whilst distinctly belonging to the inner row, might also be regarded as the end ones of the outer row; the inner row consists of a large one, then two smaller ones, then a large one at summit of apical slope, and then some smaller ones on the slope itself; the outer row commences with the largest tubercle on the elytron, and is followed by three others gradually decreasing in size; there are also a few granules on the basal half of the suture.

AMISALLUS BASIPENNIS, n. sp.

Black, appendages in places diluted with red. Densely clothed with muddy-brown, slightly variegated scales, interspersed with setæ.

Head with two fairly large but very obtuse tubercles between eyes. Rostrum moderately long, somewhat dilated towards apex. Scape with basal half thin, then suddenly and strongly dilated to apex; funicle thin, two basal joints elongate, the others subglobular. *Prothorax* strongly transverse, widely excavated along middle, strongly impressed each side in front, the sides somewhat rough. *Elytra* much wider than prothorax; with rows of large, partially concealed punctures, regular only on sides; each with two rows of conspicuous tubercles, and a few small ones on suture and towards sides. *Claw-joint* unusually long. Length, 4-4½ mm.

Hab. Victoria: Mallee (C. French).

The inner row of tubercles on each elytron is composed of six or seven, and the outer of five or six; the basal tubercle of each row is large, elongate, oblique, and rapidly slopes downwards, with its base slightly overhanging the base of the prothorax. It is the smallest of the genus, and readily distinguished from all others by the four, large, basal tubercles of elytra; the groove on the prothorax is deeper than usual, and the walls by which it is bounded are roughly elevated rather than tuberculate: the rostrum is so densely clothed that the median carina, if present, is entirely concealed.

I am acquainted with two other small species of *Amisallus*, one of which has a remarkably stout scape; but the specimens are so heavily encrusted with mud (that could not be removed without much of the clothing as well) that it is inadvisable to describe them.

POLYPHRADES APICALIS, n.sp.

Black, tarsi reddish, other parts of appendages very obscurely diluted with red. Densely clothed with light brown scales, with a few spots of darker scales, but becoming ashen on undersurface and legs; with rather dense, more or less depressed setæ.

Rostrum short and wide, on an almost even plane with head, with a narrow median line continued on to head; inter-antennary space wide; apical plate triangular and densely punctate. Scape curved, stout at apex; first joint of funicle as long as second and third combined, fourth to seventh lightly transverse. *Prothorax* (at widest) almost twice as wide as long, sides rather strongly and evenly rounded; with dense, round granules, traceable before abrasion. *Elytra* subovate, sides rather strongly rounded, base no wider than base of prothorax; with regular rows of large punctures, appearing much smaller before abrasion. *Claws* almost equal and distinctly separated only at tip. Length, 5 mm.

Hab.—Queensland (Henry Hacker's No.952).

The second and third striæ (from the suture) near the apex are deflected, at right angles, to become the first and second lateral ones, without interruption of any sort; on most species of the genus, there is a costate elevation there (as on *P. longipennis*) or at least the continuation of an interstice interposed, as it were, between the sutural and lateral striæ, and by this character alone (although there are others) it may be distinguished from all the other species from Queensland. The head and rostrum, from behind, appear to be on an even plane, but, from the side, there is seen to be a slight depression at their junction; the rostrum is scarcely longer than in *P. brevirostris* (a species it has little in common with), but the inter-antennary space is less conspicuously dilated posteriorly. Although not a strikingly distinct species, I know of no really closely allied one. The darker markings on the prothorax are mostly basal; on the elytra, they are mostly feeble spots starting from punctures in the striæ.

POLYPHRADES CORDATUS, n.sp.

Black, appendages more or less reddish. Densely clothed with muddy-brown mottled with ashen scales, becoming almost entirely ashen on undersurface; elytra with sparse setæ, distinct only on sides and on apical slope.

Rostrum not very long, sides almost parallel, transversely impressed on each side of base; inter-antennary space almost parallel, not conspicuously tricarinate; apical triangle distinct. Antennæ not very stout; first joint of funicle as long as second and third combined, second as long as third and fourth combined, third to seventh transverse. *Prothorax* strongly transverse, sides rather strongly rounded, derm concealed. *Elytra* conspicuously cordate, each separately rounded at base, sides strongly rounded: with regular rows of large punctures, appearing much smaller and in narrow striæ before abrasion. *Claws* short and feebly cleft. Length, 3 mm.

Hab.—N.S.W.: Forest Reefs (A. M. Lea).

A very small species, with the elytra more perfectly heart-shaped than in any other species (even including *P. cordipennis*) before me. From the many small species of the genus, readily distinguished by the combination of heart-shaped and inconspicuously setose elytra, short rostrum (notched on each side of base), and short scape. In general appearance, it comes fairly close to *P. marmoratus* before abrasion, but the elytra are somewhat different at the base, the prothorax and rostrum are narrower, and the colour of the derm is different: *P. inconspicuus* has distinctly longer elytra, rostrum, and antennæ. In some lights, a row of setæ may be traced on each elytral interstice. No granules are traceable on the prothorax before abrasion; and where the disc has been partly abraded, a few fairly large punctures are in evidence, but no granules. The type appears to be a female.

POLYPHRADES SUBTERRANEUS, n.sp.

♂. Blackish, some parts obscurely diluted with red, appendages usually entirely reddish. Densely clothed with somewhat variegated scales; mixed with numerous stout, more or less erect setæ.

Eyes not very large, and almost circular. Rostrum rather short, apparently non-carinate; apical plate subtriangular. Scape moderately long and lightly curved, thickened towards apex; first joint of funicle rather stout, as long as second and third combined, the following ones transverse. *Prothorax* rather strongly transverse, sides strongly rounded; with numerous, small, round granules, and fairly large punctures, but all more or less concealed before abrasion. *Elytra* briefly elliptic-ovate, each separately rounded at base, sides rather strongly and evenly rounded; with regular rows of rather large punctures, appearing very small through clothing. Length, 2-2½ mm.

♀. Differs in having somewhat larger elytra, basal segments of abdomen more convex, and legs somewhat shorter.

Hab.—Tasmania: Hobart; abundant at roots of beach-growing plants in July (A. M. Lea).

A small *Mandalotus*-like form, but without free claws; these at first appear to be single, but on very close examination are seen to be cleft at the tip; consequently the species is referable to *Polyphrades*. The clothing is very variable, but is mostly of a muddy-brown, more or less conspicuously variegated with ashen (sometimes almost white); and, in certain lights, many of the paler scales frequently have a golden gloss; each side of the prothorax is usually clothed with a conspicuous pale patch; on the elytra, the pale spots and patches vary from scarcely traceable and of but slight extent, to very conspicuous and occupying fully one-third of the surface; the sculpture of the upper surface of the rostrum is entirely concealed by the scales. The derm itself is often reddish in parts, especially on the elytra and undersurface; the legs are usually conspicuously reddish, but the femora and tibiæ are sometimes deeply infuscated.

Mandalotus microscopicus, n.sp.

Of a dingy reddish-brown, antennæ and tarsi paler. Densely clothed with muddy-brown, feebly variegated scales, interspersed with stout setæ.

Rostrum rather short, sculpture of upper surface entirely concealed. Scape not very long, somewhat dilated to apex; first joint of funicle stouter and longer than second, the others all transverse. *Prothorax* almost as long as wide, sides rather strongly rounded. *Elytra* elongate-subovate, at widest about middle. Two basal segments of *abdomen* flat in middle. *Legs* rather short and stout; front coxæ lightly but distinctly separated. Length, 2 mm.

Hab.—N.S.W.: Muswellbrook (Dr. E. W. Ferguson).

A minute and rather narrow species, of which two specimens, probably males, are before me; its size alone will readily distinguish the species from all those referred to K, in the 1914 table of the genus. One specimen has the derm considerably paler than the other, its undersurface being no darker than the legs. The setæ on the upper surface are of two colours, stramineous and dark brown, the paler ones being stouter and more conspicuous than the others. On abrasion, the pronotum is seen to be without granules, but with rather dense punctures; on the elytra, the punctures, although fairly large, are entirely concealed, their places being marked by light striation of the clothing.

MANDALOTUS MAGNICOLLIS, n.sp.

♂. Blackish, some parts obscurely diluted with red; antennæ castaneous. Densely clothed with ashen-grey scales, on the elytra mottled with brown; with numerous setæ.

Rostrum moderately long, median carina narrow and distinct throughout. Antennæ rather long and thin; second joint of funicle distinctly longer than first. *Prothorax* almost as long as wide; sides evenly rounded, with a narrowly impressed median line, and a deeper transverse one at base; with numerous rounded granules, readily traceable through clothing. *Elytra* slightly narrower than prothorax, and not twice as long, base truncate, sides parallel to beyond the middle; with regular rows of large, partially concealed punctures; alternate interstices feebly elevated, with a few indistinct scattered granules, but some fairly distinct ones on suture. *Metasternum* and *abdomen* with a large excavation common to both; basal segment of the latter with a feeble carina in middle of apex, second segment with a rather conspicuous curved carina near apex. Front *coxæ* rather widely separated; femora stout: tibiæ granulate, the front pair rather strongly denticulate on lower surface. Length, $5\frac{1}{2}$ mm.

Hab.—N.S.W.: Taralga (Dr. E. W. Ferguson).

In the latest table of the genus,* would be associated with *M. granulatus* and *M. fuligineus*, but readily distinguished from these by the abdomen. In general appearance, it is something like *M. piliventris*, *M. caviventris*, and some specimens of *M. ventralis*, but with the abdomen carinate: the only other described species having the abdomen transversely bicarinate is *M. bicarinatus*, but, on that species, the carina on the first segment is much more distinct than on the second, the front coxæ are much closer together, and the size is very much less. The excavation on the undersurface is very conspicuous, but less so than on *M. foveatus*. On the prothorax, there is a depressed seta on each granule; on the elytra, the setæ are in single rows on the interstices, but the four lateral ones, except at the tip, are non-setose. A few inconspicuous granules are present on the elytra.

Family CERAMBYCIDÆ.

Uracanthus glabrilineatus, n.sp.

♂. Dark piceous-brown, becoming black in places; elytra with apical two-thirds light castaneous. Densely but somewhat irregularly clothed with stramineous pubescence, very dense along undersurface of middle femora.

Head with median line deep and narrow, base rather densely punctate. Antennæ almost extending to tip of elytra, fourth to tenth joints dilated on one side of apex, eleventh about one-third longer than tenth, slightly notched on lower side near apex. *Prothorax* much longer than wide, base about one-fourth wider than apex, sides bisinuate: transversely corrugate throughout, and with two small nodes in middle. *Elytra* moderately narrowed from shoulders to basal third, thence parallel-sided almost to apex, each strongly emarginate and acutely bispinose

* Trans. Roy. Soc. S. Aust., 1914, p.299.

at apex, the sutural spine longer and more acute than the other; basal third with dense punctures of moderate size, the interspaces with small, dense ones, elsewhere with very small punctures. Length, 25 mm.

Hab.—Western Australia: Mullewa (Miss J. F. May).

In some respects close to *M. simulans*, but tips of elytra bidentate, subhumeral markings partially clothed, and each elytron with five glabrous lines. Each elytron, to the naked eye, has a large dark subhumeral patch, on which the clothing is sparse in places, but the space between the patches is quite as dark as the patches themselves; although, being densely clothed, its colour is normally concealed; from each of the subglabrous patches, three glabrous lines extend almost to the apex; the suture and the margin are also narrowly glabrous. On the prothorax, the clothing has a somewhat loose appearance, but is condensed into two fairly conspicuous oblique lines.

URACANTHUS INERMIS, n.sp.

♂. Reddish-castaneous. Densely but irregularly clothed with pale pubescence, four hind femora conspicuously clothed along middle of undersurface.

Head with median line narrow and abruptly terminated before base, the latter densely granulate-punctate; clypeus densely punctate, suture deep and semicircular. Antennæ terminated a short distance before apex of elytra, most of the joints very feebly produced on one side at apex, eleventh about one-third longer than tenth. *Prothorax* distinctly longer than wide, base very little wider than apex, sides feebly dilated at middle; strongly transversely corrugated, but the corrugations more or less interrupted before middle, each side of middle with a small, round nodule. *Elytra* very little (except near base not at all) wider than prothorax, sides feebly diminishing in width to basal fourth, thence parallel-sided to apex, where each is evenly rounded; with several scarcely visible longitudinal elevations; punctures very minute. Length (♂♀), 22-26 mm.

♀ Differs in having somewhat shorter antennæ, wider abdomen, and femora not densely clothed along undersurface.

Hab.—Queensland: Cairns (E. Allen), Endeavour River (C. French).

In general appearance, strikingly close to *U. bivittatus*, but with tips of elytra quite strongly rounded, without the least traces of notches or spines. The prothorax has four conspicuous lines of subochreous pubescence, with the intervening spaces highly polished and almost glabrous; but just outside of the submedian line, there are two small spots of clothing; the median subglabrous space is unusually wide. On each elytron, a fairly wide glabrous line commences on each shoulder, and is traceable almost to apex; but, from about the middle, it is distinctly narrowed and lightly clothed. The false suture of the eleventh joint of antennæ is quite distinct on two of the specimens before me, and traceable on the other. The corrugations of the prothorax are strong, but, along the middle, the surface (except at base and apex) is smooth and shining.

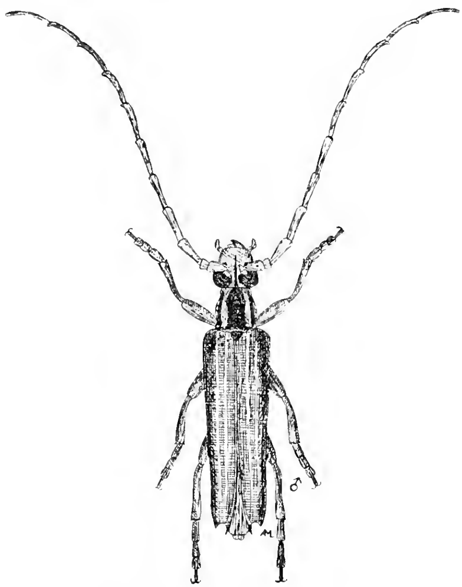
URACANTHUS MALEFICUS, n.sp.

♂. Piceo-castaneous, elytra and parts of appendages somewhat paler. Densely clothed with short stramineous pubescence, becoming almost golden on head and prothorax, on the latter condensed into conspicuous vittæ, leaving three polished and almost glabrous spaces; sterna with almost golden pubescence, somewhat longer and darker than on abdomen.

Head with median line very narrow; clypeus with moderately dense, partially concealed punctures, suture deep and semicircular. Antennæ long and thin, fully two joints passing elytra, most of the joints rather acutely produced on one side at apex, eleventh about one fourth longer than tenth. *Prothorax* about twice as long as the apical width, but this much less than that of the base, sides somewhat dilated in middle, surface gently undulating and smooth. *Elytra* considerably wider than prothorax, each at apex semicircularly emarginate and strongly bispinose, each with two feeble elevations and remnants of a third; basal third with dense and fairly coarse punctures, becoming much smaller to middle, thence with very small ones only. Length (♂♀), 25-32 mm.

♀. Differs in having antennæ terminated before apex of elytra, with their serrations less pronounced, elytra longer and wider, with smaller punctures about base, abdomen larger, and legs somewhat shorter, with thinner tarsi.

Hab.—Tasmania: Sprent (A. M. Lea).



Uracanthus maleficus, n.sp.

The widely glabrous, median portion of pronotum, without transverse or irregular corrugations, and wide, immaculate elytra, each conspicuously bispinose at apex, readily distinguish this from all previously described species. The elytra are uniformly clothed throughout, except that, on each side of the scutellum, the pubescence is slightly longer and more brightly coloured than elsewhere; the glabrous median space on the pronotum is about twice the width of the lateral ones; there is a cluster of coarse punctures on each side of the clypeus, but they are normally almost concealed. The clothing of the undersurface of the four hind femora of the male is rather denser than on the female, but is not conspicuously different as on so many species of the genus.

A hazelnut-hedge at Sprent was practically destroyed by larvæ of this species, and the specimens described were reared from sections of the affected trees.

Uracanthus ventralis, n.sp.

♂. Reddish-castaneous. Rather densely clothed with whitish pubescence; four hind femora along middle of undersurface with dense subochreous clothing; three basal segments of abdomen each with a conspicuous round medio-apical spot, on which the clothing is somewhat darker and longer than on the adjacent parts.

Head with median line deep and narrow; clypeus with dense irregular punctures, suture partially concealed. Antennæ distinctly passing elytra, third joint lightly, fourth to tenth triangularly produced on one side at apex, eleventh about one-fourth longer than tenth. *Prothorax* much longer than wide, base not much wider than apex, sides strongly and almost evenly rounded in middle, strongly transversely corrugated, but across middle irregular. *Elytra* distinctly wider than prothorax, tips evenly rounded but suture strongly spinose; each with two feebly elevated lines and remnants of two others; basal third with dense and coarse punctures, rapidly becoming smaller to middle, and dense and small posteriorly. Length, 17 mm.

Hab.—Western Australia: Mullewa (Miss J. F. May).

In general appearance, fairly close to *U. strigosus* and *U. albatus*, and with somewhat similar abdominal clothing to the males of those species, but each elytron unispinose instead of bispinose, prothorax with more uniform clothing, the lateral node more obtuse and more distant from the base, antennæ considerably longer, etc. It is allied to *U. suturalis*, but is paler, prothorax with sides more evenly rounded, each with four lines of pale clothing, with the interspaces sparsely clothed (on *U. suturalis* the lines of clothing are more numerous, and the interspaces are glabrous), but in particular by the curious abdominal clothing.

Uracanthus corrugicollis, n.sp.

♂. Piceous-brown, elytra and parts of appendages paler. Moderately densely clothed with ashen pubescence, somewhat shorter and sparser on elytra than elsewhere; middle femora densely clothed along middle of undersurface.

Head with median line deep and narrow; clypeus with dense, irregular punctures, suture deep and triangular. Antennæ extending to tip of elytra, fifth to tenth joints triangularly produced on one side at apex, eleventh about one-fourth longer than tenth. *Prothorax* moderately long, base distinctly wider than apex, sides subangular about middle; strongly transversely corrugated, but irregular and with a few small nodes across middle. *Elytra* distinctly wider than prothorax, moderately decreasing in width to basal fourth, each moderately notched at apex, with the suture spinose; densely and minutely punctate. Length, 26 mm.

Hab.—Western Australia: Mullewa (Miss J. F. May).

A rather dark species of moderate size, with elytra lightly but uniformly clothed, and without distinctly elevated lines; each is unispinose only, as the outer portion of the apical notch is quite evenly rounded; the prothoracic corrugations are unusually strong.

Uracanthus ater, n.sp.

♂. Deep black, part of elytra very obscurely diluted with red. Moderately clothed with ashen pubescence, four hind femora along middle of undersurface with dense, conspicuous clothing.

Head with median line very narrow; clypeus with a few large punctures, its suture semicircular. Antennæ slightly passing elytra, fifth to tenth joints triangularly produced on one side at apex, eleventh one-third longer than tenth. *Prothorax* not much longer than basal width, which is somewhat greater than that of apex, sides angulate in middle; strongly and irregularly corrugated, with some small nodes across middle. *Elytra* not much wider than prothorax, parallel-sided from about basal third, each rounded at apex, but slightly notched near suture, with the suture briefly spinose; densely and rather finely punctate, and with very feeble elevated lines. Length, 21 mm.

Hab.—Central Australia (H. Hacker).

Structurally close to the preceding species, but much darker, elytra with rather coarser (although not large) punctures, prothoracic corrugations more irregular, and hind femora, as well as the middle pair, with dense, masculine clothing. The pubescence on the head is dense, on the prothorax it is longer and sparser, on the elytra it is rather short and sparse (the type evidently has the base of the elytra somewhat abraded), on the sterna it is very dense.

Earinus bimaculatus, n.sp.

♂. Head, antennæ, and legs black, with a more or less brassy-green gloss; elytra, mesosternum, metasternum, basal and apical segments of abdomen, and tips of the others metallic bluish-green; prothorax (two large spots excepted) and most of the three median segments of abdomen flavous. Clothed with long, straggling, black and ashen hairs, third and fourth segments of abdomen each with a rounded, medio-apical space with very dense, sooty pubescence.

Head with very dense and rather coarse punctures, but becoming sparse in front. Four basal joints of antennæ shining and with distinct punctures, third as long as first and much longer than fourth, eleventh slightly longer than tenth. *Prothorax* very little wider at base than at apex, from about middle strongly dilated towards base, but abruptly narrowed before same; with sparsely and irregularly distributed punctures, mostly of moderate size. *Elytra* very little wider than widest part of prothorax, rather strongly narrowed to beyond the middle, each somewhat acute at apex: with dense and rather coarse punctures, but shoulders and extreme base with sparse and small ones. *Legs* moderately long and thin, and with distinct punctures. Length, 14 mm.

Hab.—Tasmania: Huon River (A. M. Lea), unique.

The genus is now first recorded from Tasmania; the species is allied to *E. mimulus*, but the elytra are non-fasciate and prothorax bimaculate. The spots on the prothorax are large, blackish-brown, slightly nearer the base than apex, and slightly nearer the sides than middle, the long hairs on the antennæ do not extend beyond the sixth joint, on the elytra the clothing is sparser and paler than on the prothorax. The elytral punctures are not in regular series; although with an irregular lineate arrangement in places, they are coarsest at about one-fifth from the base: at about one-fifth from the apex, there is a feebly elevated (somewhat purplish) irregular transverse elevation, immediately beyond which the punctures decrease in size.

Earinus humeralis, n.sp.

Flavous; head between eyes, clypeus, a large spot on each side of middle of prothorax, scutellum, shoulders, apex and a postmedian fascia on elytra, mesosternum, most of metasternum, legs (base of femora and parts of coxæ excepted) and antennæ (base of third, fourth, and fifth joints excepted) black or blackish. Clothed with long, straggling, blackish and ashen hairs; elytra, in addition, with short, pale, and rather sparse pubescence.

Head with very dense and rather coarse punctures, but becoming sparser and smaller on clypeus; median line narrow and deep. Antennæ moderately thin, four basal joints shining and with distinct punctures, third joint slightly longer than first and much longer than fourth, fifth distinctly longer than fourth and sixth, eleventh longer than tenth. *Prothorax* with basal and apical fourths comparatively narrow and parallel-sided, the intervening space strongly dilated towards base, but abruptly narrowed before same; with punctures varying from sparse and small to moderately dense and coarse. *Elytra* very little wider than widest part of prothorax, moderately narrowed to basal third; with dense and rather coarse punctures, becoming smaller posteriorly, and much sparser on shoulders and about extreme base. *Legs* moderately long, and with distinct punctures. Length, 10 mm.

Hab.—Queensland: Townsville (H. H. D. Griffith).

Allied to *E. pictus*, but prothorax with two disconnected spots (rounded in front and angular behind), each shoulder with a black, isolated patch, and basal half of third, fourth, and fifth joints of antennæ pale. The postmedian fascia on the elytra is slightly longer than the flavous portion between it and the apex. The long hairs on the antennæ do not extend beyond the fifth joint. The abdomen is missing from the type.

Two specimens of this species in Mr. Griffith's collection are in perfect condition; on each of them the abdomen is of a bright red with a large black spot on the side of each segment, except of the posterior one, which is black throughout, except for a narrow medio-basal portion; the four basal segments have each a conspicuous patch of golden hairs on each side posterior to the black spots. They are probably males.

AUSTRALIAN *TABANIDÆ* [DIPTERA]. No. ii.*

By FRANK H. TAYLOR, F.E.S.

(From the Australian Institute of Tropical Medicine, Townsville.)

The present paper contains the descriptions of a new genus and twelve new species, a change in the names of two species, with notes and additional localities for previously known forms. The egg mass of *Silvius australis* Ricardo, is also described.

The new species are distributed in the following genera:—*Diatomineura* (one), *Corizoneura* (one), *Elaphromyia*(g. et sp.n.), *Silvius* (two), and *Tabanus* (seven).

The type-specimens have been deposited in the Institute collection.

Subfamily PANGONINÆ.

EREPHOPSIS GUTTATA Donovan.

Gener. Illustr. Ent., i., Hym. et Dipt. (1805); Ricardo, Ann. Mag. Nat. Hist. (8), xvi., p.26 (1915).

Hab.—Eidsvold, Queensland (Dr. Bancroft).

For synonymy, *see* Ricardo.

EREPHOPSIS BANCROFTI Austen.

Ann. Mag. Nat. Hist. (8), ix., p.2 (1912).

Hab.—Eidsvold, Queensland (Dr. Bancroft).

EREPHOPSIS AUREOHIRTA Ricardo.

Ann. Mag. Nat. Hist. (7), v., p.116, Pl. i., fig.10 (1900); *op. cit.*, (8), xvi., p.23 (1915).

Hab.—Kuranda, Queensland (F. P. Dodd).

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* Continued from Vol. xl., p.806, 1915 (1916).

DIATOMINEURA CROCEA, sp.n.

Length, ♂, 8-9; ♀, 8-8·5: width of head, ♂, 3-3·5; ♀, 3: length of wing, ♂, 7-8; ♀, 8: width of front at vertex, 0·5; length of proboscis, 2·5 mm.

♂. *Head* orange-buff, beard similar; first two segments of antennæ dull golden; the first swollen, about twice the length of second, and clothed with fairly long, orange-buff hairs; second about two-thirds the width of the first, and clothed with fairly long, black hairs; third orange, annuli black; palpi pale orange, slender, tapering to a point, clothed with fairly long, orange hairs, with a few black ones at the apex, about one-third the length of the proboscis, the latter black; eyes black, pubescence black.

Thorax densely clothed with fairly long, orange-buff and black hairs; scutellum and pleuræ densely covered with orange-buff hairs.

Abdomen darker than thorax, clothed with short, orange-buff and black hairs, with a median, fairly broad, orange-coloured stripe extending the full length of the abdomen, apex blackish, with a few black hairs; venter bright orange-buff.

Wings with the inner two-thirds almost hyaline, rest smoky; veins brown, costa black; stigma dark brown, elongate, conspicuous, squamæ clear. Halteres with pale stems and dark knobs.

Legs: fore- and mid-femora, and tibiæ orange-buff; first tarsals brownish, with black apices; rest black, with narrow, pale, basal rings; hind tibiæ and basal half of the first tarsals brown, femora clothed with orange-coloured hairs, apical half of the first tarsals and tarsi two to five black; spurs on mid- and hind-tibiæ black, prominent.

♀. Similar to ♂, but not so brightly coloured. Front orange-buff, with numerous, erect, black hairs; no frontal callus; ocellar triangle darker than front, ocelli prominent; abdomen chocolate-brown, clothed with black hairs, with a dull, median, orange-buff stripe the full length of the abdomen; venter paler than in the ♂.

Hab.—Queensland: Kuranda (F. P. Dodd), Cairns (F. H. Taylor).

A very handsome and distinct little species, unlike any other with which I am acquainted.

DIATOMINEURA BREVIROSTRIS Macquart.

Dipt. Exot., Suppl. iv., p.326 (1842) [*Pangonia*]; Ricardo, Ann. Mag. Nat. Hist., (8), xvi., p.28 (1915).

Hab.—Queensland: Montville (Dr. Turner), Kuranda (F. P. Dodd and F. H. Taylor).

I am indebted to Mr. Austen for the identification of this species, which is apparently a common one at Kuranda.

DIATOMINEURA VIOLACEA Macquart.

Dipt. Exot., Suppl. iv., p.326, Pl. xi., fig.3 (1849) [*Pangonia*]; Ricardo, Ann. Mag. Nat. Hist., (8), xvi., p.30 (1915).

Hab.—Q.: Mount Tambourine (W. W. Froggatt), Barron Falls (F. H. Taylor).

The specimens from Mount Tambourine agree perfectly with those from Kuranda, a district where it is a fairly common species.

CORIZONEURA KURANDÆ, sp.n.

♀. Length, 13-15; width of head, 4-5; width of front at vertex, 0·4-0·6; length of wing, 11·5-13 mm.

Head: face, cheeks, and front grey, face and cheeks with short, white hairs, beard white; frontal callus black, spear-shaped, gradually tapering to a fine point, reaching the ocellar triangle; the latter dark, with a golden tinge, ocelli prominent; subcallus grey; antennæ and palpi black, first and second segments of the former densely clothed with black hairs, third with the base triangular, palpi about two-thirds the length of the proboscis, the latter short, black; eyes black, inner margins parallel.

Thorax grey, with three, well-defined, black stripes, clothed with semi-erect, grey hairs; scutellum dusky-brown, with a narrow, posterior, grey margin, clothed with grey hairs, posterior fringe grey, fairly long; pleuræ black, with grey tomentum, and fairly long, grey hair.

Abdomen mahogany-red, becoming darker toward the apex, clothed with black hairs; first segment dark, first six segments with median, triangular, white, apical flecks: second segment with a border of black round the white fleck; all the segments with lateral, greyish-white spots, those on the first and second largest; in addition, there are narrow, apical, grey bands to all the segments; venter black, first three segments pale, tinged with black, second to the apex all with grey-white, apical banding.

Wings smoke-coloured, except the discoidal and inferior basal cells, which are clear; veins dark brown; stigma brown, elongate, inconspicuous; squamæ clear. Halteres dark brown; no appendix to upper branch of third long vein.

Legs black, femora densely covered with short, grey hairs; tibiæ similarly covered with black ones; spurs on mid- and hind-tibiæ black, conspicuous.

Hab.—Q.: Kuranda (F. P. Dodd), Cairns (F. H. Taylor).

A striking species owing to the general resemblance to species of the genus *Tabanus*, being not unlike some of the northern forms of that genus.

Elaphromyia, gen.nov.

Ocelli, and spurs on hind-tibiæ present. Antennæ with six divisions to the third joint, with the last two divisions indistinct, which is broad and *Tabanus*-like at the base, the first segment almost bell-shaped, about half as wide again, laterally, at the apex, second segment about one-third the length of the first. Palpi very small, cylindrical, about one-fourth the length of the proboscis, the latter comparatively long. Wings with all posterior cells open; no appendix.

Type, *E. carteri* Taylor. ♀ unknown.

Elaphromyia carteri, sp.n.

♂. Length, 21; width of head, 5; length of wing, 16; length of abdomen, 14; greatest width of thorax, 4·5 mm.

Head: subcallus yellow, clothed with yellow tomentum and scattered golden hairs; face and cheeks orange, the former produced into a large, blunt tubercle between the antennæ and palpi, cheeks and undersurface of head densely clothed with fairly long, orange-coloured hairs; antennæ testaceous, first and second segments densely clothed with fairly long, mixed, black and orange hairs; base of third segment broadly triangular, with scattered, short, black and golden hairs; palpi very short, two-jointed, cylindrical, densely clothed with long, black hairs; apical segment testaceous; eyes black, shining, facets small, nude; proboscis dark brown, apex and upper basal two-thirds testaceous.

Thorax with three, fairly broad, black stripes, yellowish on each side of the median one, and orange laterally, clothed with golden hairs; pleuræ black, clothed with golden tomentum, and scattered, golden hairs; scutellum similar to thorax.

Abdomen as wide as thorax, becoming narrower toward the apex; first five segments pale, the first and second with fairly large, median, black spots as broad as the segments, and black, lateral patches also; third to fifth segments with broad, black, basal banding, expanding laterally, and clothed with short, golden hairs; venter with first segment pale, second with two, basal and apical, pale spots; third to fifth black, with pale, apical ones; sixth with a narrow, black band, rest of segment and remaining ones testaceous; all segments with a lateral fringe of orange-coloured hairs.

Legs testaceous, spurs on the mid-tibiæ stout, black, those on hind-tibiæ testaceous and slenderer; the claws black, sickle-shaped, fairly large.

Wings orange-yellow; veins brown, except the subcostal, which is reddish; the apex and inner margin to the base of the marginal cells dusky, pale on the axillary cell; a pale spot in the middle of the cubital cell, the discoidal and inferior basal pale, also the basal half of the anal cell. Halteres orange.

Hab.—Q.: Kuranda (F. P. Dodd).

Described from a single specimen. A second specimen was submitted to Mr. Austen, who informed me that it belonged to a new genus and species allied to *Osca* (subgenus *Corioneura*). It is an easily recognised species on account of its abdominal markings, and extreme length in proportion to the width of the thorax.

It affords me great pleasure to associate the name of my friend, Mr. H. J. Carter, with this striking species.

Silvius ater, sp.n.

♀. Length, 13-14; width of head, 4; width of front at vertex, 0·5; length of wing, 12-13 mm.

Head: front ashen-grey; frontal callus spear-shaped, dull black, tumid, with a fairly deep, median groove on its apical half, about two-thirds the width of front at its base; ocellar triangle dark brown, prominent, ocelli black; face ashen-grey; antennæ pitch black; first two segments clothed with black hairs, base of the third broadly triangular, forming an obtuse angle on its upper edge; palpi black, nearly as long as proboscis, the latter black; eyes black, nude, their inner margins parallel.

Thorax black, denuded, with traces of black and yellowish hairs on the sides; scutellum denuded; pleuræ black.

Abdomen black, clothed with short, black hairs; first segment broadly marked with grey at the apex and on the sides, second segment with the grey not so prominent on the sides, remaining segments with narrow, more or less distinct, apical bands; venter black, segments two to four with narrow, white, apical bands, five to apex with pale, narrow, apical bands.

Wings black, a semitransparent streak in the cubital cell along part of the third long vein, the apical, first to fourth posterior, the discal and inferior basal cells with semitransparent spots; no appendix to upper branch of the third long vein.

Legs black, spurs on mid- and hind-tibiæ conspicuous.

Hab.—Northern Territory: Brock's Creek and Mary River (G. F. Hill).

An easily recognised species, and very different from other Australian forms on account of its general black colour, and abdominal markings.

Co-type in Coll. Hill.

Silvius subluridus, sp.n.

♀. Length, 12; width of head, 5; width of front at vertex, 0·75; length of wing, 10 mm.

Head: front brown, black when denuded; frontal callus a small plug, black, shining, tumid, about three-fourths as wide as the front, base a short distance from the subcallus, apex ending in a blunt point; subcallus shining black, protuberant; first and second segments of antennæ yellowish, clothed with numerous black hairs, markedly so on their dorsal apices, first cup-shaped, second very small, third reddish, its base fairly large and broad; palpi pale reddish, nearly the length of the proboscis, the latter black; eyes bare, inner margins slightly converging toward their bases.

Thorax slate coloured, denuded, with traces of short, golden hairs; scutellum similar; pleuræ slate-coloured, with scattered, grey hairs.

Abdomen yellowish-brown, the two apical segments darker; basal segments of venter paler than dorsum, penultimate and apical segments blackish.

Legs: basal half of femora slate-coloured, the remainder and tibiæ reddish, the former clothed with grey hairs, the latter with short, black ones; fore-tarsi black; mid and hind dusky; spurs on mid-tibiæ black, conspicuous; hind ones pale, inconspicuous.

Wings clear, veins dark except the subcostal, which is yellowish; stigma yellowish; all posterior cells widely open; no appendix.

Hab.—Northern Territory: Darwin (G. F. Hill).

A specimen closely resembling *S. luridus* Walker, from Port Stephens, N.S.W., but differing in the antennæ, legs, etc. Described from a single specimen, sent by Mr. Hill, labelled "taken on horse, eyes brown."

Silvius doddi Ricardo.

Ann. Mag. Nat. Hist., (8), xvi., p.261 (1915).

Hab.—Q.: Kuranda (F. P. Dodd).

Silvius frontalis Ricardo.

Ann. Mag. Nat. Hist., (8), xvi., p.262 (1915).

Hab.—N. Territory: Darwin and 34-Mile Siding (G. F. Hill).

This appears to be rather a common species.

Silvius indistinctus Ricardo.

Ann. Mag. Nat. Hist., (8), xvi., p.262 (1915).

Hab.—Q.: Ching Do (F. H. Taylor), Bowen.

This would appear to be a widely distributed species, as it was described from the Adelaide River, and Palmerston, Northern Territory.

Silvius australis Ricardo.

Ann. Mag. Nat. Hist., (8), xvi., p.263 (1915).

The eggmass of this species is very long and narrow, measuring 29 mm., by an average of 1·5 mm., and contains a very large number of eggs, which are a light amber-brown, cylindrical, and pointed like a cigar at the apex, and measure 1·3 × 0·2 mm. (xix).

They were found on a blade of grass overhanging a small, sandy creek in Townsville, just as the fly had finished laying them. It is a common species at Ching Do and Kuranda.

Hab.—Q.: Eidsvold (Dr. Bancroft), Townsville, Ching Do (F. H. Taylor), Kuranda (F. P. Dodd).

Subfamily Tabaninæ.

Group iv. Forehead with no callus.

Tabanus griseohirtus, sp.n.

♀. Length, 11·5-13·75; width of head, 4-4·5; width of front at vertex, 0·5-0·75; length of wing, 9·5-11 mm.

Head: face and cheeks grey, beard white; front creamy, with numerous black hairs; frontal callus absent; subcallus grey; antennæ reddish-yellow, first two segments paler, clothed with pale hairs and a few black ones on their dorsal apices, third broad at the base with an obtuse angle; palpi pale creamy, with white hairs, about one-half the length of the proboscis, the latter brown; eyes bare, inner margins converging toward the apex.

Thorax grey, clothed with mixed black and golden, appressed hairs, the latter predominating: scutellum similar to thorax: pleuræ grey, with scattered white hairs.

Abdomen black, entirely covered with grey tomentum, clothed with mixed, pale yellowish and black hairs, the black ones fairly long on the posterior margin of the apical segment; all segments with narrow, apical, yellowish banding; venter similar to thorax, clothed with short, whitish hairs.

Legs: femora and tibiæ yellowish, the former clothed with black pubescence.

Wings clear, veins yellowish-brown; stigma pale: anterior branch of the third long vein with an appendix.

Hab.—Northern Territory: Melville Island (G. F. Hill, No.75).

Allied to *T. nemopunctatus* Ricardo, but differing in not having the inner margins of the eyes parallel, and the general colour being grey, besides other points of difference. The appendix on the anterior branch of the third long vein of the wing is variable in length, being longer in some than in others.

Co-type in Coll. Hill.

TABANUS NEMOPUNCTATUS Ricardo.

Ann. Mag. Nat. Hist., (8), xiv., p.388 (1914).

This species, originally described from Dunk Island, Queensland, has been forwarded from the Northern Territory by Mr. Hill.

These specimens show slight variation in the size of the tooth on the base of the third joint of the antennæ, and also have the tip black instead of ferruginous, but, in all other respects, they are typical.

Hab.—N. Territory: Darwin, Stapleton, and Batchelor.

Group vii. Abdomen with one or more stripes, usually continuous.

TABANUS MASTERSI, nom.nov.

Tabanus gregarius Taylor, *nec* Erichson.

Rep. Aust. Inst. Trop. Med., 1911, p.63 (1913); Austen, Ann. Mag. Nat. Hist., (8), xiii., p.265 (1914).

♂. Length, 13-15·5; width of head, 5-5·7; length of wing, 11-12·75 mm.

Similar to ♀, but the dorsum of thorax and abdomen darker. Eyes with the large facets copper-coloured, and occupying about two-thirds of the surface, reaching about the middle of the frontal triangle, leaving a narrow border of small, blue-black facets, which extend to the vertex.

This species appears to be very variable in size, judging from the specimens before me—a ♀ measuring 17·5 mm. in length, whilst the smallest specimen, a ♂, measures only 13 mm.

I have much pleasure in dedicating this handsome species to the memory of the late Mr. George Masters, for many years the Curator of the Macleay Museum, Sydney.

Hab.—N. Territory: Darwin (G. F. Hill).—Queensland: Bowen, Mackay, Cardington, and Townsville (F. H. Taylor).

It is closely related to *T. Strangmani* Ricardo, but differs in the antennæ and legs. The extension on the frontal callus also differs in being extended to the ocellar triangle.

TABANUS DUPLONOTATUS Ricardo.

Ann. Mag. Nat. Hist., (8), xiv., p.396 (1914).

Specimens received from the Northern Territory differ from the description of the specimens from S. Queensland only in having the venter dark, femora reddish, and the veins of the wing brown.

Hab.—N. Territory: Darwin (G. F. Hill, No.65).

Group ix. Species with paler bands, and sometimes spots on the abdomen.

TABANUS TRYPHERUS, sp.n.

♀. Length, 7·25-8; width of head, 2·75-3; width of front at vertex, 0·25; length of wing, 6·75-7 mm.

Head: face grey, with scanty grey hairs; beard white, scanty; front black, covered with dull golden tomentum, about one-third narrower posteriorly; frontal callus black, almost square, with a short, thick extension, tumid, shining, nearly the width of the front at base, and about one-half the length of front, no lineal extension; subcallus chestnut, with pale yellowish tomentum; palpi pale creamy-white, about two-thirds the length of the proboscis, pubescence black, with some fairly long, white hairs basally, first two segments of antennæ creamy-yellow, with black pubescence, third with the base reddish-yellow, forming an obtuse angle; tooth small, with some black pubescence, annuli dark.

Thorax denuded, ash-coloured, with lateral and posterior margins paler; scutellum paler; pleuræ grey, pubescence grey.

Abdomen chocolate-brown, with fairly broad, grey bands; pubescence black; venter black, with grey tomentum.

Wings clear, veins brown; stigma yellow-brown, elongate, conspicuous; anterior branch of third long vein with a long appendix.

Legs: fore and hind femora blackish; mid with apical half yellowish, tibiæ yellowish, apical half of fore-tibiæ blackish, tarsi black, hind ones with pale bases, pubescence on femora and tibiæ mixed pale and black, black on tarsi.

Hab.—N. Territory: Fannie Bay, near Darwin (G. F. Hill, No.104).

A species readily distinguished from the other Australian members of Group ix., by its small size, colour, and the front converging toward the apex.

Co-type in Coll. Hill.

TABANUS GRISEOANNULATUS, sp.n.

♀. Length, 10; width of head, 4; width of front at vertex, 0·5; length of wing, 10·75 mm.

Head: front grey at base and vertex, blackish elsewhere; frontal callus black, tumid, nearly square, about two-thirds the width of the front at the base, with a lineal extension reaching the middle of the front; subcallus dark ashen, face and cheeks grey, pubescence grey, beard white; palpi black, about two-thirds the length of the proboscis, with grey tomentum and black hairs, with a few fairly long, grey ones at the base; first joint of antennæ black, with black hairs; second joint light reddish-yellow, with black hairs, about one-third the length of the first;

third reddish-brown, with minute, grey pubescence, base broad and flat, no tooth present, with a very shallow angle, annuli darker; inner margins of eyes parallel.

Thorax black, denuded, with traces of grey pubescence, scutellum similar to thorax; pleuræ covered with grey tomentum and white hairs.

Abdomen black, covered with black hairs, all the segments with fairly broad, greyish-white, apical bands, and fairly broad, grey, lateral patches; venter covered with grey tomentum, with mixed grey and black hairs.

Legs black, pubescence black, with a yellow knee-spot on the mid-legs.

Wings grey, costa black, veins dark brown, stigma black, elongate, conspicuous; anterior branch of the third long vein with a short appendix.

Hab.—N. Territory: Brock's Creek (G. F. Hill).

A medium-sized, compact species, not closely related to any other species of Ricardo's Group ix. The tricoloured antennæ, and the yellow knee-joint on the mid-legs are very distinctive. Type unique.

Tabanus australis, n.sp.

♀. Length, 10; width of head, 3·75; width of front at vertex, 0·5; length of wing, 9·5 mm.

Head: front creamy-yellow, subcallus similar; rest of head covered with grey tomentum, beard white; frontal callus chestnut, darker toward apex, oblong, with a lineal extension tapering to a fine point; antennæ reddish-yellow, first two segments paler, with black pubescence; third segment with the base broad, and forming an obtuse angle on the dorsal surface, with black pubescence on the apex of the angle, annuli black; palpi creamy, with pale hairs on the base, black elsewhere, about one-half the length of the proboscis; eyes black, nude, inner margins parallel.

Thorax ash-coloured, with scattered, short, black, appressed hairs, lateral black and grey hairs fairly long, scutellum similar to thorax; pleuræ grey, with scattered, grey hairs.

Abdomen: first three segments reddish-brown, the remainder dark brown, with scattered, yellow, short, appressed hairs, all the segments with narrow, grey, apical bands, venter similar.

Legs: fore-legs dusky, except basal half of tibiæ, which is yellowish; mid- and hind-femora dusky, mid- and hind-tibiæ also; first hind tarsal yellowish, remaining tarsi of both legs dusky, all femora with pale pubescence, tibiæ and tarsi with black pubescence.

Wings clear, veins brown; no appendix.

Hab.—N. Territory: Stapleton (G. F. Hill).

A specimen of the above was submitted to Mr. Austen, who informed me that it was close to *T. nigrimanus* Walker, from which it may be distinguished, *inter alia*, by the colour of the antennæ and legs.

Tabanus doddi, nom.nov.

Tabanus abstersus Taylor, *nec* Walker, Rept. Aust. Inst. Trop. Med., 1911, p.60(1913); Austen, Ann. Mag. Nat. Hist., (8), xiii., p.264 (1914).

A change of name becomes necessary for this species, due to a misidentification of Walker's species, as pointed out by Austen; and also because, as far as I am able to judge from all the descriptions of Australian Tabani, it remains unnamed.

It is a very distinct and easily recognised species, owing to the white-haired fleck on the hind margin of each of the first five segments, the black ground-colour of the dorsum of the abdomen, and the angle on the expanded portion of the third joint of the antennæ, which is produced into a long, thumb-like process. All the specimens before me (19) show the annuli of the third joint of the antennæ with a marked, upward curve.

Hab.—S. Queensland (H. Tryon).—Q.: Kuranda (F. P. Dodd), Mourilyan (F. H. Taylor).

Group x. Species with the abdomen unicolorous, or almost so, sometimes darker at apex.

Tabanus darwinensis, sp.n.

♀. Length, 10·5; width of head, 3·8; width of front at vertex, 0·5; length of wing, 9·5 mm.

Head: front dull golden, covered with numerous, black, erect hairs; frontal callus black, pear-shaped, tumid; subcallus dull golden, light chestnut when denuded, rest of head grey, beard grey-white; first two segments of antennæ golden-yellow, clothed with numerous, fairly long, black hairs; base of third joint reddish-brown, covered with minute, pale hairs, an obtuse angle on the upper margin, annuli black; palpi creamy, clothed with fairly long, black and short, pale hairs, about one-half the length of proboscis; eyes black, the inner margins converging toward the vertex.

Thorax grey-black, clothed with mixed, pale and black hairs; scutellum similar to thorax; pleuræ slate-coloured, clothed with grey hairs.

Abdomen grey-black, clothed with numerous, mixed, black and pale hairs, venter similar, posterior margins of segments with a narrow band.

Wings clear, veins black; stigma yellowish-brown, elongate; anterior branch of the third long vein with an appendix.

Legs: basal third of the fore- and mid-femora slate-coloured, the rest reddish-brown, hind slate-coloured, apical third reddish-brown, tibiæ reddish-brown, fore-tibiæ darker on the apical third, tarsi black, femora clothed with mixed, black and pale hairs, tibiæ and tarsi clothed with black ones.

Hab.—N. Territory: Darwin (G. F. Hill, No.107).

Described from two specimens. It is related to *T. funebris* Macq., but differs, *inter alia*, in having the wings clear. *T. funebris* is described as being entirely black, and having the veins shaded brown.

Co-type in Coll. Hill.

Group xi. Species with pubescence on the eyes (*Therioplectes*).

TABANUS ANTECEDENS Walker.

List Dipt., i., p.178 (1848); Ricardo, Ann. Mag. Nat. Hist., (8), xvi., p.279 (1915).

Melbourne specimens differ from Ricardo's description in having the antennæ black, the first segment with fairly long, mixed, black and golden hairs; and the broad, basal portion of the third segment lacking a distinct angle, the tooth being very small.

In other respects, they conform to a specimen determined as *T. antecedens* Walker, by Mr. Austen, for the writer.

Hab.—Victoria : Melbourne (Dr. Cumpston).

Tabanus milsoni, sp.n.

♀. Length, 10; width of head, 4; width of front at vertex, 0·75; length of wing 9 mm.

Head: face ashen-grey, pubescence grey; beard grey; front almost parallel, grey with traces of dark yellow, pubescence pale; ocellar triangle brown; frontal callus square, resting on the subcallus, black, tumid, shining, as wide as front, with a short, stout extension; subcallus chestnut, with grey tomentum; first two segments of antennæ black, with grey tomentum, and long, black pubescence; third joint reddish-yellow, annuli black, basal portion broad, with an obtuse angle, tooth small, with a few black hairs; palpi dull red-brown, about two-thirds the length of proboscis, tomentum grey, pubescence mixed pale and black; eyes with very scanty, pale pubescence.

Thorax chocolate-brown, tomentum grey, with three, well-defined, dark stripes, pubescence grey and black, long on the lateral margins; scutellum chocolate-brown, pubescence similar to thorax, pleuræ grey, pubescence grey.

Abdomen dark chocolate-brown, all segments from the second with grey bands expanding laterally, the second with an additional one, which does not meet in the middle; segments two to five with median, grey, triangular spots, pubescence black, long on the apical segments, grey on the bands and spots, long on the lateral, grey expansions; venter chocolate-brown, grey banding prominent, pubescence dense, mixed grey and black.

Wings clear, veins dark brown; stigma yellowish-brown; anterior branch of the third long vein with a small appendix.

Legs black, coxæ and trochanters with long, grey pubescence, basal half of the fore-tibiæ yellowish-brown, mid- and hind-tibiæ yellowish, femoral pubescence grey, tibial and tarsal pubescence black, very dense.

Hab.—N.S.W.: Milson Island, Hawkesbury River(Dr. Cleland).

Closely resembling *T. imperfectus* Walker, but differs in having the base of the third joint of the antennæ reddish-yellow, the frontal callus shorter, with a lineal extension; and the thorax with three, well-defined, dark stripes. There are also well-defined, grey, median spots on the second to fifth segments; whilst, in *T. imperfectus* Walker, these are present only on the second to fourth segments.

TABANUS SPADIX, sp.n.

♀. Length, 9; width of head 4; width of front at vertex, 0·5; length of wing, 8·5 mm.

Head: face pale creamy; beard pale creamy; front golden, distinctly narrower at vertex; pubescence black; frontal callus pear-shaped, tumid, shining, dark chestnut-brown, about one-half the width of the front; subcallus chestnut, tomentum golden; first two joints of antennæ yellow, pubescence black, third joint reddish-yellow, annuli darker, tooth small; palpi yellowish, stout, apical third thin, tapering to a fine point; pubescence on eyes pale, scanty.

Thorax ashen-grey, with five, dark chocolate-brown stripes, the median one very narrow, the two submedian ones short, extending to the middle of the thorax, pubescence mixed pale and black, lateral hairs long; scutellum black, tomentum grey, pubescence long, pale; pleuræ grey, pubescence long, grey.

Abdomen: first three segments light brown, fourth to the apex dark brown, segments two to the apex with pale bands, expanding laterally, the second segment basally pale also, the second to sixth segments also with indistinct, median, pale, triangular spots, pubescence black, pale on the segmentations; venter creamy, pubescence pale, penultimate and apical segments dark.

Legs: coxæ and trochanters with long, grey pubescence, fore-legs black, basal two-thirds of tibiæ yellowish, apical two-thirds of mid-femora and tibiæ yellowish, apex of hind femora and the tibiæ yellowish, rest of mid-and hind-legs blackish, pubescence black.

Wings clear, veins dark brown; stigma dark yellowish-brown; anterior branch of the third long vein with a short appendix.

Hab.—N.S.W.: Sydney (Dr. Cleland).

Both this and *T. milsoni* mihi, known from single specimens only, are closely related. *T. spadix* may be distinguished, *inter alia*, by its broader front, differently shaped, frontal callus, the thorax having five stripes; and the paler abdomen.

TABANUS VETUSTUS Walker.

List Dipt., i., p.179 (1848); Ricardo, Ann. Mag. Nat. Hist., (8), xvi., p.277 (1915); White, Pap. and Proc. Roy. Soc. Tas., 1915, p.15.

Hab.—Tasmania: Launceston (Simson, Coll. W. W. Froggatt).

This specimen has the third joint of the antennæ black, and, in addition, the abdomen is entirely clothed with thick, grey pubescence, except for two, small, median patches of yellowish pubescence on the first and second segments.

SOME NOTES ON THE BIONOMICS OF THE BUFFALO-FLY (*LYPEROSIA EXIGUA* de Meijere).

By Gerald F. Hill, F.E.S., Government Entomologist, Northern Territory of Australia.

(Plate liii.)

The Buffalo-fly, under which name it is best known to stock-owners in the Northern Territory, is well-known as an important pest, owing to the annoyance and suffering it causes to cattle and horses, and to the loss in condition so often observed in stock grazing upon fly-infested country.

The greater number of individuals of this species and the longer period of their seasonal occurrence make Lyperosia a more formidable pest than the larger and more voracious blood-sucking flies of the genera Tabanus and Silvius, both of which are well represented in this country.

During the early part of the wet season (November and December) certain species of Tabanus, notably *T. nigritarsis* Taylor, are responsible for perhaps more annoyance to horses than is caused by Buffalo-flies during these months. The actual loss of blood due to these larger Tabanids is, no doubt, considerable, and this, combined with the fact that horses, in particular, are kept in a constant state of motion from before sunrise until after nightfall, accounts in a large measure for the poverty of stock in certain localities at a season when pasturage is most abundant. But Tabanidæ do not attack abraded surfaces, sores, or the sites of recent bites, as Lyperosia does; hence, after a momentary flinch or a kick as the skin is pierced, little notice is generally taken of the fly by the host. The species which dash at their victim with most noise are more dreaded than the more sluggish species.

The wounds caused by even the largest Tabanidæ heal without showing signs of inflammation, but the blood, which frequently runs from the puncture after the withdrawal of the proboscis, attracts Stomoxys, Lyperosia, Musca, and other flies to the wound, which may thus develop into a characteristic "fly-sore." On the other hand, Lyperosias cluster in great numbers on a small area of skin, and, by repeated bites, produce what must be practically a constant state of irritation. This irritation causes the host to rub the part against some convenient object—a fence-post, stump, or branch—until a raw surface is exposed to further attacks by *Lyperosia exigua*, *Stomoxys calcitrans*, Musca, Pycnosoma, and other Diptera. The size and duration of the resulting sores are largely determined by the species and temperament of the host, its ability to find protection in mud, water, or undergrowth, by the prevalence of flies, and by the use or neglect (in the case of stabled or yarded domestic animals) of medicaments and repellant preparations. As may be supposed, horses suffer more in this respect than do cattle, and it is no uncommon occurrence to find, on the brisket, a raw surface of from 3-5 inches in diameter.

Old, poor-conditioned, and sickly stock (horses and cattle) are noticeably subject to annoyance. The colour of the hair makes no appreciable difference, although individuals may be seen which are practically unmolested; while others, in the same mob, are habitually infested. Goats are rarely molested, while dogs, pigs, sheep, and kangaroos appear to enjoy immunity from attack. Horses are generally attacked on the belly, brisket, underparts of the neck, flanks, about the eyes and withers, the characteristic lesions generally showing on the first three positions. Cattle are generally attacked on the belly, brisket, lower surface of the neck, the inner corners of the eyes, and on the flanks. The lesions are usually noticed on the neck, and in the corners of the eyes (Plate liii.), those in the latter position often presenting a very painful and inflamed appearance, due to the part being rubbed against the knees or scraped with the hind-hoofs.

Buffaloes, both domestic and those roaming wild in the country to the East and South-East of Darwin, are habitually infested, and show the characteristic sores as found on domestic cattle and wild Brahmin cattle, but to a lesser degree, owing, no doubt, to the thickness of the skin, and the protection afforded by the submersion of the body and neck in mud or water for long periods throughout the day, and often to a protective coat of adhesive mud.

The habit of attacking man is exceptional in this species, although one is occasionally bitten while riding fly-infested horses. As has been stated above, wild buffaloes are habitually infested. While hunting these animals, it has been noticed that Lyperosias do not feed or rest upon a freshly skinned beast, but transfer themselves to the hunters' horses. In these circumstances, those engaged in skinning are not infrequently bitten, especially if the part is blood-stained or moist with sweat. Several species of Tabanidæ, not usually prone to bite man, will do so under similar circumstances.

Introduction into Australia and Local Distribution.

It is reasonable to suppose that the first importations of Lyperosia were made with some of the early shipments of stock (buffaloes, cattle, and ponies) from the East Indies, since 1824. That these flies can be transported by sea, a short distance at any rate, has been proved by the writer, who recently travelled from Port Darwin to the Daly River (90 miles by sea) in a small vessel, which carried two young bulls for the settlement situated about 60 miles up the river. A score or more flies were carried on these beasts for three days, and were dislodged only when their hosts were lowered into the river to swim ashore.

The distribution of the Buffalo-fly appears to coincide fairly well with the spread of the introduced buffaloes, which now roam wild over a large area of country roughly bounded by the Daly River on the south-west, the Roper River on the south, the Liverpool or perhaps the Goyder River on the west, and the littoral on the north. Although stray buffaloes have been found beyond these natural boundaries, the fly does not appear to have made much headway south of the Roper River, or west of the Daly River. Melville Island, on which buffaloes have run since 1824, is said to be badly infested; while the adjacent Bathurst Island, which is stocked with goats only, is free.

Description of Early Stages, Life-History, and Habits.

The eggs, which are pale reddish-brown in colour, 1 mm. in length, curved on one side and flattened on the other, are laid singly on their sides on the wet surface of fresh dung, occasionally in crevices in dung or in fouled mud an inch or more away from it, and occasionally in fouled mud around buffalo-wallows. Oviposition takes from 2-4 minutes, during which time from 12-20 eggs are laid. The young larvæ descend into the dung, where they attain a length of 7·25 mm., and change in colour from nearly white to dirty-white. Under natural conditions, pupation sometimes takes place in the soil under the dung, but usually in the dung itself. In breeding-jars, pupation invariably took place in the latter situation, whether the dung rested on clean sand or on loamy soil. On two occasions, these flies have been observed depositing eggs on the hair of sweating horses, but it is most improbable that the resulting larvæ would reach maturity.

In the full-grown larvæ, the posterior stigmatic plates, which are situate on the hind margin of the anal segment, are large, blackish, rounded on the outer sides and nearly straight on the adjacent inner margins, with three, irregular, paler spots, and a central opening in each. On the ventral surface of the anal segment, there are several paired tubercles of varying size, surrounded by coarsely granulated skin. The puparium is of the usual Muscid type, 3 mm. in length by 1·30 mm. in width, barrel-shaped, and reddish-brown in colour.

Three reared under laboratory-conditions, in March, gave an average of 169 hours for the completion of the life-cycle (192, 195, 120 hours). The weather during the shortest period was warm and sultry, while a good deal of cool weather and rain were experienced during the longer periods. A later rearing (in June), when the weather was often chilly, took 208 hours to complete the cycle. The periods occupied by the different stages were not accurately noted in any of the above rearings, but, from other observations under varying conditions, it was found to be as follows—egg-stage, 18-20 hours; larval stage, from hatching of egg to the formation of the puparium, 72-96 hours; pupal stage, 72-120 hours.

Courting takes place on the host, but the process of mating has not been observed, either upon the host or elsewhere. The position of the fly while resting or feeding upon the host is usually that with the body vertical and the head downward. During courtship, this position is maintained by one sex, the other occupying a vertical position with the head directed upwards. The wings of both are kept in constant vibration until the pair leave the host, presumably to couple.

During the heat of the day and at night, the majority of the flies rest upon the flanks and withers of horses, and about the horns of cattle.

Natural Enemies.—Few indigenous birds gather their food in dung; it is improbable, therefore, that dung-breeding flies and other insects are preyed upon in their earlier stages by these agents. The imagines of Lyperosia, like those of other flies, are preyed upon to some extent by Fantails (*Rhipidura bicolor*), which follow and rest upon the backs of stock.

Insect-predators play a more important part in the control of of this pest, but it is not believed to be considerable. The recently deposited eggs are gathered by certain species of ants for food, amongst which the following species may be mentioned —*Solenopsis geminata* F., var. *rufa* Snd., *Iridomyrmex detectus* Smith, and *Odontomachus ruficeps* Sm., var. *acutidens* Forel. A more important enemy is a small Hymenopteron (*Sericophorus relucens* Sm.) which captures the flies while feeding or at rest.

Methods of Control.—The flies are naturally bush-insects, breeding, for the most part, in the fresh droppings of cattle and buffaloes. Accumulations of stable-manure and litter do not attract them, nor do they breed up in numbers if fly-infested horses are brought in from the bush, and kept in the stable or stable-yards. It has been observed frequently that, under such circumstances, the flies decrease and finally disappear. On the other hand, milking-pens and cow-yards in regular use do serve as breeding-places and sources of infestation. The frequent removal of manure from such places would do much to reduce the number of Lyperosia, as well as Stomoxys and non-blood-sucking Muscids in the vicinity, but to control their numbers on the immense and thinly-populated grazing-areas would be obviously impracticable.

Lyperosia exigua and disease.—None of the pathological conditions of stock in the Northern Territory are known to be transmitted by these flies, nor have the results of numerous microscopical examinations suggested their probable connection with the spread of disease.

EXPLANATION OF PLATE LIII.

Head of calf, showing early stage of lesion caused by *Lyperosia exigua*.

ORDINARY MONTHLY MEETING.

November 29th, 1916.

Mr. C. Hedley, Vice-President, in the Chair.

A letter from Mrs. T. W. E. David, returning thanks for sympathy, was communicated by the Chairman.

Candidates for Fellowships, 1917-18, were reminded that the 30th inst. was the last day for the receipt of applications.

The Donations and Exchanges received since the previous Monthly Meeting (25th October, 1916), amounting to 14 Vols., 82 Parts or Nos., 10 Bulletins, 4 Reports, and 7 Pamphlets, received from 58 Societies, etc., were laid upon the table.

EXHIBIT.

Mr. Fred Turner exhibited a specimen of *Dampiera eriocephala* De Vriese, var. *alba* Turner, which was collected by Mrs. A. E. Stephens, Jindarra, West Australia, who forwarded it to the exhibitor for botanical determination. During Mrs. Stephens' long residence in, and extensive travels over, the western State, she has found only two specimens of this very rare and interesting plant.

DESCRIPTION OF APHANTOPHRYNE, A NEW BATRACHIAN GENUS FROM NEW GUINEA; WITH COMPARATIVE NOTES ON THE PECTORAL MUSCULATURE.

By Dene B. Fry, Australian Museum, Sydney.

(Plates liv.-lv.)

The material on which the present paper is based consists of a collection of six small frogs belonging to a single species. They were collected in 1896 by the late A. Giulianetti, at an altitude of 12,200 feet on Mount Scratchley, in the Owen Stanley Range, British New Guinea. While they undoubtedly belong to the family Brevicipitidæ* (Engystomatidæ *auct.*), I cannot find a definition of any genus with which they agree even approximately. Therefore, a new genus has been characterised, for which the name *Aphantophryne* is proposed.

The most interesting feature about this new form is the apparent absence of a sternal plate. At first, thinking that my dissection of a small, poorly preserved specimen was at fault, I regarded the absence of this important element with reserve. However, after a careful examination of three specimens, I have failed to find it, and, as will be seen later, the modification of the pectoral musculature certainly points to its total reduction.

There are twenty-six genera of Brevicipitidæ recognised from India, Malay, East Indies, Papuasia, and Australia, sixteen of which have a highly specialised sternal apparatus, modified by the loss of the procoracoid cartilage and clavicles. As *Aphantophryne* also lacks these elements, its affinities must be sought amongst this group of genera.

* I have followed Stejneger (Proc. Biol. Soc. Wash., xxiii., 1910, p.165), who shows that, as the name of the type-genus of the family Engystomatidæ, namely *Engystoma*, is untenable, Cope's name Brevicipitidæ must replace it.

I am unable, however, to place it definitely. The absence of a sternal plate separates it from all members of the Brevicipitidæ, with the exception of the African *Hemisus*, in which genus, the clavicles and omosternum are well developed. If we put aside consideration of the remarkable sternal apparatus, and turn our attention to other characters used to differentiate genera, its affinities appear to be equally divided between *Hylophorbus* Macleay,* (*Mantophryne* Blgr. et auct.), and *Metopostira* Méhely. Its relationships are best shown by the following table.

Table showing the chief generic characters of the Indo-Malayan, East Indian, and Papuasian genera of Brevicipitidæ, in which the clavicles and procoracoid cartilages are absent.

	Palate toothed	Palate toothless.	Palate ridged	Tympanum hidden.	Number of œsophageal ridges.	Tongue entire.	Pupil.	Toes free.	Fingers disked (or swollen).	Toes disked (or swollen).	Terminal phalanges.	Sternal plate absent.
Aphantophryne Fry ...	.	×	.	.	2	×	–	×	.	.	T	×
Hylophorbus Macleay..	.	×	.	.	2	×	–	×	×	×	T	.
Gnathophryne Méhely.	.	×	×	.	2	×	–	×	×	×	T	.
Xenorhina Peters ...	×	×	.	.	1	×	–	×	.	×	T	.
Metopostira Méhely ...	.	×	.	.	2	×	–	×	×	×	T	.
Copiula Méhely ...	.	×	×	.	1	×	–	×	×	×	T	.
Copiula(?) Wandolleck†	.	×	.	.	1	×	–	×	×	×	T	.
Phrynixalus Böttger ...	.	×	×	.	1	×	–	×	×	×	T	.
Pomatops Barbour ...	.	×	.	×	2	×	0	×	×	×	T	.
Cophixalus Böttger ...	.	×	×	×	1	×	–	.	×	×	T	.
Phrynella Boulenger ...	.	×	.	×	?	×	–	.	×	×	T	.
Gastrophryne Fitzinger‡	.	×	×	×	1	×	1	×	×	×	1	,
Microhyla Tschudi ...	.	×	×	×	1	×	1	.	×	×	1	.
Kaloula Gray ...	.	×	×	×	2	×	1	..	×	×	1&T	.
Callulops Boulenger ...	×	.	×	.	1	×	1	×	×	×	1	.
Phrynomantis Peters ...	.	×	×	×	0	.	1	×	×	×	T	.
Xenobatrachus P. & D.	×	.	.	.	?	.	?	×	×	×	?	.

* *See* Fry, Mem. Q'land Mus., ii., 1913, p.48.

† Wandolleck, Abh. v. Ber. d. k. Zool. u. Anthr.-Eth. Mus. zu Dresden, xiii., 1910, p.11.

‡ Stejneger, Proc. Biol. Soc. Wash., xxiii., 1910, p.165. It is here shown that *Gastrophryne* Fitzinger, 1843, must replace *Engystoma* Fitzinger, 1828, as the latter genus is based on *Rana ovalis* Schn., which was also the type of Merrem's genus *Breviceps*, of 1820.

APHANTOPHRYNE,* gen.nov.

Pupil horizontal, oval. Tongue oval, entire, free behind and slightly on the sides. Palate toothless, not ridged. Two transverse folds in front of the œsophagus; the anterior small and sometimes not papillose, the posterior situated between the eustachian tubes, and strongly papillose. Choanæ moderately large, oval. Tympanum slightly visible. Skin smooth. Fingers and toes free; they are flattened, but not enlarged or disked at the tips. Outer metatarsals separated by a groove. Terminal phalanges T-shaped.

Clavicles, procoracoid cartilage, omosternum, and sternum absent. A thin ligament extends from the scapula to the symphysis, where it is produced a little. Coracoids very strong and expanded at the symphysis. The cartilage (epicoracoid) is produced slightly and rounded posteriorly, and may represent a degenerate sternal plate, but no such plate is present as a separate element.

Type, *A. pansa* Fry.

Relationships doubtful, but showing affinity to *Metopostira* Méhely, and *Hylophorbus* Macleay.

APHANTOPHYRNE PANSA,† sp.nov.

(Plates liv.; lv., fig.2.)

Habit robust. Head very broad, triangular; its length two-thirds($\frac{2}{3}$) its width at the level of the tympana. Snout rounded, slightly prominent, as long as or slightly shorter than the diameter of the orbit. Nostril much nearer the tip of the snout than the eye. Canthus rostralis feebly marked, rounded; loreal region shelving, slightly concave. Interorbital space broader than the upper eyelid. Tympanum slightly visible, covered by skin, about one-half the diameter of the eye. Lower jaw trilobed, and but very slightly truncate. Tongue large, oval, entire, and free for about one-half its length posteriorly, and a little on the

* Meaning "obscure toad." This name may be taken as having reference to both its affinities and habitat.

† "Broad-footed."

sides. Choanæ placed well forward, with a groove entering anteriorly from the side. Palatine ridges not present.* Two dermal ridges in front of the œsophagus; the anterior is sometimes not papillose, being represented by a median dermal lobe, the posterior long and always papillose. Arms rather weak. Fingers subcylindrical or depressed, not fringed or disked, the first a little shorter than the second. Hind limb stout. Foot broad. Toes moderate or rather short, subcylindrical or depressed, not fringed or disked. A weak indication of an inner metatarsal tubercle, otherwise the palmar and plantar surfaces are smooth. The length of the outstretched hindlimb, from the anus to the tibio-tarsal articulation, equals the distance from the anus to the axilla. Skin perfectly smooth.

Colour (in spirits) uniform dark brown above. Lower surfaces also uniform dark brown, or creamy-white, variously clouded and speckled with dark brown (Pl. liv., fig.2). Anterior part of forearm sometimes yellowish. Lower eyelid white.

Total length of type from snout to vent, 27 mm.

Loc.—Six specimens, from Mount Scratchley, on the Owen Stanley Range, British New Guinea, at an altitude of 12,200ft. Collected by the late A. Giulianetti in September and October, 1896. The largest specimen, figured on Plate liv., fig.1, has been chosen as the type.

Type in the Australian Museum, Sydney.

The ligament mentioned in the above diagnosis of the genus *Aphantophryne* is made clear by reference to the Plates. The question must necessarily arise as to whether this ligament represents a stage in the process of the degeneration of the procoracoid cartilage. If we trace the reduction of clavicles and procoracoids through the many phases exhibited by the recent genera, several facts in turn become evident.

i. As the clavicle weakens (as, say, in *Chaperina*) the proco-

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* The palatine bones are seen, through the transparency of the integument of the palate, to meet in the middle line, and form a slight expansion. This is shown in fig.1*b* on Plate liv., and is also the case in *Metopostira* and *Hylophorbus*.

racoid appears to strengthen, being, no doubt, influenced by the tendency to counterbalance, liable to occur in any evolutionary process.

ii. A further reduction of the clavicle marks the cessation of the increase in the procoracoid.

iii. As the clavicle becomes almost totally reduced (as exhibited by the genus *Sphenophryne*), and the bone can no longer be said adequately to perform its original function in the girdle, the procoracoid, which cannot replace it in supplying the necessary support and muscle-attachment, also weakens. At this stage we can notice—(*a*) a reduction in the size and arrangement of the pectoral muscles; (*b*) a correlated reduction in the size and strength of the arms; (*c*) a marked strengthening and expansion of the coracoids at the symphysis; and sometimes (*d*) an increase in the size and strength of the sternal plate.

(iv.) A further stage is shown by the genus *Microbatrachus* Roux, in which the clavicles appear to be quite absent, and the procoracoid a weak, tape-like cartilage extending from the scapula to the symphysis.

v. Finally, we have the complete reduction of the clavicular and procoracoidal elements shown in *Kaloula*, *Hylophorbus*, etc.

It will be seen, then, that the ligament of *Aphantophryne* occupies an analogous position to the procoracoid of *Microbatrachus*, but, for the following reasons, we cannot regard them as homologous. There is no reason to doubt that the tape-like band of the latter is a true cartilaginous procoracoid of a degenerate nature, but, in *Aphantophryne*, it is a tough, translucent, fascia-like band, which, from a macroscopical examination, I have no hesitation in pronouncing a true ligament. Then, too, in some species of *Sphenophryne*, the reduced procoracoid has lost its connection with the scapula, but its free distal end is joined to the shoulder by a true, ligamentous band. This would appear to be the homologue of the ligament in question. In fact, if we imagine the final reduction of the procoracoid to take place along this line, we should then have a decreasing cartilage, with an increasing band of ligament, which, in the end, would connect with the symphysis. Such a band would have an analagous position to the ligament anterior to the coracoid in *Aphantophryne*, and it is reasonable to presume that it was along such lines that the remarkable ligament of this new genus evolved.

NOTES ON THE PECTORAL MYOLOGY OF APHANTOPHRYNE PANSA COMPARED WITH THAT OF LIMNODYNASTES DORSALIS AND KALOULA PULCHRA.

The interesting nature of the pectoral muscles of *Aphantophryne pansa*, revealed by the dissection to examine the sternal apparatus of the type-specimen, has led me to prepare the following notes.

It would have been more satisfactory to have reserved any anatomical investigation till more suitably preserved material came to hand, but the variation of the breast-muscles is of such an unusual nature, and is so directly related to the most interesting taxonomic feature of this new form, namely, the absence of a sternal plate, that any notice, however superficial, will, I think, be of present interest. It is hoped that the poor condition of my material has led to but few serious errors.

The pectoral musculature of several members of the family Brevicipitidæ (Engystomatidæ *auct.*) has been dealt with by Dr. F. E. Beddard, in a series of papers published in the Proceedings of the Zoological Society of London. I must acknowledge the great assistance I have received from these fine papers, and have gleaned from them the main points of accord and discord, and intercalated them briefly below.

For comparative purposes, two hitherto unfigured frogs are illustrated, and briefly described. One, *Limnodynastes dorsalis* var. *dumerilii* Peters,* belonging to the family Cystignathidæ, has a complete arciferous pectoral girdle. The other, *Kaloula pulchra* Gray,† belonging to the same family as *Aphantophryne*, and systematically not far removed from it, has a firmisternal girdle with no clavicles or omosternum, but differs from it in

* Fry, Rec. Austr. Mus., x., 1913, p.26, Pl. iii., fig.2.

† Boulenger, Cat. Batr. Brit. Mus., 1882, p.167, figs.

possessing a large, sternal plate. Although the first of these two frogs is much more widely separated from *Aphantophryne* than are a number of Brevicipitid frogs available for dissection, it is of interest, comparatively, since it shows more clearly the modification of the muscles correlated with the reduction of the pectoral girdle. This is the primary object of these notes.

In addition to the muscular variations due to the widely different sterna of the three species under discussion, a considerable divergence is noticed between them as regards the comparative development, and respective size of the muscles. This is mainly due to the greater or lesser development of the fore-limbs, which are largest in *L. dorsalis.*

One of the most striking differences between *L. dorsalis* and *A. pansa*, indeed, between the latter and any other Batrachian that I know of, lies in the condition of the *rectus abdominalis* muscle. In *Limnodynastes dorsalis* (Plate lv., fig.3, *ra.*), it is essentially the same as in *Rana esculenta*,* but differs somewhat from that of *Kaloula pulchra* (Plate lv., fig.1, *ra.*) owing to the absence of a linea alba in the latter. On removing the ventral skin of these frogs, it is plainly visible covering the large space between the inner edges of the pectorales abdominis. In *A. pansa*, however, the rectus abdominalis is not visible without the aid of further dissection.

When the abdominal portion of the pectoral and the two obliques (to be described later) have been removed, the remarkable, paired condition of the rectus is revealed (Plate lv., fig.2,*ra.*). Posteriorly, they are fairly broad, and in contact in the middle line; but, anteriorly, they are narrow and quite separate medially. There is, of course, no trace of a *linea alba*, and, as far as I can be sure, there is only one, very obscure *inscriptio tendinea*, situated at about the point where the pectorales abdominis meet medially. Beneath the coracoids (as viewed from the ventral side) they unite with the muscle which I take to be the sterno-hyoideus of each side. Towards the hinder part of the body,

* Hoffmann, Bronn's Klass. Thier-Reichs, Bd. vi., Abth., 2, 1873-78, Taf. xvii., *pt.*

they lie immediately beneath the obliquus muscles; but, anteriorly, they are more deeply situated. In *Rana temporaria*,* there are five poststernal *inscriptiones tendineæ*; while in *L. dorsalis* (Plate lv., fig.3, *it.*) and *Rhinoderma darwini*,† there are only four; *Megalophrys nasuta*,‡ *Xenophrys monticola*,§ and *Kaloula pulchra* have three: and *Hemisus guttatum*‖ but two; while, in *Breviceps*,¶ there is, as I suppose in *Aphantophryne*, only one.

The whole, superficial, abdominal surface of *A. pansa* is covered by two muscles. As before mentioned, the rectus abdominalis is completely hidden by these. By far the greater extent is overlain by the two, large pectorales abdominis, but a V-shaped area remains between the anterior borders and the posterior edges of the pectorales sternales. This is covered by an extremely fine, transparent muscle, whose fibres run almost parallel to those of the pectorales sternales, at an angle of about 70° to the longitudinal axis. This muscle, which is obvious on the sides of the body as well, is no doubt a true *obliquus externus.* In the median ventral line, the muscles of each side are separated, although the tough fascia appears to bridge the gap, through which may distinctly be seen the heart and conus (Plate lv., fig.2, *c.* and *v.*). Bordering this median gap, the obliquus externus is replaced by a band of longitudinal fibres (Plate lv., fig.2, *oel.*) which I had at first thought to be a distinct muscle, but which I have been quite unable to separate from it. These fibres seem to be wrapped in the same fascia as the obliquus, and to connect anteriorly with the expanded, symphysial portion of the coracoids. The different angle of the fibres is certainly conducive to regarding them as a distinct muscle, but, till better preserved material is available, this point cannot be settled.

Beneath the external oblique muscle is a layer of even more obscure fibres, which are so delicate and transparent that they

* Beddard, Proc. Zool. Soc., 1907, p.338.
† Beddard, *loc. cit.*, 1908, p.683.
‡ Beddard, *loc. cit.*, 1907, p.338.
§ Beddard, *loc. cit.*, 1907, p.882.
‖ Beddard, *loc. cit.*, 1908, p.903.
¶ Beddard, *loc. cit.*, 1908, p.683.

can only be seen by carefully angled lighting. These fibres, representing the *obliquus internus* (Plate lv., fig. 2, *oi.*), run almost at right angles to those of the more superficial muscle; that is, they run outwards and backwards from the middle line of the ventral surface. They are so extremely thin that I cannot trace their boundaries or attachments, but they appear to underlie those of the more superficial muscle *in toto*.

The *pectorales abdominis* of *A. pansa* (Plate lv., fig. 2, *pa.*) are very large, and in other respects unusual. From their origin at the posterior extremity of the body, they run forward, covering superficially almost the whole abdominal surface. For the greater part of their length, they are in contact medially, but, a short distance behind the symphysis of the coracoids, they diverge, and, narrowing rapidly, enter their insertion beneath the deltoid muscle. In *L. dorsalis* (Plate lv., fig. 3, *pa.*) and *K. pulchra* (Plate lv., fig. 1, *pa.*) their insertion is also overlain by the deltoid; while, in *Hemisus guttatum** and *Xenophrys monticola*,† they disappear beneath the pars sternalis of the pectoral. The fibres of the pectoralis abdominis run obliquely in the anterior portion of the muscle, but posteriorly are almost longitudinal. The muscle is characteristically thin, and separates readily from the underlying obliquus externus.

In *L. dorsalis* and in *K. pulchra*, the pectoralis abdominalis presents some peculiarities worthy of notice. In both these species, a remarkable modification of much the same nature occurs, which, as well as being exceptional in itself, is all the more noteworthy because of its presence in two such widely separated frogs. Thus, we find the muscle in each case divided into two distinct portions, which I have here called the portio internus (Plate lv., figs. 1 and 3, *pai.*) and the portio externus (*pae.*) relative to their respective positions.

The *portio internus* of the *pectoralis abdominis* (Plate lv., fig. 3, *pai.*) in *L. dorsalis* is fan-shaped, the fibres radiating from the narrow insertion to the line of origin on the first two poststernal segments of the rectus abdominalis. The line of origin is oblique

* Beddard, Proc. Zool. Soc., 1908, p. 899, fig. 176.

† Beddard, *loc. cit.*, 1907, p. 882, fig. 231.

and nearly straight. Starting from the posterior margin of the sternal plate some little distance from the linea alba, it runs outwards and backwards at an angle of about 45°, crossing the first and anterior two-thirds of the second segment of the rectus. The *portio externus* (*pae.*) of the muscle is long and strap-like, and lies just external to, and touching the edge of the portio internus along its whole length. It extends along the length of the abdomen, is of equal width throughout, and enters its insertion beneath the deltoid together with the inner portion. It appears to be bound in the same fascia as the portio internus, from which, however, it is easily separated.

In *K. pulchra*, the *portio internus* (Plate lv., fig.1, *pai.*) is also fan-shaped, but with this, the similarity between the pectorales cf the two forms ends Two peculiarities of the inner portion are of a most unusual nature. Firstly, the most anterior fibres, *i.e.*, those nearest the pars sternalis, overlap that muscle, and to a great extent hide it from view, finding attachment on the median line of the sternal plate, inside the origin of the fibres of the pars sternalis, which do not meet those of the muscle of the opposite side. Secondly, the portion of the pectoralis abdominis, which attaches to the sternum, is in contact with its fellow along the middle line of the breast-plate. This peculiar arrangement is made clear by the figure in Plate lv., in which the greater part of the right pectoralis is shown dissected away. The abdominal line of origin of the pectoralis abdominis is curved, and terminates postero-laterally on the first inscriptio tendinea. The *portio externus* (Plate lv., fig.1, *pae.*), although quite distinct from the inner portion, is connected to it and to the integument by multitudinous fibres, which seem to arise from the fascia investing the muscle. It is triangular in shape, thus differing from the condition in *L. dorsalis*, and is somewhat longer than the inner portion. The inner edge of the portio externus overlaps the outer edge of the inner portion to a considerable extent, as the pins in the figure indicate (Plate lv., fig.1). When seen from the ventral aspect, the triangular nature of the outer portion is not evident, as only the innermost edge is visible, the greater portion of the muscle lying on the side of the body.

The division into *pars sternalis* and *pars epicoracoidalis* of the pectoralis is very obscure in *A. pansa*. Along the line of origin on the symphysis, there is no trace whatever of any differentiation of the fibres; but, distally, as they approach their insertion beneath the detoid and pars abdominalis, a slight separation into a small anterior and a larger posterior moiety is noticeable. The anterior portion, representing the *pars epicoracoidalis* (Plate lv., fig.2, *pe.*) of other frogs, finds attachment on the anterior portion of the epicoracoid cartilage and the median expansion of the ligament (Plate liv,, fig.1g, *lig.*) which lies in the position of an omosternum. The posterior moiety, or the *pars sternalis* (Plate lv., fig.2, *psp.*) arises wholly from the epicoracoid and its weak posterior extension. It will be evident that these fibres, designated as the pars sternalis, in all probability represent the portio anterior of that muscle, as found in other frogs.

This seems to exclude whatever room for doubt there exists as to whether the sternal plate will be found in *Aphantophryne* as a separate element. In those frogs which possess a distinct sternum, we find the pars sternalis invariably attaching to it. If the sternum is cartilaginous, as in *L. dorsalis*, then the muscular attachment is of a lesser extent than in the case of such frogs as *Rana* and *Megalophrys*, in which the sternum has a strong, calcified style. In *Aphantophryne*, however, we find the most posterior fibres of the pectoralis sternalis attaching to the weak, posterior extension of the epicoracoid cartilage, making the necessity of provision for further attachment, in the form of a sternal plate, seem quite superfluous.

In *L. dorsalis*, in which there is a complete pectoral girdle, with omosternum and sternal plate, and much more powerful limbs, the arrangement is naturally very different. It shows three distinct divisions lying one in front of the other. The anterior or *pars epicoracoidalis* (Plate lv., fig.3, *pe.*) is very like that of *Rana esculenta*.* Its fibres do not attach to the omosternum. The median portion represents the *portio anterior* of

* Hoffmann, Bronn's Klass. Thier-Reichs, Band iv., 1873-78, p.134, Taf. xvii., *pe.*

the *pectoralis sternalis* (*psa.*), and arises from the epicoracoidal arc, but is separated from its fellow in the middle line. The *portio posterior* (*psp.*) arises on the anterior half of the sternum and from the ligament binding the overlapping epicoracoids. It hides from view the coraco-brachialis brevis interior, and the coraco-brachialis longus, as the pars epicoracoidalis also hides the coraco-radialis.

In *K. pulchra*, the arrangement is much the same as in *L. dorsalis*, with the exception of a few details of origin, insertion, and relative position The *pars epicoracoidalis* (Plate lv., fig.1, *pe.*) is hardly distinguishable from the pars sternalis. The median division, or *po tio anterior m. pectoralis sternalis* (Plate lv., fig.1, *psa.*) is even less distinct than in *L. dorsalis*. The most posterior fibres of this muscle attach to the sternum, but the others arise along the epicoracoid, as also do those of the pars epicoracoidalis. The *portio posterior(psp.)* is relatively weak, and its fibres originate wholly from the sternum. As before mentioned, it is almost hidden from view by the portio internus m. pectoralis abdominalis Its fibres arise a little to one side of the middle line, showing those of the pectoralis abdominalis of each side to be in contact along their line of origin.

I have been unable to find a *coraco-radialis*, like that of *Rana esculenta*, in *A. pansa*. In *L. dorsalis*, there is a muscle, which I take to be the *coraco-radialis proprius* of Hoffmann* (Plate lv., fig.3, *pr.*). It underlies the pars epicoracoidalis and portio anterior of the pectoralis sternalis, and, by those muscles, is hidden completely from view, as is mentioned by Dr. Beddard† in the case of *Megalophrys nasuta*. It arises on the epicoracoid arc, and its fibres have much the same angle as those of the more superficial pectoralis. In *K. pulchra*, there is an obscure band of muscle (Plate lv., fig.1, *pn.*) which is analogous to the coraco-radialis of *L. dorsalis*. As in that species, it is hidden from view by the pars epicoracoidalis, and partly also by the anterior portion of the pars sternalis. In *Metopostira ocellata*, a frog

* Hoffmann, *loc. cit.*, p.135, Taf. xvii., *crp.*

† Beddard, *loc. cit.*, 1907, p.337.

which possesses undoubted affinities to *A. pansa*, Professor von Méhely* has figured the coraco-radialis as plainly discernible in front of the pars epicoracoidalis.

The *pectoralis cutaneus* is absent in all three frogs under discussion. In *K. pulchra*, as in *Hemisus guttatum*, *Xenophrys monticola*, and *Megalophrys nasuta*, the septum dividing the thoracic and abdominal lymph-spaces is distinct, but is not invaded by muscle-fibres.

In *L. dorsalis*, there is a well-developed *coraco-brachialis longus* (Plate lv., fig.3, *cbl.*). In front of this is a *coraco-brachialis brevis internus* (*cbb.*) which, although not so large as the first-mentioned muscle, is nevertheless stronger than the same muscle in *R. esculenta.*† Both these muscles are hidden by the pectoralis sternalis.

I am doubtful whether the muscle homologised with the *coraco-humeralis* in *A. pansa* and *K. pulchra* is correctly so called. In the former, its fibres border the distal half of the coracoid posteriorly, attaching to that edge of the bone; in the latter, however, the muscle arises from the whole length of the coracoid, and a few fibres seem to originate on the sternal plate. This last condition is almost the same as in *R. esculenta*, and although *A. pansa* differs somewhat from it, *K. pulchra* seems to exhibit no features which supply grounds for doubting its identity. In this last species also, a slight indication of a separation of the fibres into a more anterior band is noticeable; these probably represent a coraco-brachialis brevis internus. However, my material is so poorly preserved, that I am unable to come to any definite conclusion at present.

The *deltoid* (Plate lv., fig.2, *dl.*) of *A. pansa* is weak and tape-like. A *pars episternalis* is wanting. The same muscle in *K. pulchra* (Plate lv., fig.1, *dl.*) is much stronger and broader, but is otherwise identical. In *L. dorsalis*, there is a distinct *pars episternalis* (Plate lv., fig.3, *dle.*) the fibres of which originate on the omosternum. The *portio scapularis* is overlain by the mylohyoideus.

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* V. Méhely, Termés. Füzetek., xxiv., 1901, vii., fig.6, *cr.*

† Hoffmann, *loc. cit.*, Taf. xvii., figs.6-8, *cbbi.*

The most important features of the pectoral myology of the three frogs may be briefly referred to as follows :—

APHANTOPHRYNE PANSA Fry.

(1). The *pectorales abdominis* are very large, and, meeting in the middle line a short distance behind the pectoral girdle, they obscure nearly all the other ventral muscles from view. They originate at the posterior extremity of the body.

(2). The *obliquus externus* is separated on the median, ventral line, and is on a more superficial plane than the rectus abdominis. A band of medially-placed fibres, which run parallel to the longitudinal axis of the body, may or may not be part of this muscle.

(3). The *pectoralis sternalis* is much reduced, and the division into *pars epicoracoidalis* and *pars sternalis* is obscure.

(4). A *coraco-radialis*, like that in *Rana esculenta*, is absent.

(5). A *pectoralis cutaneus* is absent.

(6). A *coraco-humeralis* (*coraco-brachialis longus* ?) seems to be present, although some doubt exists as to whether this muscle is correctly identified (see text).

(7). A *coraco-brachialis brevis internus* is not present as a separate muscle.

(8). The *deltoid* is weak and strap-like. There is no *pars episternalis*, and the *pars scapularis* is rendered rather prominent by the reduction in size of the pectoralis.

(9). The *rectus abdominis* is hidden from view by the large pectorales abdominis. On dissection, it is seen to be in two separate bands, which are widely separated in the middle line anteriorly. There is no *linea alba*, and only one(?) poststernal *inscriptio tendinea*.

KALOULA PULCHRA Gray.

(1.) The *pectoralis abdominis* is divided into two portions. The *portio internus* is fan-shaped, and arises from the first poststernal segment of the rectus; its anterior fibres are in contact with those of the other side, and attach to the sternal plate. The *portio externus* is quite distinct from the inner portion, and is triangular in shape; its inner edge overlaps the outer edge of the latter. There are numerous fibrous connections with the integument.

(1). The obliquus muscles, internus and externus, show nothing extraordinary.

(3). The *pectoralis sternalis* is well-developed. The *pars epicoracoidalis* is normal; the *pars sternalis* is divisible into two portions, an anterior and a posterior. The *portio posterior* does not meet its fellow, being separated in the median line by the attachment of the portio internus of the pectoralis abdominis. Its fibres originate wholly from the sternum.

(4). A *coraco-radialis* is present.

(5). A *pectoralis cutaneus* is absent, but the septum dividing the pectoral and abdominal lymph-spaces is well-marked, though not invaded by fibres.

(6). A *coraco-humeralis* (*coraco-brachialis longus*?) is present.

(7). A *coraco-brachialis brevis internus* is perhaps represented, as the fibres of the last-mentioned muscle (6) show an indication of a division into an anterior bundle.

(8). The *deltoid* is strong, and has no *pars episternalis*.

(9). The *rectus abdominis* is well-developed, and resembles that of *Megalophrys nasuta* and *Xenophrys monticola* in having only three, poststernal *inscriptiones tendineæ*. There is no *linea alba* present.

LIMNODYNASTES DORSALIS var. DUMERILII Ptrs.

(1). The *pectoralis abdominis* is divided into two portions, the *portio internus* which is fan-shaped, and the *portio externus* which is long and strap-like. The first arises on the two, anterior, poststernal segments of the rectus; and the latter from the posterior extremity of the ventral surface. The two pectorales are separated in the median line, and the rectus is plainly visible.

(2). The *obliquus externus* and *internus* are normal.

(3). The *pectoralis sternalis* is strongly developed. It is plainly divisible into a *pars epicoracoidalis*, and a *pars sternalis*; the latter is in two divisions, an anterior medially situated, and a posterior, whose fibres arise from both the sternal plate and the ligament binding the overlapping epicoracoids.

(4). A *coraco-radialis* is well developed.

(5). The *pectoralis cutaneus* is absent.

(6). A *coraco-brachialis longus* is normally developed.

(7). A *coraco-brachialis brevis internus* is rather strongly developed.

(8). The *deltoid* is strong, and a *pars episternalis* connects with the omosternum. The *portio scapularis* is overlain by the mylohyoideus.

(9). The *rectus abdominis* is normal. A *linea alba* is present, and there are four poststernal *inscriptiones tendineæ*.

EXPLANATION OF PLATES LIV.-LV.

Plate liv.

Aphantophryne pansa Fry.

Fig. 1.—Dorsal view of the type-specimen.
Fig. 1*a*.—Side-view of head.
Fig. 1*b*.—View of palate.
Fig. 1*c*.—Dorsal view of terminal phalanx of fourth toe.
Fig. 1*d*.—Lateral view of terminal phalanx of fourth toe.
Fig. 1*e*.—Ventral view of hand.
Fig. 1*f*.—Ventral view of foot.
Fig. 1*g*.—Sternal apparatus of type-specimen; *lig.*, ligament.
Fig. 2.—Ventral view of a very stout specimen.

(All the figures enlarged.)

Plate lv.

Fig. 1.—*Kaloula pulchra* Gray; ventral view of breast, the skin and pectoral muscles of the right side dissected away.

Fig. 2.—*Aphantophryne pansa* Fry; ventral view of breast, the skin and pectoral muscles of the right side dissected away.

Fig. 3.—*Limnodynastes dorsalis* Gray, var. *dumerilii* Peters; ventral view of body, the skin and pectoral muscles of the right side dissected away.

REFERENCES.

c., conus arteriosus of the heart—*cbb.*, coraco-brachialis brevis internus —*cbl.*, coraco-brachialis longus—*ch.*, coraco-humeralis—*cl.*, clavicle—*cor.*, coracoid—*dl.*, deltoid—*dle.*, pars episternalis deltoidei—*ec.*, epicoracoid cartilage—*it.*, inscriptio tendinea (first poststernal)—*la.*, linea alba—*lg.*, ligament—*mh.*, mylohyoideus—*oe.*, obliquus externus—*oel.*, median longitudinal fibres connected with obliquus externus—*oi.*, obliquus internus—*os.*, omosternum—*pa.*, pectoralis abdominalis—*pae.*, portio externus m. pectoralis abdominalis—*pai.*, portio internus m. pectoralis abdominalis—*pe.*, pars epicoracoidalis m. pectoralis—*pr.*, coraco-radialis (or sterno-radialis)—*psa.*, portio anterior m. pectoralis sternalis—*psp.*, portio posterior m. pectoralis sternalis (Fig. 3)—*psp.*, pectoralis sternalis (Fig. 2)—*ra.*, rectus abdominalis—*sh.*, sternohyoideus—*st.*, sternum—*v.*, ventricle of heart.

THE CHANGE OF COMPOSITION OF ALVEOLAR AIR AFTER THE STOPPAGE OF NORMAL BREATHING.

By H. S. Halcro Wardlaw, D.Sc., Linnean Macleay Fellow of the Society in Physiology.

(With two Text-figs.)

Introduction.

The tension of carbon dioxide in the alveolar air of man is maintained, under conditions of rest and normal breathing, at a definite value in each individual, from which it deviates only slightly. The constant values for different individuals vary over a wider range. These facts were first established by Haldane and Priestly (1905), and by FitzGerald and Haldane (1905). Campbell, Douglas, and Hobson (1914) have recently shown that an increase of 2 mm.Hg in the alveolar tension of carbon dioxide is sufficient to double the amount of ventilation of the lungs. Under ordinary conditions of rest, then, the amount of air breathed in a given time is so adjusted as to keep the alveolar tension of carbon dioxide practically constant. Haldane and Priestly also showed that the alveolar tensions of oxygen may be varied widely by breathing atmospheres containing different percentages of oxygen, without sensibly affecting the amount of ventilation of the lungs. Within wide limits, therefore, the ventilation of the lungs is regulated solely by the alveolar tension of carbon dioxide, and is independent of the alveolar tension of oxygen.

When, however, the normal ventilation of the lungs is stopped by holding the breath, or by rebreathing the same air, the carbon dioxide given off by the blood will accumulate in the lungs, while the oxygen present will tend to disappear. The first investigation of the change of composition of the air in the lungs, when the breath is held, seems to be that of Becher (1855), who held the breath for various periods ranging up to 100 seconds, after taking a deep inspiration. He found that the percentage of carbon dioxide in the expired air rose at a continually decreasing rate, and, towards the end of the period of holding the breath, seemed almost to have reached a constant value.

By shutting off one lobe of the lung of an animal from the exchange of gases with the inspired air, and drawing off samples of the contents through a catheter, Wolffberg (1871) attempted to measure the final tension of carbon dioxide in this portion of the lung after a state of equilibrium with the venous blood had been reached.

Loewy and von Schrötter (1905) carried out similar experiments upon human beings. They found that the alveolar tensions of carbon dioxide and of oxygen eventually reached constant values, the former gas sooner than the latter. These values they regarded as the venous tensions of the gases.

Hill and Flack (1908) observed the length of time for which the breath could be held, under normal conditions, after breathing oxygen, and after muscular exercise. They measured the tensions of carbon dioxide and of oxygen in the alveolar air when the breaking-point was reached. They also measured the final alveolar percentages after breathing as long as possible from an anæsthetic bag, filled, in one case, with expired air, in another case, with oxygen. In each case, the time of holding the breath was longer, and the final tensions of carbon dioxide were higher than when similar gaseous mixtures were simply held in the lungs. The final tensions of carbon dioxide reached were also higher when oxygen was present in excess. These investigators made experiments to determine the alveolar percentages of carbon dioxide and of oxygen after holding the breath for various periods, and found that the percentage of oxygen fell more rapidly than that of carbon dioxide. They concluded that it was the alveolar percentage of oxygen, and not that of carbon dioxide, which determined the period for which the breath could be held. From their experiments on rebreathing the same air from a bag, they concluded that holding the breath obstructed the circulation and so hindered the exchange of gases between the alveolar air and the blood.

Leimdörfer (1909) determined the composition of alveolar air after inspirations of ordinary air, and of gaseous mixtures containing different percentages of carbon dioxide and oxygen, had been held in the lungs as long as possible. He, too, found that excess of oxygen raised the final percentage of carbon dioxide attained, and concluded that the time for which the breath could be held was determined by the percentage of oxygen in the alveolar air.

Du Bois-Reymond (1910) connected one lobe of the lung of an animal with a space filled with nitrogen, and observed the rate at which carbon dioxide was given off into this space. He found that the percentage of carbon dioxide rose at a logarithmically decreasing rate, and approached a certain final value.

Christiansen, Douglas, and Haldane (1914) carried out experiments to determine the composition of alveolar air after holding in the lungs mixtures of air containing various percentages of carbon dioxide. The lungs, in fact, were used as an aërotonometer. When the percentage of carbon dioxide in the inspired mixture was below a certain value, the percentage in the alveolar air was greater after holding the breath than that present in the original mixture. When, however, the percentage of carbon dioxide in the mixture was greater than this value, the alveolar percentage, after holding the breath, was less than that in the original mixture; that is, carbon dioxide had been absorbed by the blood. These investigators concluded that the percentage of carbon dioxide in the inspired air above which carbon dioxide was absorbed by the blood, and below which carbon dioxide was given off by the blood, was the percentage in the alveolar air with which the venous blood was in equilibrium in the lungs, and from which the venous tension of carbon dioxide in the lungs could be calculated. These workers also measured the percentages of carbon dioxide in the alveolar air after holding the breath for various periods. They found that the alveolar percentage of carbon dioxide continued to rise during the whole period for which the breath was held, and concluded that the venous tension of carbon dioxide could not be determined by observations of this kind.

Recently, Boothby and Sandiford (1916) have also used the above aërotonometric method for the determination of the venous tension of carbon dioxide, and have obtained results similar to those of Christiansen, Douglas, and Haldane (*loc. cit.*).

In the present investigation, the rate at which the composition of alveolar air changes, when the admission of fresh air to the lungs is discontinued, has been examined in greater detail. The rate of alteration of the composition of the alveolar air has been studied under two different sets of conditions. In the first series of experiments, the breath was simply held for measured periods after the completion of a normal inspiration, before taking a sample of alveolar air. In the second series of experiments, after the completion of a normal inspiration, breathing was continued into and out of an empty rubber bag, samples of alveolar air being collected from time to time. It was found that the rise in the alveolar tension of carbon dioxide and the fall in the tension of oxygen were considerably more rapid in the second series of experiments than the first.

Experiments have also been carried out to examine more closely the difference between the two sets of results. It was found that movement of the same air into and out of the lungs, alteration of pressure in the closed chest, or the maintenance of negative pressure in the chest, caused a marked increase in the rate of increase of the alveolar tension of carbon dioxide. The maintenance of positive pressure in the chest, however, slightly decreased the rate of change of composition of the alveolar air after the cessation of normal respiration.

METHODS.

The experiments described in this paper were made upon one subject (H.S.H.W.). Before commencing to collect samples of alveolar air, the subject seated himself comfortably and rested for ten minutes in order to allow the respiration to become as steady as possible. The subject remained seated during the whole course of an experiment. The only work done by him was the opening of taps for the collection of samples of alveolar air, the starting and stopping of a kymograph, and the making of the deep expirations from which the samples were obtained. A complete rest of five minutes was taken after the collection of each sample. The experiments in each series in the Tables given below are recorded in the order in which they were made.

Two preliminary series of experiments, in which about two hundred analyses were performed, were carried out on two different subjects. In these experiments, attention was not paid to the necessity of allowing the subject to rest completely before taking a sample of alveolar air. The variations among individual experiments were, consequently, too great to allow precise conclusions to be drawn. The average results of each series, however, showed the same features as the experiments recorded here.

The samples of alveolar air were collected over mercury in exhausted gas-burettes. The deep expirations from the last portions of which the samples were obtained (Haldane and Priestly, *loc. cit.*) were made through a brass mouth-piece, 20 cm. long, into a rubber-lined anæsthetic-bag. The mouth-piece was provided with ten side-tubes of capillary bore; to these tubes, burettes were attached. In this way, a number of samples of alveolar air could be collected without other manipulation than the opening of spring-clips.

The instant at which an expiration was made was recorded on the drum of a kymograph by means of a manometer connected with one of the side-tubes of the mouth-piece. The instant at which respiration was stopped and the holding of the breath commenced, was recorded on the kymograph by pinching the tube leading to the manometer. A Jaquet clock was arranged to make a time-tracing, showing seconds, immediately below the tracing of the manometer. The periods elapsing between the commencement of holding the breath and the making of the expiration from which the sample of alveolar air was obtained, were determined by measurement of the graphic records. In the cases in which the subject breathed into and out of a closed bag, the intervals of time between the successive expirations were measured in the same way. Time could be measured on the tracings with an error of about 0·5 second.

Periods of holding the breath, or, between expirations into a bag, are given in the Tables to the nearest second.

The analyses of the samples of alveolar air were carried out in a small Haldane-apparatus. About 20 cc. of alveolar air were collected for each sample, about 9 cc. being used for an analysis. Duplicate analyses were performed only in those cases in which there was doubt as to the reliability of a result. The results of duplicate analyses showed divergences ranging up to 2%. The deviation from the mean is only half this figure. The results given in the Tables, therefore, have an error of less than 2%; that is to say, the percentages of carbon dioxide and of oxygen are correct to less than one-tenth of one per cent. The amounts of carbon dioxide and of oxygen in the alveolar air are expressed as percentages by volume of the dry gas. The partial tensions of carbon dioxide and of oxygen, in millimetres of mercury, are also given. The tensions were calculated from the percentage composition of the dry gas, the barometric pressure at the time of the experiment, and the tension of aqueous vapour in the lungs [43 mm. Hg, Loewy and Gerhartz (1913), Osborne (1913)]. The tensions have an error of less than 1 mm. Hg.

Effect of holding the Breath.

In the following Table are shown the percentages and tensions of carbon dioxide and of oxygen in alveolar air after holding the breath for various periods. In the last portion of the Table, the averages of the values obtained in the individual experiments are given.

Table i.

Composition of alveolar air after holding breath for various periods.

Number.	Time.	Carbon dioxide.		Oxygen.	
		Per cent.	Mm. Hg.	Per cent.	Mm. Hg.
1	0	5·26	38·4		
2	5	5·75	42·0		
3	10	5·97	43·6		
4	16	6·19	45·1		
5	20	6·25	45·6		
6	27	6·56	47·8		
7	31	6·50	47·5		

Table i.—*continued.*

Number.	Time.	Carbon dioxide. Per cent.	Carbon dioxide. Mm. Hg.	Oxygen. Per cent.	Oxygen. Mm. Hg.
8	0	5·53	40·4		
9	5	5·90	43·0		
10	11	6·01	43·9		
11	16	6·42	46·9		
12	20	6·58	48·0		
13	27	6·57	48·0		
14	30	6·67	48·7		
15	37	6·91	50·5		
16	0	5·20	37·6	16·00	115·8
17	6	5·79	41·9	14·75	106·8
18	12	6·21	45·0	13·68	99·0
19	16	6·18	44·8	13·81	100·0
20	21	6·49	47·0	12·76	92·3
21	26	6·33	45·8	12·74	92·2
22	31	6·55	47·4	11·93	86·4
23	36	6·75	48·8	11·20	81·1
24	0	5·11	36·9	16·48	118·8
25	7	5·87	42·4	14·98	108·1
26	11	6·06	43·8	14·43	104·2
27	16	6·37	46·0	13·65	98·5
28	20	6·51	47·0	12·95	93·5
29	26	6·57	47·4	12·39	89·4
30	30	6·70	48·3	11·89	85·8
31	35	6·65	48·0	12·10	87·4
32	0	5·10	36·8	16·21	117·0
33	6	5·89	42·5	14·83	107·0
34	10	6·28	45·3	14·04	101·4
35	16	6·29	45·4	13·70	98·9
36	21	6·49	46·8	12·85	92·8
37	25	6·52	47·1	12·46	89·9
38	30	6·78	49·0	11·64	84·1
39	35	6·77	48·9	11·13	80·4
40	0	5·34	37·9	16·40	116·5
41	5	5·89	41·8	14·21	101·0
42	11	5·99	42·5	14·04	99·9
43	17	6·43	45·1	12·69	90·1
44	21	6·57	46·7	12·13	86·2
45	26	6·77	48·1	11·83	84·1
46	31	6·78	48·1	11·31	80·5
47	36	6·98	49·6	10·42	71·1

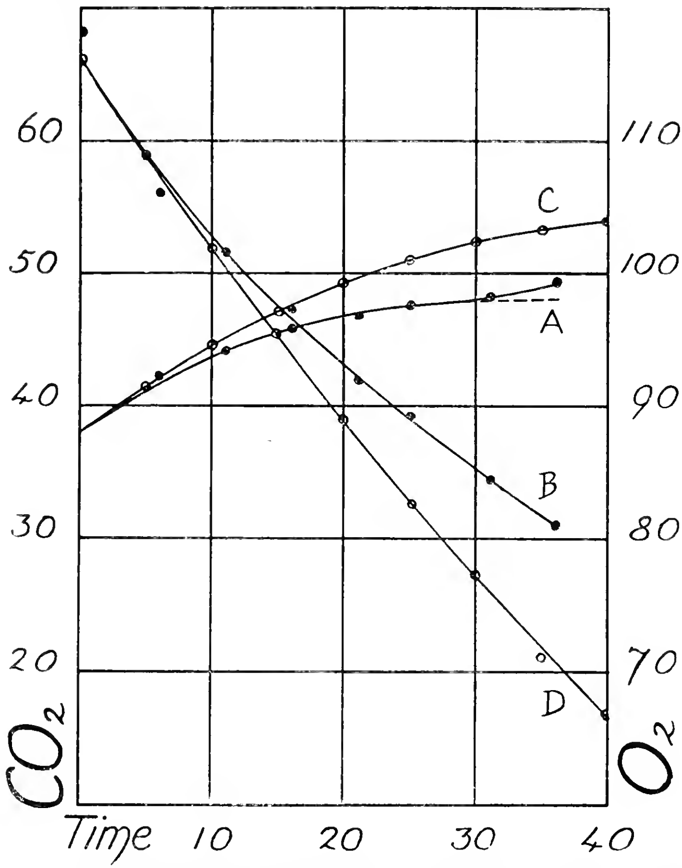
TABLE i.—*continued.*

Number.	Time.	Carbon dioxide.		Oxygen.	
		Per cent.	Mm. Hg.	Per cent.	Mm. Hg.
Average.	0	5·26	38·0	16·00	118·3
	6	5·85	42·6	14·69	106·1
	11	6·09	44·0	14·05	101·5
	16	6·31	45·6	13·46	97·3
	21	6·45	46·6	12·67	91·6
	25	6·55	47·4	12·36	89·3
	31	6·66	48·1	11·69	84·4
	36	6·82	49·3	11·21	81·0

The manner in which the composition of alveolar air changes when the breath is held, as expressed by the above figures, is more clearly shown by the accompanying diagram (Text-fig. 1). In the diagram, times are plotted as abscissæ, the corresponding tensions of carbon dioxide and of oxygen as ordinates. The points shown in the diagram represent the average values given in the Table.

DIAGRAM i.

Curve A in the diagram represents the variation of the alveolar tension of carbon dioxide with the period of holding the breath. This curve shows that, as the breath is held, the alveolar tension of carbon dioxide rises at a continually decreasing rate for about 30 seconds. During the first 5 seconds of holding the breath, the alveolar tension of carbon dioxide rises from 38·0 to 41·6, 3·3 mm.Hg. Between the 25th and 30th seconds, the tension rises from 47·5 to 48·0, 0·5 mm.Hg. that is, at only about one-seventh of the initial rate. After the 30th second, the rate of increase of the alveolar tension of carbon dioxide ceases to fall, and begins to rise again. This increase in steepness continues to the 35th second, beyond which the subject was unable to hold the breath and still retain the power of making the forced expiration necessary to obtain a sample of alveolar air. The increase in the rate at which the alveolar tension of carbon dioxide rises, after holding the breath for about 30 seconds, is due to the fact that the subject then begins to make involuntary movements of the diaphragm and of the muscles of the chest, which grow in intensity as the holding of the breath is continued. These movements, as will be shown later, markedly hasten the passage of carbon dioxide into the alveolar air. The total rise of the tension of carbon dioxide, on holding the breath for 35 seconds, is 11·5 mm.Hg.



Text-fig. 1.—Variation of alveolar tensions of carbon dioxide and of oxygen with period of holding the breath (A, B), and with period of rebreathing expired air (C, D). Times (abscissæ) in seconds, tensions (ordinates) in mm. Hg.

Curve B, in the above diagram, shows how the alveolar tension of oxygen changes as the breath is held. It will be seen that the rate, at which the tension of oxygen falls, is very much greater than the rate at which the tension of carbon dioxide rises. In 35 seconds, the tension of oxygen falls from 116·5 to 81·0, 35·5 mm.Hg, or more than three times as much as the tension of carbon dioxide rises. It will be noticed also that, although the rate of change of the alveolar tension of oxygen slows down with time. this slowing down is much less marked than in the case of the tension of carbon dioxide. During the first 5 seconds of the experiment, the tension falls 7·5 mm Hg; during the last 5 seconds, 3·5 mm.Hg or at about one-half the initial rate. The tremors of the respiratory muscles, which make their appearance towards the end of the experiment, apparently do not become of sufficient intensity to affect noticeably the rate of absorption of oxygen in the lungs.

When the breath is held for a long enough period, therefore, the tension of carbon dioxide gives indications of attaining a certain fixed value. The alveolar tension of oxygen, on the other hand, falls rapidly during the whole period for which the breath can be held.

Effect of rebreathing the same Air.

In the following Table are given the alveolar tensions and percentages of carbon dioxide and of oxygen after the air in the lungs at the end of a normal inspiration, instead of being held there for a certain period, is breathed into and out of a closed, empty bag. Under these circumstances, the air of the lungs does not remain stagnant, but is mixed together by the movements of breathing. The contents of the lungs are also mixed with the air in the mouth-piece, and in the bag, which cannot be emptied completely. The volume of this air is not more than 100 cc. The average volume of the deepest expiration which the present subject can make, after taking a normal inspiration, is 2200 cc. As the volume of the residual air may be taken as 800-1000 cc., the total volume of the air in the lungs, at the end of a normal inspiration, amounts to approximately 3000 cc. The contents of the lungs are mixed, therefore, with about 3% of their volume of air by breathing into and out of the bag. If the rate at which the alveolar tension of carbon dioxide rises, and that at which the alveolar tension of oxygen falls, be the same, when the contents of the lungs are breathed in this way as when the breath is held, the changes in the tensions of the gases will be about 3% less in the former case than in the latter. The figures given in the following Table, however, show that, on the contrary, the changes in the tensions of the gases are considerably greater in the former case.

TABLE ii.—*Composition of alveolar air after breathing into and out of closed bag for various periods.*

Number.	Time.	Carbon dioxide.		Oxygen.	
		Per cent.	Mm. Hg.	Per cent.	Mm. Hg.
48	0	5·07	36·5	15·70	112·8
49	7	5·91	42·5	14·13	101·5
50	15	6·52	46·9	12·44	89·5
51	22	6·73	48·9	11·22	80·7
52	29	7·07	50·8	10·03	72·2
53	34	7·03	50·5	9·35	67·2
54	41	7·29	52·4	8·74	62·8
55	46	7·30	52·5	8·23	59·1
56	0	5·03	35·7	15·92	113·2
57	7	5·77	41·0	14·93	106·1
58	16	6·33	45·0	13·53	96·2
59	23	6·74	47·9	12·13	86·2
60	31	6·96	49·5	11·32	80·5
61	38	7·20	51·2	10·14	72·1
62	44	7·34	52·1	9·35	66·5
63	51	7·37	52·4	8·65	61·5
64	0	5·35	38·4	15·84	113·8
65	8	6·09	43·3	14·51	104·2
66	14	6·60	47·4	13·36	95·9
67	20	6·94	49·8	11·95	85·8
68	27	7·24	49·8	10·87	78·0
69	33	7·47	53·6	9·91	71·2
70	38	7·59	54·5	8·70	62·4
71	44	7·77	55·7	7·97	57·2
72	0	5·30	38·6	16·20	118·0
73	7	5·99	43·6	15·25	110·3
74	13	6·63	47·8	13·88	100·3
75	19	7·09	51·2	12·88	93·1
76	25	7·25	52·4	11·80	85·4
77	31	7·45	53·8	11·00	79·6
78	36	7·61	55·0	9·94	71·8
79	42	7·78	56·2	9·08	65·6

Table ii.—*continued.*

Number.	Time.	Carbon dioxide.		Oxygen.	
		Per cent.	Mm.Hg.	Per cent.	Mm. Hg.
Average	0	5·25	38·0	16·1	116·4
	5	5·70	41 0	15 1	109·1
	10	6 15	44 5	14·1	101 ·9
	15	6·5	47·0	13 2	95·5
	20	6·8	49·2	12·3	89·0
	25	7 05	51·0	11 4	82·5
	30	7·25	52·4	10·7	77·2
	35	7 35	53·1	9·8	70·9
	40	7·45	53·9	9·2	66·5

The intervals of time between the taking of each sample of alveolar air and that of the next in the above series of experiments, are not considered to be uniform enough to allow average values to be calculated from them arithmetically. The average figures given in the last portion of the Table, therefore, have been determined graphically by plotting the individual experiments on squared paper, drawing a curve through the points representing each series of results, and, from the curves, determining the tensions of carbon dioxide and of oxygen for corresponding times. From the figures got thus, the average values have been calculated in the ordinary way. These values are represented in the diagram by the points on the curves C and D.

The curve C represents the manner in which the alveolar tension of carbon dioxide rises when the contents of the lungs are breathed into and out of a closed, empty bag. It will be seen that the alveolar tension of carbon dioxide rises at a continually decreasing rate. During the first 5 seconds of the experiment, the tension of carbon dioxide rises 3·5 mm.Hg, or by practically the same amount as when the breath is held in the lungs. Between the 25th and 30th seconds, however, the rise is 1·4 mm. Hg, or about thrice as great as when the breath is held. The total rise in the alveolar tension of carbon dioxide in 35 seconds is from 38·0 to 53·0, 15·0 mm.Hg, or nearly 40% greater than the rise occurring in the same period when the breath is simply held.

Curve D shows the rate at which the alveolar tension of oxygen falls when the contents of the lungs are breathed into and out of a closed bag. This rate decreases very slowly with time. The fall in the alveolar tension of oxygen during the first 5 seconds of the experiment is 7·5 mm.Hg, the same as when the breath is held. Between the 25th and 30th seconds, the fall is 6 mm.Hg, or nearly twice as great as when the breath is held. The total fall in the alveolar tension of oxygen, after breathing into and out of the bag for 35 seconds, is from 116·4 to 70·9, 45·5 mm.Hg, or nearly 30% greater than when the breath is simply held. Thus, when the same air is rebreathed, not only is there an increase of the rate at which the composition of the alveolar air changes, but the amount of the change itself is also greater than when an equal quantity of air is held in the lungs for an equal period. Although the increase in the alveolar tension of carbon dioxide and the decrease in the alveolar tension of oxygen are so much greater, when the air in the lungs is breathed to and from a bag for a given time, than when the breath is held for the same length of time, the period which elapses before the subject begins to feel acutely the need of fresh air is considerably extended in the former case. In the present subject, the feeling of distress is as pronounced after holding the breath for 35 seconds as it is after breathing to and from the bag for about 50 seconds.

Discussion of Results.

The curves in the above diagram show the rates of change of the alveolar tensions of carbon dioxide and oxygen at different times after the stoppage of normal respiration. They depict the rates of movement of these gases to and from the alveolar air. Carbon dioxide and oxygen can move only to and from the alveolar out of or into the pulmonary tissues and the blood, on the one hand, and the air of the dead space. on the other hand. At the end of a normal inspiration, the dead space amounts to about 5% of the total volume of the lungs. Even when the dead space is increased by the addition of the mouthpiece and bag, the alveolar air of the lungs still accounts for more than 90% of the air with which the blood can exchange gases. Exchanges of gases between the alveoli and the dead space, therefore, will affect but slightly the alveolar tensions, and the above curves may be taken as exhibiting the exchange of carbon dioxide and of oxygen between the blood and pulmonary tissues, and the alveolar air under the conditions of the experiments.

If diffusion play a part in this exchange of gases between the alveolar air and the blood, the variations in the rates of exchange are likely to be expressed by an equation of the form

$$d(P - p)/dt = -n(P - p) \qquad (1)$$

where P is the effective, not necessarily the actual, tension of the gas in the venous blood *entering* the lungs, p the tension in the alveolar air at the moment, and n a constant. The work of Mosso (1904), of Haldane and his collaborators (*loc. cit.*, and Christiansen and Haldane, 1914), of Krogh and Krogh (1910), and of others, has shown that the tensions of the carbon dioxide in the arterial blood *leaving* the lungs must be very close to the alveolar tension

With regard to the tension of oxygen in the arterial blood, opinion is not so unanimous. Barcroft and Cooke (1913) found arterial blood (human) to be 94% saturated with oxygen. Twort and Hill (1915) showed, however, that, during rest and shallow respiration, the degree of saturation may be considerably lower.

According to the above equation, if the tensions of the gases in the venous blood entering the lungs, after the stoppage of the exchange with the air occurring in normal respiration, remain constant for a period long enough, the alveolar tensions will approach very closely to the venous, and the blood will pass through the lungs practically unchanged.

Equation (1) is converted by integration into the form

$$\log (P - p) = \log a - nt \qquad (2)$$

where a is another constant

If the figures for p given in the above tables vary with the times of stoppage of normal respiration in the manner described by this equation, then, if instead of plotting the tensions against times, the logarithms of the differences of these tensions from certain constant tensions, P, be plotted, the curves obtained will be straight lines. The values of the constant tensions, P, towards which the tensions, p, approach, may be calculated by converting equation (2) into the form

$$P - p = a/10^{nt} \qquad (3)$$

by eliminating the logarithms. If the values of p and t be inserted into the equation for pairs of equidistant values of t, equations containing only P and p may be obtained, and, from these, the values of P may be determined. In this way, it may be calculated that, when the breath is held, the alveolar tension of carbon dioxide (curve A) rises from the initial value of 38·0 mm.Hg towards a final value of 50·0 mm.Hg. When the air in the lungs is breathed into and out of a closed bag, the alveolar tension of carbon dioxide (curve C) rises from the same initial value towards the value of 59·0 mm.Hg. The value towards which the alveolar tension of oxygen sinks when the breath is held (curve B) is found by a similar calculation to be 55 mm.Hg, the initial value being 116·4 mm.Hg. The curvature of curve B is much less than that of the two preceding curves, and the accuracy with which the value of P can be calculated is correspondingly less. In the case of curve D, representing the variation of the alveolar tension of oxygen when the air of the lungs is breathed into and out of a bag, the curvature is so small, that the value of the tension which would be reached eventually, if the tension continued to fall in the same manner, cannot be determined with any precision by the above calculation. This is due to the fact that, in the calculation, the differences of observed values appear. These differences become smaller as the curvature decreases, and as the whole experimental error falls on the differences, the uncertainty of their values soon becomes so great as to render them useless for calculation. The value given for P for each of the curves A, B, and C, is the mean of six values calculated from six different sets of points on the curve.

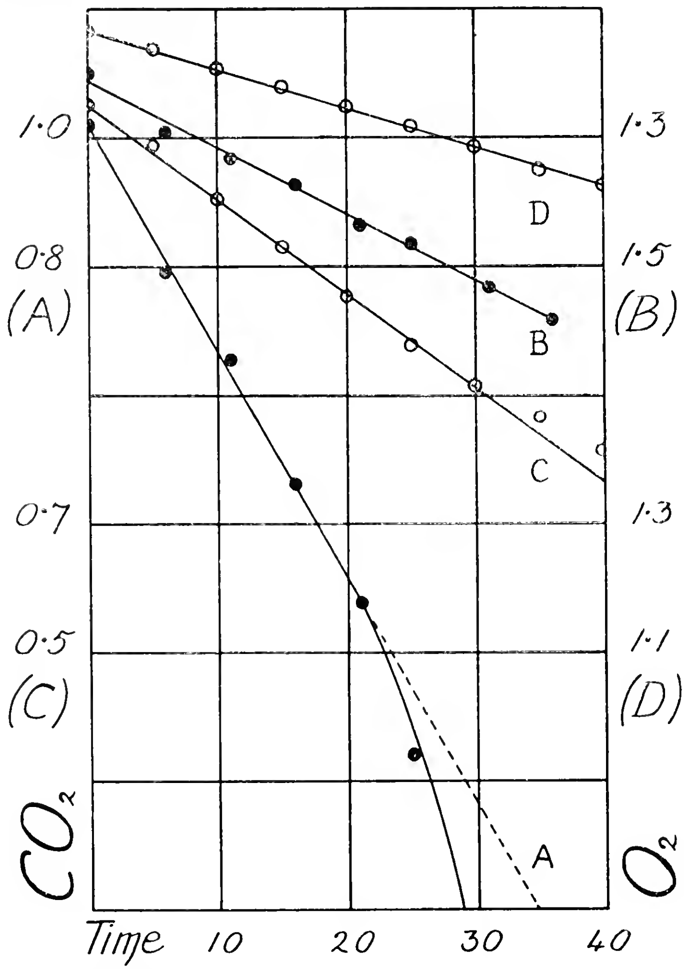
The values of these final tensions can be determined graphically with more precision by assuming certain values for P, and plotting the graphs of the corresponding equation (2). It is found that the curve so obtained is a straight line, *i.e.*, is described by equation (2), only when the value chosen for P lies between certain limits.

In the following Table are given the values of log (P – p) when the values assumed for the final tension, P, are 48·5 mm.Hg for curve A, 60·5 mm Hg for curve C, 55·0 mm.Hg for curve B, and 0·0 mm.Hg for curve D.

TABLE iii.—*Logarithms of differences between certain fixed tensions* (P) *and alveolar tensions* (p) *of carbon dioxide and of oxygen after holding the breath, and after breathing into and out of a bag for various periods* (t). *Series* A, *carbon dioxide. Series* B, *oxygen, after holding breath. Series* C, *carbon dioxide. Series* D, *oxygen, after breathing into and out of bag.*

Series.	t	P	p	P − p.	Log (P − p).
		Mm.Hg.	Mm.Hg.	Mm.Hg.	
A	0	48·5	38·0	10·5	1·021
	6		42·3	6·2	0·792
	11		44·0	4·5	0·653
	16		45·6	2·9	0·462
	21		46·6	1·9	0·279
	25		47·4	1·1	0·041
	31		48·1	0·4	−0·398
	36		49·3	−0·8	
B	0	55·0	118·3	63·3	1·801
	6		106·1	51·1	1·708
	11		101·5	46·5	1·668
	16		97·3	42·3	1·626
	21		91·6	36·6	1·564
	25		89·3	34·3	1·535
	31		84·4	29·4	1·468
	36		81·0	26·0	1·415
C	0	60·5	38·0	22·5	1·352
	5		41·0	19·5	1·290
	10		44·5	16·0	1·204
	15		47·0	13·5	1·130
	20		49·2	11·3	1·053
	25		51·0	9·5	0·978
	30		52·4	8·1	0·908
	35		53·1	7·4	0·869
	40		53·9	6·6	0·820
D	0	0·0	116·4	116·4	2·066
	5		109·1	109·1	2·038
	10		101·9	101·9	2·008
	15		95·5	95·5	1·980
	20		89·0	89·0	1·949
	25		82·5	82·5	1·917
	30		77·2	77·2	1·888
	35		70·9	70·9	1·851
	40		66·5	66·5	1·823

In the following diagram (Text-fig.2). the values of log (P − p) are shown plotted as ordinates against periods of holding the breath or of breathing into and out of a bag as abscissæ.



Text-fig. 2.—Variation of logarithms of differences between existing and final alveolar tensions of carbon dioxide and of oxygen (ordinates), with period of holding the breath (A, B), and with period of re-breathing expired air (C, D). Times (abscissæ) in seconds. In each curve, the logarithms are plotted to the same scale, but the zero ordinates are adjusted to bring the curves together.

This diagram shows that, when the above values are assumed for the final tensions, P, the points obtained for the value of log (P – p) fall upon straight lines. The curves through these depart visibly from straight lines when the values chosen for P lie outside of the following limits: 48·5±1·0 mm.Hg for curve A; 60·5±2 mm.Hg for curve C; 55·0±5 mm.Hg for curve B; 0±10 mm.Hg for curve D.

The figures for the variations of the alveolar tensions of carbon dioxide and of oxygen after the stoppage of normal breathing, according to the above relations between them, may have the following interpretation.

When the breath is held, the alveolar tension of carbon dioxide rises, during the first 25 seconds, from its initial value of 38·0 mm.Hg at such a logarithmically decreasing rate that, if the rise were to continue in the same manner, a final tension of 48·5 mm.Hg would be approached closely. This final tension is actually passed during the period of the experiment The effective difference of tension driving carbon dioxide from the blood into the alveolar air, when the holding of the breath begins, is thus 10·5 mm.Hg in the present subject. This final tension of carbon dioxide lies within the range of values found by Christiansen, Douglas, and Haldane (*loc. cit.*) for the tension of carbon dioxide in venous blood by their aërotonometric method. It is also within 2 mm.Hg of the value calculated by Boothby (1915) from the consumption of oxygen, the flow of blood through the lungs, and the respiratory quotient.

With regard to the variation of the alveolar tension of oxygen when the breath is held, the results of the present investigation show that the tension falls at a logarithmically decreasing rate such that, starting from the initial value of 116·4 mm.Hg, a final value of 55 mm.Hg would be approximated to if the fall continued in the same way. The difference of tension driving oxygen from the alveolar air into the blood is thus about 61 mm.Hg, when the holding of the breath begins. At the end of the experiment, the alveolar tension of oxygen is still 26 mm.Hg above this final value.

When the air in the lungs is breathed into and out of an empty bag, instead of being held in the closed chest, the alveolar tension of carbon dioxide rises from its initial value of 38·0 mm. Hg at a logarithmically decreasing rate such that, if the rise continued in the same way, a final tension of 60·5 mm Hg would be approached closely. During the period of the experiment, the alveolar tension of carbon dioxide rises to within 6·5 mm Hg of this final value. The initial difference of tension driving carbon dioxide from the blood into the alveolar air is, in this case, 22·5 mm.Hg, or about double that acting when the breath is held.

The alveolar tension of oxygen, when the air in the lungs is rebreathed, falls from its initial value of 116·4 mm.Hg at a logarithmically decreasing rate such that the final tension of oxygen would approach zero, if the fall continued in the same way. The initial difference of tension driving oxygen from the alveolar air into the blood is, in this case, 116·4 mm.Hg, again practically double the effective difference existing when the breath is held. During the period of the experiment, the alveolar tension of oxygen falls to a value which is still about 66 mm. Hg above this final value.

These experiments show that the rate and extent of the exchange of gases between the blood and the alveolar air are very much increased by the movements of breathing.

In the experiments of Hill and Flack (*loc. cit.*), a similar effect of respiration on the gaseous exchange in the lungs is to be observed. The experiments of these authors on the effect of breathing from a bag are not strictly comparable with those of the present work. Hill and Flack's subjects breathed from an anæsthetic bag "filled" with expired air. The volume of air with which the blood could exchange gases was very much greater, therefore, than that present in the lungs alone, and the period for which the experiments could be continued was correspondingly extended to about two minutes, or three times as long as when the breath was held. In the present experiments, the bag was empty, and the volume of air in the lungs was hardly added to. The period for which the experiment could be continued was not greatly extended beyond that for which the breath could be held in the ordinary way.

Effect of Respiratory Movements.

Hill and Flack considered, as was mentioned earlier, that the smaller respiratory exchange during the holding of the breath was due to hindrance of the circulation. They supposed that the normai respiratory movements hastened the flow of blood. Dogiel and Kowalewsky (1870) showed, however, that stoppage of artificial respiration in curarised dogs for periods of less than 40 seconds exerted no hindering effect on the circulation. More recently, Ebert (1914) has shown that the state of distension of the lungs has, of itself, no influence on the circulation through them, and that the actual movements of inspiration and of expiration respectively hasten and hinder the circulation to corresponding extents.

It is evident also in the present experiments, that the slower respiratory exchange during the holding of the breath is not due to a slowing of the circulation brought about by the absence of the movements of breathing. When the breath is held for 30 seconds, the four or five respirations, which would normally be made in that time, do not occur to exert their effect on the circulation. If circulatory disturbances due to the absence of respiratory movements be the cause of the slower gaseous exchange when the breath is held, then, as each succeeding respiration is missed, the exchange will be retarded more and more. When one respiratory movement is made during a period of 20 seconds, instead of the normal four, then the respiratory exchange will be increased, above that occurring when the breath is held, by about one-fourth of the amount of increased respiratory exchange occurring during normal respiration. The rate of the pulse of this subject is the same, after holding the breath for 30 seconds, as immediately before.

The accompanying figures give the results of experiments in which the effect of one respiratory movement in 20 seconds, and of three respiratory movements, are compared with the effect on the gaseous exchange of holding the breath for the same period. The figures in column "a" represent the alveolar percentages of carbon dioxide after holding the breath for 20 seconds. The figures in columns "b" and "c" are the corresponding alveolar percentages when one and three respirations, respectively, are made in this period.

TABLE IV.

Effect of frequency of respiratory movements on gaseous exchange.

Expt.	a	b	Expt.	a	c
1	6·00	6·40	5	6·09	6·49
2	5·96	6·42	6	6·29	6·57
3	5·99	6·51	7		6·65
4	6·13	6·47	8	6·00	6·51
Mean	6·01	6·45	Mean	6·13	6·56
	Increase	0·44		Increase	0·43

The above experimental results show that the alveolar tension of carbon dioxide is not raised any higher, above that found after holding the breath for 20 seconds, by making three respirations than by making one respiration in the same period. In creasing the rate of the respiratory movements three times, therefore, causes no parallel increase in the alveolar percentage (and tension) of carbon dioxide, within these limits.

The following experiments show that not only is the increase in the respiratory exchange in a given time independent, within the limits of the work, of the number of respiratory movements in a given time, but also of the extent of these movements. In these experiments, the alveolar tensions of carbon dioxide, after holding the breath quietly for 20 seconds, are compared with those reached when the four respiratory efforts are made in the same time with the pharynx closed, "d".

TABLE V.

Effect of respiratory efforts with closed chest on gaseous exchange.

Expt.	a	d
9	6·36	6·76
10	6·26	6·71
Mean	6·31	6·74
	Increase	0·43

The increase in the respiratory exchange in this case is as great as in experiments "b" and "c", although the movements of the chest were very much smaller than in those experiments. It is evident, then, that neither the extent, nor the frequency of the respiratory movements in a given time, has any effect on the respiratory exchange under the conditions of these experiments, in which the renewal of the air in the lungs was prevented. There still remain to be considered, however, the variations of pressure of the air in the lungs, which accompany the respiratory movements.

Effect of Variations of Pressure.

To enable the pressure in the lungs to be measured, the mouthpiece, through which the expirations were made, was provided with a small, lateral opening near its end. This opening lies inside the mouth of the subject when the mouthpiece is in position. Another small hole was drilled through the wall of the mouthpiece at a position lying outside of the mouth of the subject. These two small holes were connected together by a very narrow brass tube lying inside the bore of the mouthpiece, and soldered in place. The end of the narrow tube, which is to lie inside of the mouth of the subject, terminates flush with the wall of the mouthpiece. The end of the tube lying outside of the mouth of the subject projects through the wall of the mouthpiece and is connected with a mercury-manometer. When in position during an experiment, the mouthpiece is held firmly between the lips, the end being tightly closed by the tongue. The nose of the subject is held at the same time. Pressures existing in the mouth are then registered by the manometer. When the pharynx is kept open, the pressure in the mouth will be practically equal to that in the lungs, if no sudden variations of pressure occur. The maximal differences of pressure between the air in the lungs and the atmosphere, which the present subject is able to maintain for about 20 seconds, are approximately plus and minus 30 mm.Hg. When these differences are greater than about 10 mm.Hg, it is found impossible to keep them absolutely steady. These variations, which cannot be avoided, lie within a range of about 2 mm.Hg from the average pressure.

Positive pressures.—In the following Table are given the percentages of carbon dioxide found in the alveolar air after holding the breath under various pressures in excess of that of the atmosphere. The corresponding percentages of carbon dioxide reached, when the breath is held under normal pressure, are given for comparison.

When the breath is held under pressures differing from that of the atmosphere, it is found to be rather difficult to note the time to within a second. The subject is obliged to watch the manometer as well as to observe the time. The figures in the accompanying Tables show that variations of several seconds occur in the periods of holding the breath, as determined from the graphic records. The percentages of alveolar carbon dioxide found, therefore, cannot be compared directly with one another, and it has been necessary to reduce the results to a common period. In the last column of the Tables, the alveolar percentages of carbon dioxide are given, reduced to a period of holding the breath of 20 seconds. In the case of Table vi., this reduction has been made from the data given in the average figures in Table i. From these figures it will be seen that, between the 21st and 26th seconds of holding the breath, the alveolar carbon dioxide rises at the rate of 0·025% per second. During a period of this length, the rise is very nearly uniform, as is shown by curve A (Text-fig. 1). For each second for which the breath was held longer than 20 seconds, 0·025 has been subtracted, therefore, from the percentage of carbon dioxide found.

TABLE vi.

Effect of increased pressure on alveolar percentage of carbon dioxide after holding the breath for 20 seconds.

Expt.	Pressure.	Period.	CO_2 found.	CO_2 at 20 sec.
11	0 mm. Hg	20 sec.	6·24%	6·24%
	10	23	6·09	6·01
	20	25	6·29	6·16
	30	26	6·34	6·19
12	0	20	6·18	6·18
	10	22	5·98	5·93
	20	21	6·06	6·03
	30	23	5·94	5·86
Mean	0	20		6·21
	Positive	20		6·03
			Increase ...	-0·18

These figures show, that holding the breath under increased pressure certainly does not increase the gaseous exchange in the lungs. Indeed, the average alveolar percentage of carbon dioxide reached in 20 seconds, when the pressure in the lungs is greater than atmospheric pressure, is lower than that reached when the breath is held under normal conditions.

The average deviation of the above results from the mean, calculated as described by Krogh (1916), is $\pm 0{\cdot}13$. This number is not much smaller than the amount by which the alveolar percentage of carbon dioxide, after holding the breath under normal pressure, exceeds that found after holding the breath for the same period under positive pressure. The results, therefore, only show definitely that holding the breath under increased pressure does not accelerate the gaseous exchange. The differences observed are too small to allow any more precise conclusions to be drawn from them.

Negative pressures.—In Table vii., are given the alveolar percentages of carbon dioxide found after holding the breath for definite periods, under pressures lower than that of the atmosphere. The control-determinations for normal pressure are given also. In the last column of the Table, the figures are reduced to a common period of holding the breath of 20 seconds, in the manner explained above.

TABLE vii.

Effect of decreased pressure on alveolar percentages of carbon dioxide after holding the breath for 20 seconds.

Expt.	Pressure.	Period.	CO_2 found.	CO_2 at 20 sec.
13	0 mm. Hg	20 secs.	6·34%	6·34%
	– 2	22	6·41	6·31
	– 6	22	6·63	6·53
	– 10	23	6·95	6·80
	– 14	23	7·22	7·07
	– 18	23	7·08	6·93
	– 22	25	7·19	6·94
	– 26	24	7·28	7·08
14	0	20	6·47	6·47
	– 2	21	6·58	6·53
	– 6	23	6·72	6·57
	– 10	25	6·80	6·55
	– 14	27	7·22	6·87
	– 18	23	6·94	6·79
	– 22	26	7·11	6·81
	– 26	25	7·21	6·96
15	0	21	6·35	6·30
	– 2	22	6·40	6·30
	– 6	24	6·83	6·63
	– 10	27	7·23	6·88
	– 14	25	7·05	6·80
	– 18	26	7·19	6·89
	– 22	27	7·29	6·94
	– 26	25	7·29	7·04
Mean	0	20		6·37
	– 2-6	20		6·48
	– 10-30	20		6·88
			Increase ...	... 0·51

These figures show at once that holding the breath under pressures less than that of the atmosphere increases the gaseous exchange in the lungs. As the percentage of carbon dioxide is rising, in this case at a rate about equal to that at which it rises when the contents of the lungs are breathed to and from a bag, the data given in Table ii. have been used for the calculation of the percentages of carbon dioxide after holding the breath for 20 seconds. The figures in Table ii. show that, between the 20th and 25th seconds of breathing into the bag, the alveolar carbon dioxide is rising at the rate of 0·05% per second. Curve C, in Fig.1, shows that, during this period, the rise is practically uniform. From the percentages of carbon dioxide found, therefore, 0·05 has been subtracted for each second for which the breath was held longer than 20 seconds.

The above results may be divided into two groups, (1) those obtained when the breath is held under pressures numerically less than – 10 mm.Hg, (2) those obtained under pressures numerically greater than – 10 mm.Hg. The alveolar percentages of carbon dioxide shown in the first group of results vary with the pressure under which the breath is held. The lower the negative pressure is, the higher the percentage of carbon dioxide is. In the second group of results, however, the percentages of carbon dioxide found are, with one exception, practically constant and independent of variations of the pressure under which the breath is held. The mean alveolar percentage of carbon dioxide reached, when the breath is held for 20 seconds under negative pressures numerically greater than – 10 mm.Hg, is 0·51 higher than that reached in an equal period under normal pressure. The average deviation of these results from the mean is ±0·12. Practically the same increase of the rate of gaseous exchange is produced, therefore, by holding the breath under pressures more than 10 mm.Hg below that of the atmosphere, as by performing the movements of breathing into a closed bag. This fact is additional evidence that the increased respiratory exchange, caused by the movements of breathing, is not brought about by a quickening of the circulation. The respiratory exchange is increased during breathing owing to the existence of negative pressure in the chest during the act of inspiration. The figures indicate that the pressure in the lungs, during inspiration, must fall at least as low as – 10 mm.Hg.

In these experiments, the alveolar percentages of oxygen have not been estimated, as a knowledge of the variations in the percentages of carbon dioxide alone is sufficient to lead to the recognition of differences in the rates of gaseous exchange. The accompanying figures, however, give the results of experiments in which the alveolar percentages of oxygen, as well as of carbon dioxide, were determined after holding the breath for about 20 seconds under various pressures below that of the atmosphere.

TABLE viii.

Effect of negative pressure on respiratory exchange in lungs.

Expt.	Pressure.	CO_2	O_2
16	0 mm. Hg	6·32%	13·60%
	−10	7·01	11·48
	−20	7·09	11·90
	−30	7·06	11·62
17	0	6·58	12·70
	−5	6·87	11·60
	−10	6·83	11·62
	−15	6·81	11·62

These figures show that higher percentages of carbon dioxide are accompanied by lower percentages of oxygen in the same way, when the breath is held under negative pressures, as when the air of the lungs is rebreathed from a bag.

The results of these experiments indicate that the movements of breathing, or the negative variations of the intrapulmonary pressure which accompany them, accelerate, under certain conditions, the respiratory exchange of gases in the lungs. This acceleration is brought about not only by increase of the rates at which the alveolar tensions of carbon dioxide and of oxygen tend toward certain final (venous) tensions, but by a seeming alteration of these final tensions themselves. Negative intrapulmonary pressures increase the effective gradient of tension between the gases of the alveolar air and those of the venous blood entering the lungs. It is unlikely that the movements of breathing, or negative pressures in the chest, have any actual effect on the tensions of the gases of the venous blood. These factors also can have only a very slight effect on the partial tensions of the gases of the alveolar air. It seems, therefore, that, in the lungs, some mechanism must exist by which the effective difference of tension between the gases of the alveolar air and the gases of the venous blood may be altered.

Summary.

1. When the normal ventilation of the lungs is discontinued by holding the breath, the alveolar tensions of carbon dioxide and oxygen may be expressed as exponential functions of the period for which the breath is held.

2. When the normal ventilation of the lungs is discontinued by breathing into and out of an empty bag, the alveolar tensions of carbon dioxide and oxygen may be expressed as exponential functions of the period for which the contents of the lungs are rebreathed.

3. The rate of the gaseous exchange in the alveolar air is about twice as great when the movements of breathing are performed, as when the breath is held under normal pressure.

4. The rate of gaseous exchange in the lungs is also increased to the same extent when the breath is held under pressures less than that of the atmosphere by a certain amount.

5. Holding the breath under pressures greater than that of the atmosphere slightly decreases the rate of respiratory exchange.

6. The rate of the gaseous exchange, when the renewal of the air in the lungs is prevented, is not affected by the depth or frequency of the respiratory movements during the period of these experiments.

In conclusion, I wish to express my thanks to Professor Sir Thomas Anderson Stuart, in whose laboratory this work was done, to Dr. H. G. Chapman, whose advice and criticism were of the greatest value, and to Miss E. C. Pinkerton, B.Sc., who assisted in the preliminary experiments.

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THE CHEMICAL INVESTIGATION OF SOME POISONOUS PLANTS IN THE N.O. SOLANACEÆ.

Part iii. The Occurrence of Nor-Hyoscyamine in *Solandra longiflora.*

By James M. Petrie, D.Sc., F.I.C., Linnean Macleay Fellow of the Society in Biochemistry.

(From the Physiological Laboratory of the University of Sydney.)

In 1907, an investigation of the constituents of *Solandra lævis* Hook., (syn. *S. longiflora* Tussac), a plant belonging to the N.O. Solanaceæ, was carried out by the author,* when a new member of the group of midriatic alkaloids was discovered and isolated. The properties of this alkaloid were examined, and shown to differ from those of the solanaceous alkaloids previously known. It was accordingly named, from its source, "solandrine."

In 1912, Carr and Reynolds† published an account of their investigations of the alkaloids of another plant of the Order Solanaceæ, *Scopolia japonica;* and although it has been well known for the last thirty years, that this plant contained hyoscyamine, atropine, and scopolamine, these authors discovered a fourth alkaloid, which they isolated by means of a long and tedious process of fractional crystallisation. Carr and Reynolds named this new alkaloid nor-hyoscyamine, after determining its constitution and its relation to the other alkaloids. In addition, they proved the identity of their nor-hyoscyamine with the pseudo-hyoscyamine, which Merck in 1892 found in *Duboisia myoporoides*, which Hesse in 1901 found in *Mandragora officinarum*, but which neither of these eminent authorities was able to obtain in a pure state.

* "Solandrine, a new Midriatic Alkaloid." Proc. Linn. Soc. N. S. Wales, 1907, xxxii., 789.

† Journ. Chem. Soc., ci., 1912, 946.

In the description of this nor-hyoscyamine base and its compounds, the author recognised a close resemblance to the properties of his "Solandrine," which he discovered five years earlier.

With interest thus renewed, a larger supply of material was obtained, and its alkaloids subjected to a more complete chemical investigation, the results of which have proved the identity of solandrine with Carr and Reynolds' nor-hyoscyamine.

Nor-hyoscyamine is the next lower homologue of hyoscyamine. In constitution it is a secondary base, and on the nitrogen bridge across the tropine radicle it contains the group $:N{\cdot}H$ in place of the tertiary group $:N{\cdot}CH_3$ in hyoscyamine. Only the *lævo*-rotatory forms of these occur in nature, and just as hyoscyamine may readily be racemised to inactive atropine, so the new alkaloid is converted into nor-atropine, the two pairs of isomers differing from one another in constitution only by a methyl group. It is this small difference, however, which constitutes the point of remarkable interest in this compound, since nearly all the known alkaloids are tertiary bases of the type $R_3 \vdots N$

Among the numerous chemical reactions in the metabolism of plants, one of the commonest, according to Pictet, is the methylation of amino groups by formaldehyde,

$$R : \overline{NH} + CH_2O = R : \overline{NCH_3} + O$$

These amino groups are numerous in the plant. Not only are they the products of katabolic processes, including the break down of protein and chlorophyll, but they are also products of chemo-synthesis. Formaldehyde is formed by photo-synthesis in the leaves.

Further, it is well established that these methylated compounds can be made to undergo intramolecular change, whereby the methyl group is taken into the ring as an internal link in their chains of carbon atoms, and in this way such rings are enlarged, for example:—

pyrrole	methyl pyrrole	pyridine
$C_4H_4 : \overline{NH}$	$C_4H_4 : \overline{NCH_3}$	$\overline{C_5H_5} \vdots N$

Pictet* has isolated some of these simple substances from the

* Ber. der deut. chem. Ges., 40, 1907, 3771.

leaves of a number of different plants, and he terms them proto-alkaloids. He believes the latter may form nearly all the complex alkaloids by methylation, condensation, and ring enlargement, as explained above.

The nor-hyoscyamine molecule contains a reduced pyrrole and a pyridine ring united together; but the methylation of its nitrogen atom, which is found to have taken place in almost all the alkaloids, seems here to have been prevented. Only one other such case is known—the alkaloids of the hemlock, coniine and methylconiine—where there exist together, in the same plant, two alkaloids differing from one another only as secondary and tertiary bases, *i.e.*, with the amino group and its methyl derivative. Since, however, nor-hyoscyamine is always accompanied in plants by hyoscyamine, the methylation has been arrested only partially,—to a small extent in the case of nor-hyoscyamine, and to a very much larger amount in coniine.

Occurrence of Nor-hyoscyamine.

Nor-hyoscyamine has been discovered in five distinct members of the Solanaceæ. Carr and Reynolds, by working on very large quantities of material (over 100 kilos.), have isolated this new base from the first four plants tabulated below. The *Duboisia myoporoides* was collected in the Philippine Islands, which is probably the northern limit of this Eastern-Australian tree. The *Mandragora* was investigated by Hesse.*

	Scopolia japonica.	*Datura metel.*	*Datura meteloides.*	*Duboisia myoporoides.*	*Mandragora officinarum.*
Nor-hyoscyamine	0·03%	0·01%	0·02%	0·15%	0·01%
L-hyoscyamine...	0·15	0·04	...	1·10	0·36
Atropine ...	...	...	0·03	...	...
Scopolamine ...	...	0·10	0·10	...	0·04
Meteloidine ...	...	...	0·05	...	...
Mandragorine ...	...	...	...	...	...
air-dried	rhizome.	root, stem, leaf.		stem and leaf.	small amt. root.

* Hesse, Journ. f. prakt. Chem., 64, 1901, 274.

Solandra longiflora.

This plant was first described by Tussac in the Flora Antillarum, 1818 (ii., 49, t.12). The name is synonymous with *S. lævis* of Hooker, which is described and figured in the Bot. Mag. 1848 (t.4345). Although the material for the first investigation was collected under the name of *S. lævis* Hook., the latter is now replaced by *longiflora*, since this has priority by thirty years.

S. longiflora is a beautiful evergreen shrub, grown in many gardens for its magnificent trumpet-flowers. It was originally introduced from the West Indies.

The material for this investigation consisted of the autumn prunings from a number of shrubs cultivated in the Botanic Gardens of Sydney: and the author takes this opportunity to express his appreciation of the kindness of the Director, Mr. J. H. Maiden, F.R.S., in providing the material in the quantity required, and in confirming the species.

Experimental.

Extraction of the alkaloid.—The air-dried leaves were ground to a fine powder, and exhausted with 70% alcohol by successive extractions during four weeks The sixth extract contained a trace only of alkaloid These alcoholic solutions, measuring about 40 litres, were distilled under diminished pressure, at a temperature not exceeding 40°C., till the residue was of the consistency of a thick syrup, and was free from alcohol. This dark brown mass was dissolved in hot water slightly acidulated, and filtered.

The fluid thus obtained was still dark brown in colour, quite opaque, and contained chlorophyll and fatty oils. All attempts to remove these by shaking out with petroleum spirit or ether were in vain, on account of the formation of emulsions. The aqueous extract was decolourised by agitation with a solution of gelatin, which was then removed by precipitation with alcohol. This yielded a clear yellow fluid from which the colour could not be removed with ether. The solution was next treated with basic lead acetate, and after filtering from the precipitate which formed, and taking out the lead, the alkaloids were separated by precipitation with Wagner's solution. From this precipitate the alkaloids were recovered in a clear water-white solution. This solution was extracted with ether until the latter ceased to dissolve any more impurities. By making the solution alkaline with ammonia, the alkaloids appeared as a white precipitate, and were dissolved out with chloroform. The chloroform solution was carefully dried with anhydrous sodium sulphate, and distilled under diminished pressure. A pale yellow viscous residue of alkaloids remained. This residue possessed a peculiar odour like pyridine, a characteristic which was also noted by Dunstan and others at the same stage in the isolation of their solanaceous alkaloids.

Formation of the Aurichlorides.—The viscous residue was now dissolved in dilute hydrochloric acid, the solution filtered, and pure gold chloride added to it. The yellow precipitate, which first formed, was redissolved by addition of sufficient water, and by warming, then set aside to slowly crystallise. The spontaneous evaporation of the solution was continued so long as the bright yellow crystals formed, but towards the end, there separated viscous particles of a yellowish-brown colour, which readily melted on warming the liquid, and were completely soluble in alcohol. This uncrystallisable portion was decomposed and the gold removed, shaken out from alkaline solution with chloroform, and again treated with hydrochloric acid and gold chloride. In this way another small quantity of crystals was obtained, but the greater part still separated as viscous particles. By repeated attempts this could not be induced to crystallise further.

Fractional Crystallisation of the Aurichlorides.—The whole of the yellow crystals was brought into solution in one per cent. hydrochloric acid, and set aside to recrystallise slowly. The superfluid was decanted each day from its small crop of crystals. The melting-point of each crop was determined, and those portions having the same melting-points were combined. Each fraction was dissolved and crystallised many times, and by gradually bringing together similar fractions, each of these finally possessed a constant melting-point.

Results.—Extract (a) from 4 kgms. of dried leaves examined in 1911, yielded 2·63 gms. of aurichloride crystals, which were separated into the following fractions:—

(1) 1·32 gms. with melting-point 176°C.-178°C.
(2) 0·72 gm. with melting-point 165°C.
(3) 0·59 gm. with melting-point 137°C.-157°C.

Extract (b) from 2 kgms. of dried leaves examined in 1915, yielded 0·47 gm. of aurichloride salt, and this was separated into the following fractions:—

(1) 0·24 gm. with melting-point 176°C.
(2) 0·15 gm with melting-point 165°C.-166°C.
(3) 0·03 gm. with melting-point 137°C.-157°C.

The total weight of alkaloid, obtained as combined gold salts, thus falls short of the amount represented by the assay value of the leaves. The relative weights of the gold salts, on this account, do not indicate the relative amounts of each alkaloid in the plant, but only the amounts yielded in this case by the lengthy and elaborate process described.

Properties of the Aurichloride Fractions.

First Fraction.

Nor-hyoscyamine aurichloride.—The first fraction possessed the melting-point of Carr and Reynolds' nor-hyoscyamine salt, and the pseudo-hyoscyamine salt of Merck and Hesse; it was recrystallised a number of times, and the melting-point remained constant at 178°C. The crystals separated from dilute hydrochloric acid in brilliant golden-yellow scales. They contained no water of crystallisation.

In a weighed portion of this salt the amount of metallic gold was determined.

Au 31·94% found.
{32·0% required for nor-hyoscyamine.
{31·3% required for hyoscyamine.

Nor-hyoscyamine picrate.—The aurichloride was converted into picrate, by decomposition of the salt with sulphurous acid, and precipitation of the alkaloid with picric acid. The precipitate was redissolved in water, and crystallised several times, when a mass of pale yellow needle-shaped crystals was obtained, possessing the constant melting-point of 220°C, at which temperature the crystals decomposed. The melting-point of the picrate of Carr and Reynolds' nor-hyoscyamine, and also that of Merck's pseudo-hyoscyamine, was 220°C.

Nor-hyoscyamine oxalate.—This salt was prepared from the aurichloride. It crystallised from water and acetone in long, colourless, prismatic needles, which melted at 243-244°C. The melting-point of Carr and Reynolds' oxalate was 245°C.

Second Fraction.

Hyoscyamine.—The second fraction consisted of aurichloride crystals with melting-point 165°C. They were brilliant golden-yellow prisms, and were anhydrous.

A portion was converted into the picrate as before, and after two crystallisations, consisted of long, pale yellow needles, which melted at 163°C with decomposition.

Hyoscyamine aurichloride and picrate were prepared as controls from pure hyoscyamine, specially obtained from Messrs. Burroughs Wellcome's laboratories in London, through the kindness of the Sydney manager, Mr. Hector, and the author's best thanks are due to them. The melting-point of this pure hyoscyamine aurichloride was 165°C, and the picrate 163°C.

This second fraction, therefore, consists entirely of hyoscyamine.

Third Fraction.

Nor-atropine and atropine.—This fraction of the gold salts consisted of flaky yellow crystals, which were much paler in colour than the two previous fractions, and, unlike the latter, were not shining and glistening in appearance, but dull, opaque, and lustreless. From this, a small quantity of crystals was separated, which melted at 156-157°C. The nor-atropine of Carr and Reynolds is stated to have a melting-point of 157°C.

Another small fraction was obtained with a melting-point of 137°C. The melting-point of atropine gold salt is 137°C. This was checked by preparing the aurichloride from a sample of Messrs. Burroughs Wellcome's pure, optically inactive alkaloid.

The remainder of this third fraction was found to melt between 137° and 157°C, and was apparently a mixture of atropine and nor-atropine.

Many careful trials were made to isolate fractions melting above 178°C., from the mother-liquors of these aurichlorides; none, however, could be obtained, and it must therefore be concluded that the lævo and inactive scopolamines were absent.

Estimation of the total Alkaloids.

The modified method devised by Dunstan and Brown (Trans. Chem. Soc Lond , 75, 1899, 72) for the assay af alkaloids of the Solanaceous plants, was employed for the estimation of the total amount of alkaloids in the leaves.

The finely powdered material was extracted with alcohol, and the solution of the bases finally titrated with centinormal acid and iodeosin indicator.

Results.

(a) 1911 leaves—0·16% total alkaloids on plant dried at 100°C.
(b) 1916 leaves—0·17% total alkalaids on plant dried at 100°C.
Equivalent to 0·154% total alkaloids on air-dried leaves.
Equivalent to 0·033% total alkaloids on fresh leaves.

Alkaloids were detected also in extracts from the flowers, wood, and bark.

Summary

The leaves of *Solandra longiflora* are found to contain nor-hyoscyamine as the chief alkaloid. This was previously isolated and described by the author as a new alkaloid in 1907, under the name of "solandrine"; and is now identified with the alkaloid which Carr and Reynolds isolated in 1912, from other solanaceous plants. Solandra also contains hyoscyamine in lesser amount, and scopolamines are absent. The total amount of alkaloid obtained was 0·17% in the leaves (dried at 100°C).

In conclusion, the author desires to express his indebtedness to Professor Sir Thomas Anderson Stuart, for laboratory facilities afforded in carrying out this investigation.

AUSTRALIAN FRESHWATER PHYTOPLANKTON. [PROTOCOCCOIDEÆ.

By G. I. Playfair, Science Research Scholar of the University of Sydney.

(Plates lvi.-lix.)

The bulk of the material, on which the following notes are based, has been gathered at intervals during the past ten years, from the suburbs of Sydney, and from the neighbourhood of Lismore on the Richmond River. A few records are included, however, from still earlier up-country gatherings at Collector, and from certain samples which have been received from places outside the State of New South Wales. The opportunity has been taken, also, of revising the nomenclature of some of the plankton-forms noted in "Plankton of the Sydney Water-Supply" (these Proceedings, 1913).

Habitats.—The term "plankton" has been taken in a wide sense to include material found floating in the water of river, lake, lagoon, and pond, or shaken out of weeds in some depth of water. The following list shows the character of the habitat of all the gatherings referred to in the notes. River: 26, 44, 63, 74, 80, 81, 90, 100, 115, 180, 182, 187, 188, 189, 191, 193, 195, 196, 269, 274, 276, 281. Lagoon: 17, 37, 50, 51, 71, 91, 92, 95, 97, 99, 108, 133, 136, 144, 145, 152, 155, 258, 259, 260, 263, 285, 286, 290, 298. Pond: *3, 23, 45, 70, 77, 88, 124, 125,* 138, 150,* 156,* 158,* 172. Creek-pool: 112, 129, 130.

New forms.—One new genus is proposed, and descriptions are given of 61 forms of *Protococcoideæ*, which appear to be new, 18 being classed as species, 37 as variations, and 6 as forms.

* Gardeners' tank, in the Botanic Gardens, fed from the Sydney Water-Supply.

VOLVOCACEÆ.

Genus CARTERIA Diesing.

CARTERIA MULTIFILIS (Fresen.) Dill, forma.

Cellulæ globosæ (formæ immaturæ subglobosæ, oblongæ, vel ovales) apicibus plerumque leviter deplanatis (interdum mediana papilla instructis) vel indentatis; membrana tenui, hyalina, vel dilute rufescente.

Cell. (sphæric.) diam. 22-26; (oval., oblong., vel subglob.) long. 24-25, lat. 22-23μ.

Parramatta Park (97). (Pl. lvi., figs. 1-4).

Cf. Francé, Der Algengatt. *Carteria*, Természetrajzi Füsetek, xix., 1896, T. iii., f. 1-5, etc. Obtained in quantity from rain-water-pools in Parramatta Park, where it showed as a pale yellow cloud in the water. Francé found it in a somewhat similar habitat ("aus dem Wasser einer grossen Strassenlache"). I have hesitated, for long, to identify our specimens with the European type, as they do not seem to agree very well in general appearance with Francé's excellent, coloured figures. Apart from the finely developed chloroplasts and red spot of the Hungarian specimens, ours differ chiefly in the shape of the cell, and the indented or flattened apex, the latter usually furnished with a minute papilla (alt. ca. 1μ). When full-grown, the cell is spherical, but more or less irregular subglobose; oblong or oval forms are common. The membrane, at first hyaline (or very slightly coloured) and very thin, later becomes somewhat stouter, and pale brown in colour, without markings. Francé gives dimensions, long. 19-25, lat. 12-15μ.

CARTERIA SCROBICULATA, n.sp. (Pl. lvi., f. 5-7).

Cellulæ, fronte visæ, circulatæ, subcirculatæ, vel oblongæ, ubique rotundatæ, apicibus levissime indentatis; a latere compressæ, membrana crassa, rufescente, dense scrobiculata.

Cell. long. 18-22, lat. 18-20μ.

Guildford (45); Lismore (263, 290).

This form differs from all the other species of *Carteria*, of which I have any knowledge, in having a closely scrobiculate membrane. The cells, in front view, are very similar to the form of *C. multifilis* described above, but slightly smaller. In side-view, however, they are seen to be not globular but compressed from front to back. The membrane is always pale brown, and, under pressure, splits with a vitreous fracture, like the lorica of *Trachelomonas*. The lorica in this species, though in a solid piece, often breaks into two halves by an almost straight line down the sides, simulating the two adherent valves of *Phacotus*. Pl. lix., f.18, shows the compressed shape of the cell, and the overlap of the sides at the apex.

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

Forma ovalis, circa dimidio major. Cell. long. 30, lat. 24μ.

Lismore (263).

CARTERIA AUSTRALIS, n.sp. (Pl. lvi., f.9).

Cellulæ oblongæ, fronte modice cuneatæ, postice late-rotundatæ; lateribus leviter arcuatis. Membrana crassa. Cytoplasma dilute viride, minute granulatum, chloroplastidibus nullis distinctis nec pyrenoidibus. Nucleus in media cellula globo cavo chlorophyllaceo circumcinctus. Flagella 4.

Cell. long. 30, lat. 17; glob. chlorophyll. diam. 8μ.

Lismore (263).

The nearest published species to this form would seem to be *C. obtusa* Dill, which is described by Chodat (Alg. vertes, p.138) as "Cellules ellipsoides . . . . . chromatophore en cloche allongée . . . . . dimensions 25-30μ." I have not seen Dill's type-figure, but Francé (Algengatt. *Carteria* T. iii., f.16-18) gives figures of typical specimens, which do not at all agree with our form, either in outline or in the arrangement of the cell-contents. The cytoplasm is finely granular, without any distinct arrangement, pyrenoid absent. The nucleus occupies the centre of the cell, surrounded by a hollow sphere of darker-coloured chlorophyll. From all sides, the appearance is the same.

Var. OVATA, n.var. (Pl. lvi., f.10).

Cellulæ ovatæ, fronte obtusæ, postice late-rotundatæ; ceteris ut in f. typica. Cell. long. 24, lat. 18μ. Lismore (263).

Compare *Carteria Fritschii* Takeda, Ann. Bot. xxx., 1916, p.370.

Genus CHLAMYDOMONAS Ehr.

CHLAMYDOMONAS GLŒOCYSTIFORMIS Dill.

Cell. long. 20-21, lat. 17-21; corp. long. 13-16, lat. 8-10μ.

Botanic Gardens (125). (Pl. lvi., f.11).

Cell. long. 14-18, lat. 12-15; corp. long. 8-10, lat. 7-8μ.

Lismore (263). (Pl. lvi., f.12).

Cf. Dill, Gatt. Chlamyd., p.18, T. v., f.37, 38; Wille, Gatt. Chlamyd., Alg. Not. xi., p.143, T. iv., f.17; Bernard, Protococc. et Desm., p.163, f.307, 308. The last-named gives, membrane, 20-25 × 17-20; inner cell, 16-17 × 12-13μ. Our Lismore specimens are considerably smaller.

CHL. PISIFORMIS var. CYLINDRACEA Playf.

Cell. long. 21-26, lat. 12-15μ.

Rookwood.

Var. ATTENUATA, n.var. (Pl. lvi., f.13).

Cellulæ a tergo attenuatæ; long. 20, lat. 12μ.

Rookwood. Cum priori.

Var. GLŒOCYSTIFORMIS, n.var. (Pl. lvi., f.14).

Cellulæ cylindraceæ, angustæ; apicibus rotundatis; binæ in cœnobio mucoso involutæ.

Cœnob. (2 cell.) diam. 50; cell. long. 20, lat. 8μ.

Botany.

A family of 4 cœnobia, in a vegetative Glœocystis-condition, noted. The mucus was somewhat laminated. There were two cells in each cœnobium, the chloroplasts showing the characteristic arrangement of *Chlamydomonas*. The cells were placed head to tail, and were narrower and more strictly cylindrical than usual. This form is another point in favour of my contention that *Glœocystis* and *Sphærocystis* are vegetative states of *Chlamydomonas*.

CHLAMYD. GLOBULOSA var. PERTUSA, n.var.

Cellulæ sphæricæ, fronte levissime deplanatæ. Chloroplastis angusto lineari foramine supra pyrenoidem instructa.

Cell. long. 18, lat. 20; foramin. long. 6μ.

Lismore (263). (Pl. lvi., f.15).

Plentiful in gathering No 263. The cell is slightly but distinctly flattened in front, the membrane incrassate; and there is a narrow, linear aperture in the chloroplast just above the pyrenoid.

CHLAMYD. MONADINA var. OVALIS, n.var.

Cellulæ exacte ovales. Long. 22-24, lat. 17-20; pyren. long. 10, lat. 2μ.

Lismore (263). (Pl. lvi., f.16).

Instead of the spherical shape of the type, this form is a perfect oval. The pyrenoid, as usual, is strap-shaped, and $10 \times 2\mu$ in dimensions.

CHLAMYDOMONAS GLOBOSA Snow. (Pl. lvi., f.17).

Cell. diam. 8-12μ. Auburn; Lismore (263).

Cf. Julia W. Snow, Plankt. of L. Erie, Bull. U. S. Fish. Comm., 1902. The specimens from Lake Erie were 5-8μ in diameter. In ours, the chloroplasts were not fully formed, being gathered towards the hinder part of the cell. Stigma distinct.

CHLAMYDOMONAS LISMORENSIS, n.sp. (Pl. lvi., f.18).

Cellulæ minutæ, oblongæ; lateribus levissime arcuatis pæne parallelis; apicibus rotundatis; stigmate bacilliformi.

Cell. long. 8-10½, lat. 3-5μ.

Auburn; Lismore (263, 299).

In the warm waters of tropical and subtropical countries, there is a tendency for flagellates to become motile at a very early stage of their development. This is a very small form, oblong, almost cylindrical with rounded ends; the usual bell-shaped chloroplast very shallow behind, no pyrenoid, as a rule.

Var. OVATA, n.var. (Pl. lvi., f.19, 20).

Cellulæ elongatæ, ovatæ, postice late-rotundatæ, fronte attenuatæ; apicibus acuminatis. Cell. long. 10, lat. 3-5μ.

Lismore (298).

Elongate elliptical-ovate in shape, broadly rounded behind, gradually attenuate towards the apex, which is more or less acuminate. Both this form and the type are very active. Distinct central nucleus, very rarely a pyrenoid, stigma wick-shaped, orange or red, in the anterior third of the cell. It is possible that this form is identical with *Chl. mucicola* Schm.,* Alg. d. Schwarzw. u. d. Oberrh., p.17, T. ii., f.4-8, which it very much resembles. The latter, however, has a *central pyrenoid*, and the *nucleus posterior to it* in the end of the cell ("In der Körpermitte ist ein . . . pyrenoid und hinter demselben der sehr kleine Zellkern") and no stigma.

Genus Phacotus Perty.

Phacotus bullatus, n.sp. (Pl. lvi., f.21, 22).

Cellulæ, a fronte visæ, circulatæ vel subcirculatæ, margine inæquali; a latere subhexagonæ, infra apices constrictæ, apicibus rotundatis, lateribus planis vel paullulo retusis; a vertice cruciatæ, late-lineares bullis magnis singulis utrinque in medio instructis; membrana aspera dilutissime rufescente.

Cell. long. 13-14, lat. 13, crass. 9μ.

Lismore (263).

Found in quantity in company with *Pteromonas cruciata*, infra, The cells, in front view, are generally subcircular; a broad ridge runs down front and back, beginning and ending a little within the apices. In lateral view, these show as produced ridges on either side. End-view cruciform, the ridges appearing as large, central, capitate bosses. Membrane very minutely rough, and very faintly coloured.

Var. conicus, n.var. (Pl. lvi., f.23).

Cellulæ conicæ, fronte truncatæ, a tergo acuminatæ; lateribus arcuatis.

Cell. long. 16, lat. 13μ.

Lismore (263).

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* *Chl. muscicola* Schm., in Wille, Alg. Notizen ix.-xiv., p.136, by a slip of the pen, for Schmidle says, p.18, "Sie lebt in der Gallerte des Froschlaiches" (frogspawn).

Genus Pteromonas Seligo.

Pteromonas cruciata, n.sp (Pl. lvi., f.24, 25).

Cellulæ ovales alis geminatis binis cruciatim dispositis instructæ; a fronte visæ (alis inclusis) ovatæ, postice acuminatæ, margine inæquali aspero; a latere inæqualiter quadratæ (alis inclusis) anteriore angustatæ fronte truncatæ, lateribus planis, postice levissime arcuatæ, apice in bulla conica projiciente; a vertice cruciformes, corpore rhomboideo, angulis productis. Membrana hyalina.

Cell. long. s. alis 16-20, lat. 10-12; c. alis long. 24, lat. 18μ.

Lismore (263).

The body is oval, with contents as in *Chlamydomonas*, save that the red spot is placed towards the hinder end. The cell is furnished with two pairs of wings lying in planes which intersect at right angles, making the end-view cruciform.

Var. pulchra, n.var. (Pl. lvi., f.26).

Cellulæ a latere angulis alarum inferioribus truncatis et protractis, lateribus paullo retusis; ceteris ut in f. typica.

Cell. c. alis long. 24, lat. fronte 12, postice 18μ. Alæ long. 20μ.

Lismore (263).

The lower angles of one pair of wings are truncate and produced, the sides somewhat retuse. A pyrenoid present, as a rule, in both type and variation.

Genus Volvulina Playf.

Volv. Steinii var. lenticularis Playf., forma.

Cœnob. diam. 32-50; cell. diam. 10, inter se dist. 1μ, alt. in sect. optical. 5-12μ. Lismore (263, 293).

A new locality for *Volvulina*. The cœnobium gives the impression that the cells are the result of fragmentation of a parietal chloroplast. From above, the cells are generally quadrate or polyhedral, fitting into one another, the edges not more than 1μ apart; sometimes, however, they are circular. The cells are certainly lenticular in optical section. There are 16 in the cœnobium, arranged more or less in three layers, 4 + 1, 6, 4 + 1.

HYDRODICTYACEÆ.

Genus Pediastrum Meyen.

Pedi. tetras var. fluviatile, n.var. (Pl. lvii., f.1).

Cellulæ sinu rectangulo, in brevem angustam fenestram introrsum producto, minime incisæ; angulis exterioribus apiculo minuto instructis.

Cœnob. (4 cell.) long. 18, lat. 18μ.

Lismore (188).

Instead of being deeply incised, the cells merely have the outer angle excised by a more or less rectangular sinus, the point of which is produced inwardly into a short loop. The free angles are minutely apiculate. The markings in the cells are not pyrenoids, but vacuoles in the cytoplasm; under a low magnification, they appear so plainly as to be easily mistaken for a part of the sinus. Cf. *P. rotula* Kütz., in Nägeli, Gatt. einz. Alg., T.vb, fig.3c.

Var. apiculatum, n.var. (Pl. lvii., f.2).

Cellulæ extrorsum sinu amplo leviter excisæ, vel alte emarginatæ; angulis rotundatis, minuto hyalino apiculo instructis.

Cœnob. (8 cell.) diam. 22; cell. diam. 7μ.

Botanic Gardens (125).

Syn., *P. tetras* var. *integrum* (Näg.) Playf., Biol. Richm. R., p.110, Pl. iii., f.26. *P. integrum* Näg., has the outer edge of the cell quite flat. In this form, the cells are slightly excised by a wide, shallow sinus, or else deeply emarginate; the angles are rounded, and furnished with a minute, hyaline apiculus.

PROTOCOCCACEÆ.

Genus Crucigenia Morren.

The species of *Crucigenia* are, to my thinking, merely infantile forms of *Pediastrum*, developed from the resting-cell or zygospore, which is the outcome of the union of gametes. This resting-cell, or something very near to it, I have described and figured under the name of *Pedi. tetras* var. *unicellulare* in "Plankton Sydney Water-Supply," p.517, Pl.56, f.4. In spite of their probable connection with *Pediastrum*, it is convenient to arrange these forms under a separate genus, even if it is only a conventional one. Those mentioned, *l.c.*, these Proceedings, 1913, may be summarised thus:—

CRUCIGENIA AUSTRALIS mihi.

Syn., *Pedi. tetras* var. *australe* Playf., *l.c.*, p.516, Pl.56, f.2.

CRUCIGENIA TETRAPEDIA (Kirch.) W. & G. S. West.

Cœnob. (4 cell.) long. 7-8, lat. 7-8μ.

Fairfield (130).

Syn., *Pedi. tetras* var. *tetrapedia* (Kirch.) Playf., *l.c.*, p.517, Pl.56, f.3; also *Pedi. tetras* var. *quadratum* Playf., *ibid.*, Pl.56, f.3a, which differs hardly at all from *C. tetrapedia.*

Var. ORNATA, n.var. (Pl. lvii., f.3).

Cœnobium (4 cell.) parvo cytoplasmatis granulo ad angulos ornatum.

Cœnob. long. = lat. = 7-8μ. Fairfield (130).

The cœnobium of *C. tetrapedia* is formed from a single cell by the gradual division of the contents into four, from the centre outwards. The last sign of this division is a slight band of cytoplasm connecting the outer angles of the cells. *Cf.* Chodat, Alg. vertes, p.222, f.148a, No.2 (sub nom. *Lemmermannia emarginata*) and my figure in Plankton Sydney Water-Supply, Pl.56, f.3 (*Pedi. tetras* var. *tetrapedia*). The small, chlorophyllaceous granule found in var. *ornata* seems to be brought about by the segregation of this band.

CRUCIGENIA FLORALIS, nom.nov.

Cœnobium in medio foramine parvo rectangulari instructum; cellulis binis rotundato-ovatis, alteris oblongis, cruciatim dispositis.

Cœnob. long. 8, lat. 7μ. Potts Hill (138).

Syn. *Pedi. tetras* var. *triangularis* (Chod.) Playf., forma, *l.c.*, p.517, Pl.56, f.5. This form is not strikingly like *Crucigenia triangularis* Chodat, although the upper and lower cells are somewhat ovate.

CRUCIGENIA CORDATA, nom.nov.

Cœnob. in medio foramine parvo rectangulari instructum; cellulis plus minusve cordiformibus, utrinque ad apices apiculo minuto interdum ornatis.

Cœnob. (4 cell.) long. 25, lat. 23μ,

Botanic Gardens (158).

Syn., *Pedi. tetras* var. *integrum* (Näg.) Playf., forma, *l.c.*, p.518, Pl.56, f.7. The cells are more or less heart-shaped, and are often tipped with a minute, indistinct apiculus. The species should be compared with *Pedi. tetras* var. *apiculatum*, supra.

CRUCIGENIA TRIANGULARIS Chodat. (Pl. lvii., f.4).

Cœnob. diam. 10-16; cell. diam. ca. 5-7μ.

Collector; Guildford (88); Lismore (188).

Cf. Chodat, Alg. vertes, p.223, f.14-19. The cœnobium consists nearly always of 4, minute, pale green, ovate cells, occasionally with pyrenoids.

CRUCIGENIA QUADRATA var. SECTA, n.var. (Pl. lvii., f.5).

Cellulæ circulatæ in partes subtriangulares 4 per crucem divisæ.

Cœnob. (4 cell.) long. 6, lat. 6; cell. diam. ca. 2μ.

Lismore (188). Cum. *C. rectangulari.*

The original cœnobium, before division, must have been constituted of 4 circular cells arranged in a square; hence, I have placed this form under *C. quadrata* Morren, *cf.* G. S. West, Brit. Frw. Alg., p.216, f.90D, E. Pale green in colour.

Genus TETRASTRUM Chodat.

TETRASTRUM ELEGANS, n.sp. (Pl. lvii., f.6).

Cœnobium (4 cell.) quadratum; cellulis subcirculatis distinctis, extrorsum spinis longis tenuissimis singulis ornatis.

Cœnob. diam. c. sp. 28, cell. diam. 4μ.

Parramatta (136).

This species might be described as a spinous form of *C. quadrata* Morren, just as *T. staurogeniæforme* of *C. triangularis*

Chodat. The cells are subcircular, arranged in a square, and each furnished with a long, thin, delicate spine. Cytoplasm pale green.

Var. DENTATUM, n.var. (Pl. lvii., f.7).

Cœnobium (4 cell.) quadratum vel rhomboideum; lacuna distincta rectangulari; cellulis plus minusve ovatis adpressis, lateribus angulatis, ad apices spinis longis tenuissimis singulis instructis et altero latere dentibus vel spinis brevibus singulis.

Cœnob. (4 cell.) c. sp. diam. 30-38; cell. diam. 3-4μ.

Parramatta (136).

In this form, the cells are more or less ovate, with angular sides, adpressed, the apices outwards, and furnished with a long, thin spine. A little lower down, on one side, is a second, much smaller spine or tooth. The lacuna is sharply rectangular.

Genus CŒLASTRUM Näg

Cœl. microporum Näg., is by far the most common form in this country, and, next to it, *Cœl. crenatum* Arch. *C. sphæricum* Näg., very rare.

CŒLASTRUM CRENATUM Archer.

Cœnob. diam. 32-83; cell. diam. 6-32μ.

Collector, Rose's Lagoon; Botany (91); Guildford (124).

Cf. G. S. West, Brit. Frw. Alg., p.213, f.87A. Syn., *Cœl. pulchrum* Schm., Algenfl. d. Schwarzw. u. d. Rheineb., T. ii., f.10.

Var. CUBICUM, n.var. (Pl. lvii., f.8).

Cœnobium plus minusve cubicum angulis truncatis; cellulis quattuor circa unum ordinatis; foraminibus amplis octagonis.

Cœnob. diam. 33-55; cell. diam. c. 10μ.

Guildford (77).

Generally the cells are arranged 5 or 6 round one, in this form 4, which gives the cœnobium a cubical or octagonal shape; the foramina, also, are wide and octagonal in outline. Very like *C. cubicum*, but that species has three projections to each cell, two visible at the margin.

Cœlastrum obtusum (Eichler) mihi. (Pl. lvii., f.9).

Cellulæ conicæ e basi ipsa protractæ; apicibus rotundatis nec truncatis; foraminibus amplis.

Cœnob. (8 cell.) diam. 24μ. Collector.

Syn., *C. cubicum* var. *obtusum* Eichler, Flory wodor ok. Miedzyr., 1894, p.122, T. ii., f.1, where he gives "diam. cœnob. 17-20μ." The cells are conical, drawn out right from the base, with rounded apices. Compare *C. pseudo-cubicum* Schröd., Plöner Berichte, v., 1897, T. iii., especially fig.1a. His figures show conclusively that *C. proboscideum* Bohlin, *C. cubicum* Näg., and this form of Eichler's are, biologically, one species. The last differs too much from *C. cubicum*, however, to be placed under that species, and it has priority over *C. proboscideum* Bohlin, 1897.

Genus Selenastrum Reinsch.

Selenastrum gracile Rein.

Cell. long. 18-25, alt. c. 18, crass. 3-8μ.

Botanic Gardens (125); Clyde, Duck Creek (26); Sydney Water (63); Lismore (182, 260).

Reinsch, Algenfl. v. Frank., p.65, T. iv., f.3a, b. This species is often found in the form of two cells back to back. There are generally only a few cells in the cœnobium. A family of 8 cœnobia, of 8 cells each, was noted. Solitary cells are not uncommon.

Var. minutum, n.var. (Pl. lvii., f.10).

Cellulæ dimensionibus dimidio minores quam in f. typica.

Cell. long. 9-18, alt. 7-8, crass. $1\frac{1}{2}$-2μ.

Botanic Gardens (125); Lismore (298).

Genus Scenedesmus Meyen.

Sc. quadricauda var. incurvus, n.var. (Pl. lvii., f.11).

Forma spinis apicalibus incurvis. Cœnob. (4 cell.) s.sp. 30 × 22μ.

Centennial Park.

Cf. Ralfs, Brit. Desm., T.31, f.12a, b. The terminal spines are generally divergent, but in this form they are incurved.

Var. INERMIS, n.var (Pl lvii., f.12, 13).

Forma sine spinis. Cœnob. (4 cell.) 15-20 × 11-12μ.

Botany (145); Lismore (260); Enoggera.

Not γ *ecornis* Ralfs, Brit. Desm., T.31, f.12h [= *Sc. bijugus* (Turp.)]. In the latter, all the cells are of the same size, and are regularly or irregularly oval. In var. *inermis*, the outer cells are slightly smaller than the inner, the latter also being strictly cylindrical, with parallel sides and rounded ends.

SC. DENTICULATUS var. GRACILIS, n.var. (Pl. lvii., f.14).

Cellulæ gracillimæ, lineares, elongatæ, lateribus parallelis.

Cœnob. (4 cell.) long. 12-21, lat. 12-20; cell. diam. 3-5μ.

Botany (17, 50, 95, 145, 155); Guildford (70); Centennial Park (133); Lismore (187).

Much more common here than any other form of *Sc. denticulatus*. The cells are linear and very slender, with parallel sides, cœnobia generally 4-celled.

Var. OPOLIENSIS (Richter) mihi.

Cœnob. (2 cell.) s.sp. long. 8-12, lat. 12-15; sp.long. 6-10μ.

Botany (50, 108); Parramatta (136); Enoggera.

Syn., *Sc. opoliensis* Richter, Phycotheca universalis, No.686; *Sc. quadricauda* var. *opoliensis* (Richter) W. & G. S. West, Frw. Alg. Ceylon, p.197, Pl.17, f.16, 17. The apical denticulations stamp this form as a variation of *Sc. denticulatus*. The presence of the long, terminal spines in *Sc. hystrix* var. *armatus* Chodat (also found here) shows that they are not necessarily indicative of *Sc. quadricauda*.

Var. AUSTRALIS, n.var. (Pl. lvii., f.15).

Cellulæ dentibus singulis ad apices instructæ; long. s. dent. 16, lat. 6μ. Collector.

Forms of *Sc. denticulatus* generally have two or three denticulations at the apices; in this form, there is one only. *Cf.* G. S. West, Br. Frw. Alg., p.220, fig.92J.

SCENEDESMUS SECURIFORMIS, n.sp. (Pl. lvii., f.16, 17).

Cellulæ exteriores (interdum etiam medianæ) modice securiformes, spinis nullis.

Cœnob. (2 cell.) 8-9 × 6-8; (4 cell.) 12-18 × 8-14μ.

Casino (189) and Lismore (187), Richmond River.

The outer cells are almost rectangular, and somewhat securiform; the central cells are sometimes the same shape, sometimes cylindrical with rounded ends.

Genus Ankistrodesmus Corda.

Syn., *Rhaphidium* Kütz., *Schröderia* Lemm.

Ank. falcatus var. mirabilis W. & G. S. West. (Pl. lvii., f.18).

Cell long. 36-90, lat. 1-3μ.

Botany (37, 155); Clyde, Duck Creek (26, 44); Canley Vale (129); Guildford (172); Sydney Water (63); Enoggera; Perth Water.

Syn., *Rhaph. polymorphum* var. *mirabile* W. & G. S. West, Frw. Alg. S. of Eng., p.501, Pl.7, f.9-13. The contents are generally homogeneous, and of a pale blue tint.

Var. contortus (Thuret) mihi. (Pl. lvii., f.19).

Cell. long. 16-60, lat. 2-3μ.

Clyde, Duck Creek (26); Canley Vale (129); Botanic Gardens (156); Lismore (258).

In Brébisson, Liste, p.158, Pl.1, f.31. I have found this form in quantity on several occasions. There is a tendency for the apices to be setaceous, but not to the extent of var. *setigerus* (*Schr. setigera*).

Ankistrodesmus dulcis, n.sp. (Pl. lvii., f.20).

Cellulæ solitariæ, valde æqualiter arcuatæ, gracillimæ, apicibus acutissimis haud autem setiformibus; chloroplastidibus homogeneis, ab apicibus retractis, medio interdum interruptis; elæoplastidibus singulis nonnunquam in extremis, interdum etiam in locello mediano, instructis; pyrenoidibus nullis.

Cell. long. (chorda) 30-70, crass. 2-4, alt. 20-40μ.

Botany (155); Parramatta Park (136); Sydney Water (63, 100); Lismore (258).

Var. CINGULUM, n.var. (Pl. lvii., f.21).

Cellulæ magis arcuatæ, tres quadrantes circuli efficientes, apicibus modice incurvis. Cell. long. (chorda) 26, crass. 2, alt. 20μ.

Botany (92).

A very pretty species, both from its graceful curvature and from the disposition of the cell-contents. The cell has the regularly arched form of a *Closterium*, very slender and gradually narrowing to the very acute tips. The latter are not drawn out into setæ, and are not incurved. The homogeneous chloroplast is generally confined to the body of the cell, leaving the tips clear; it is also often interrupted in the centre, or there is a locellus at the centre, placed to one side. Very often, an elæoplast is situated at each end of the chloroplast, sometimes also one in the middle. In var. *cingulum*, the curvature extends over three parts of a circle, the ends being somewhat incurved.

ANKISTRODESMUS BRAUNII (Näg.), forma. (Pl. lvii., f.22).

Cell. long. 40, lat. 3μ. Lismore (196).

The figure shows four cells, produced by longitudinal division, and still connected by the membrane of the mother-cell, which has become twisted into a stipes.

Var. MINUTUS, n.var. (Pl. lvii., f.23-25).

Cellulæ parvæ, longitudine usque ad formæ typicæ dimidium.
Cell. long. 10-20, lat. 2-3 (rarius 5) μ.
Lismore (182, 191, 196).

Cells only half as long as those of the type (or less), and generally a little more lunate, sessile on pieces of flocculent matter, water-plants, etc.

Genus ACTINASTRUM Lagerh.

ACTINASTRUM HANTZSCHII Lag. (Pl. lvii., f.26, 27).

Cœnob. (2 cell.) diam. 54, cell. 25 × 4; (4 cell.) diam. 28-50, cell. 16-25 × 2-4; (8 cell.) diam. 40-50, cell. 20-30 × 2-3μ.

Parramatta (136); Botany (50); Lismore (258); Grafton, Nymboidia River (269).

Lagerheim, Pedi. Protococc. o. Palm., p.70, T. iii., f.25, 26. Cells somewhat fusiform, outer ends acute, inner ends blunt. In all forms of *Act. Hantzschii*, the cell-contents are indifferently hyaline, pale blue or pale green. The chloroplast, when distinct, is generally somewhat retracted from the apex, and an elæoplast is often present.

ACTINASTRUM BACILLARE, n.sp. (Pl. lvii., f.28, 29).

Cellulæ bacilliformes, gracillimæ. Cœnob. (8 cell.) diam. 16-35, cell. 8-20 × 1½-2μ.

Parramatta Park (136); Lismore (274).

The cells, instead of being fusiform, are narrow and linear, sometimes very short.

ACTINASTRUM ACICULARE, n.sp. (Pl. lvii., f.30).

Cellulæ subulatæ, modice arcuatæ, basi inflatæ, apice acutæ.

Cœnob. (8 cell.) diam. 35, cell. 22 × 3μ.

Lismore (274).

The cells are somewhat awl-shaped, slightly curved, inflated at the base, and acute at the tip. Contents pale blue, an elæoplast present.

ACTINASTRUM GUTTULA, n.sp. (Pl. lvii., f.31).

Cellulæ in modo guttulæ conformatæ, introrsum acutissimæ.

Cœnob. (2 cell.) diam. 40, cell. 20 × 4μ.

Parramatta Park (136).

A 2-celled cœnobium noted with drop-shaped cells, the acute end inwards.

Genus KIRCHNERIELLA Schm.

KIRCHNERIELLA ELEGANS, n.sp. (Pl. lvii., f.32).

Cellulæ graciles; lateribus parallelis; apicibus obtusis in modo soleæ equi circumflectæ. Cell. diam. 6, crass. 2μ.

Sydney Water (63).

The cells in this form are very slender, with parallel sides and blunt ends, bent round into the shape of a horseshoe. A four-celled cœnobium noted with cells disposed as figured.

KIRCHN. LUNARIS var. ACUTA, n.var. (Pl. lvii., f.33).

Cellulæ lunatæ; apicibus protractis acutissimis, longo intervallo inter se distantibus. Cell. diam. 8, alt. 7, crass. 3μ.

Botanic Gardens (150).

The apices of the cell, which are wide apart, are drawn out to a very acute point.

Genus OOCYSTIS Näg.

O. CRASSA var. OSTENFELDII Playf., forma. (Pl. lviii., f.1).

Chloroplastides 8, pyrenoidibus instructæ. Cell. long. 20, lat. 13μ.

Lismore (285).

Cf. "*Oocystis* and *Eremosphæra*," p.124, Pl.7, f.18, 19. This variation generally has 2-4 chloroplasts; here we have it with eight.

Var. ELONGATA, n.var. (Pl. lviii., f.2, 3).

Cellulæ longe-ovales; apicibus acute-rotundatis; chloroplastidibus 8. Cell. long. 25-27, lat. 15μ.

Lismore (285, 286).

The cells are more elliptic than in either the type or var. *Ostenfeldii*; the apices more or less pointed, not incrassate or apiculate. There is a parietal chloroplast, obviously fragmented into eight parts, with pyrenoids.

Var. GRANULOSA, n.var. (Pl. lviii., f.4).

Cellulæ late elliptico-lanceolatæ, lateribus æqualiter arcuatis, apicibus acuminatis. Membrana ad apices introrsum incrassata. Chloroplastides nullæ distinctæ, chlorophyllo diffuso, cytoplasmate granuloso.

Cell. long. 27, lat. 19½μ.

Lismore (298).

The nearest to the type that I have noticed, the shape broadly elliptic-lanceolate, with pointed, inwardly incrassate apices. There are, however, no distinct chloroplasts, nor yet a parietal lamina; but the contents are granular, and the chlorophyll apparently diffused. The nucleus was visible in the centre.

O. APICULATA var. MAJOR Playf.* (Pl. lviii., f.5).

Cellulæ ellipticæ, duplo majores quam in f. typica, apicibus minute apiculatis.

Cell. long. 38, lat. 20μ.

Lismore (286).

There are two forms of the type, an oblong and an elliptic. This is a larger form of the latter, as var. *splendida* is of the former. *Cf.* these Proceedings, Pl. viii., f.2; the figure there is not sufficiently elliptic, too oblong. This form is liable to be mistaken for *O. solitaria*; there is no anterior, apical incrassation, however, and an apiculus is present, though very small and inconspicuous.

Var. SPLENDIDA Playf.

Cell. long. 33-41, lat. 21-26μ. Lismore (285, 286).

"*Ooc.* and *Eremo.*", p.131, Pl. viii., f.23. These figures extend the dimensions considerably. Var. *splendida* is a larger (about twice the size) and somewhat more elongate form of var. *obesa*. The two forms run into one another however.

Genus NEPHROCYTIUM Näg.

N. AGARDHIANUM var. MAJUS Näg. (Pl. lviii., f.6).

Cœnob. long. 75-78, lat. 50-55; cell. long. 37, lat. 21μ.

Guildford (23).

Syn., *N. Nägelii* Grun.; *N. obesum* West, New Brit. Frw. Alg., p.13, Pl. ii., f.39, 40. *Cf.* Nägeli, Gatt. einz. Alg., T. iii.c, fig. i, k, p. Nägeli's fig.p works out at 34 × 15μ for the cells; West, *l.c.*, gives "long. cell. 34-42, lat. cell. 24-28μ" for *N. obesum*. Except in the slightly greater breadth of the cells, West's figures agree exactly with those of Nägeli.

Var. PLANKTONICUM, n.var. (Pl. lviii., f.7, 8).

Cœnobium sphæricum mucosum. Cellulæ lunatæ 4-8 (plerumque 4) cunctæ, per extremitates (ut videtur) conjunctæ vel radiantes, ad apices angustatæ, apicibus obtusis.

* This form was mentioned in "*Oocystis* and *Eremosphæra*," p.110, but the description and notes were inadvertently omitted.

Cœnob. diam. 96-112; cell. long. 20-27, lat. 4-8μ.

Botany.

The cœnobium consists of a mucous sphere, as in *Sphærocystis* or *Glœocystis*, with lunate cells, generally in groups of 4, which appear to be either joined loosely by the extremities, or radiate from a common centre.

Genus TETRALLANTOS Teiling.

TETRALLANTOS LAGERHEIMII Teiling. (Pl. lviii., f.9, 10).

Cœnob. (4 cell.) long. 38-40, lat. 20-24; (8 cell.) 54 × 20; cell. long. 12-16, alt. 6-12, crass. 3-6μ.

Botany (37, 152); Botanic Gardens (125); Lismore (258, 260).

Cf. Einar Teiling, Schwedische Planktonalgen, ii., *Tetrallantos*, eine neue Gattung der Protococcoideen, p.63, f.1-7, 1916.

Genus TETRAEDRON Kütz.

TETRAEDRON MINIMUM (A.Br.) Hansg. (Pl. lviii., f.11).

Cell. long. = lat. = 6-8μ.

Parramatta Park (136); Guildford (88); Lismore (260, 276).

Polyedrium minimum A. Braun, Alg. unicell., p.94, footnote; G. S. West, Brit. Frw. Alg., p.231, fig.101A. The type has rather acute, radiating angles, and emarginate sides, alternate sides more deeply emarginate ("*lateribus alternis profundius emarginatis*"—A. Braun, *l.c.*) than the others. There are several well-marked forms of the species.

Var. AUSTRALE, n.var. (Pl. lviii., f.12, 13).

Cellulæ lateribus alteris planis levissime convexis, alteris altissime emarginatis.

Cell. diam. 5-8μ. Botany (95); Lismore (180, 276).

Cell. diam. 10-12μ. Botanic Gardens (3); Casino (189).

The most common form of the species here. The ends are flat or nearly so, slightly turned down at the angles, while the sides are very deeply emarginate and arched. In shape, it resembles *Tetr. platyisthmium* (Arch.) G. S. West, "Some critical green Algæ," p.286, Pl.21, f.36-39, but is very much smaller, and certainly a form of *Tetr. minimum*, being commonly found in company with other forms of the species.

Var. PINACIDIUM (Reinsch) mihi. (Pl. lviii., f.14, 15).

Cell. long. 6-13, lat. 5-11μ.

Botanic Gardens (3); Clyde, Duck Creek (26); Botany (108).

Polyedrium pinacidium Reinsch, Spec. generibusque, T.2A, f. iii.; Lagerheim, Pedi. Protococc. o. Palm., p.69, T. i., f.27. Syn., *P. minimum* f. *tetralobula* Reinsch, *Polyedr.* Monog., T. iv., fig.2d (forma *tetralobulata* in text, p.499); *P. tetragonum* Rèinsch (non Näg.), *l.c.*, T. iv., f.10. The cell is plane, with rounded angles, all four sides equally retuse. Reinsch and Lagerheim figure the cell as quadrate; our specimens were somewhat oblong.

Var. RECTILINEARE, n.var. (Pl. lviii., f.16, 17).

Cellulæ plus minusve quadratæ, lateribus rectilinearibus, angulis obtusis plus minusve rectis.

Cell. long. = lat. = 10-13μ. Guildford.

Cells more or less regularly square, with flat sides and bluntly rounded angles. *Cf.* Bernard, Protococc. et Desm., f.467.

Var. MORSUM (W. & G. S. West) mihi. (Pl. lviii., f.18).

Cell. long. = lat. = 9μ, constr. 8μ.

Botanic Gardens (3).

Tetrapedia morsa W. & G. S. West, Frw. Alg. Madag., p.85, Pl. v., f.3. The sides of the angles are flattened, and run back at right angles from the apex, for about one-third the length of the side of the cell. The other third is occupied by a sudden, rounded excavation. Cell plane, contents green; found in company with var. *pinacidium* and the type, very rare.

TETRAEDRON REGULARE Kütz., forma. (Pl. lviii., f.19).

Cell. diam. c. sp. 34, s. sp. 24μ. Parramatta (136).

Kützing, Phycolog. germ., p.129. Syn., *Polyedrium tetraëdricum* Näg., pro parte, Gatt. einz. Alg., T. iv.B, fig.3c, d. *P. trigonum* Näg., *p.p.*, *loc. cit.*, T.iv.B, fig.1c, d. I am in great doubt as to the characteristics of this type. Both Chodat, Alg. vertes, p.220, f.146, and G. S. West, Brit. Frw. Alg., p.231, f.101c, identify Kützing's plant with *P. tetraëdricum* Näg., but their figures do not agree with one another nor even exactly with Nägeli's figures. Also Nägeli gives the same two types to *P. trigonum* and *P. tetraëdricum*, relying for a specific characteristic on the plane or tetraëdral form of the cell. There is no biological difference, however, between plane and tetraëdral cells, the latter being developed often from the former; and as the classification is on the basis of outward configuration, it is extremely inconvenient to have types of a mixed character. The occurrence of biradiate and triradiate forms in the same type is well known in the Desmid genus *Staurastrum*, and these are strictly analagous to the plane and tetraëdral forms of *Tetraëdron*. I consider, therefore, that Nägeli's T. iv.B, fig.1a, and T. iv.B, fig.3a, b, should be arranged under *Tetr. trigonum*, while T. iv.B, fig.1c, d, and T. iv.B, fig.3c, d, should be classed as *Tetr. regulare* (*tetraëdricum*).

Var. INERME, n.var. (Pl. lix., f.17).

Cellulæ planæ; lateribus leviter concavis; angulis levissime inflatis; spinis nullis. Cell. diam. 14, crass. 6μ.

Collector.

The cells are plane, and have the concave sides and slightly inflated angles of the type, but are without spines.

Var. PAPILLIFERUM (Schröd.) mihi, forma. (Pl. lviii., f.20).

Forma maxima tetraëdrica; cellulæ obesæ; lateribus paullo concavis; angulis latis, inflatis, papillis singulis præditis.

Cell. diam. 64μ. Collector, Rose's Lagoon.

Cf. *Polyedrium trigonum* var. *papilliferum* Schröder, Plöner Berichte, v., 1897, T. ii., f.6. In optical section, our form is the exact same shape as Schröder's, from which it differs in its tetraëdral form, and very much larger size (diam. 12-15μ—Schröder). Both forms, with their hollow sides and inflated angles, naturally fall under *Tetr. regulare*, though somewhat more plump than figured by Nägeli (*P. tetraëdricum*). *Cf.* G. S. West's form, *l.c.*, *supra*. The occurrence of a plane and tetraëdral variety, in such a distinct form as this, goes far to bear out my contention, that there is no biological difference between them, but that both may be found in the same species.

TETR. SPINULOSUM Schm., forma. (Pl. lviii., f.21).

Forma pentaëdrica; lateribus subplanis; angulis obtusis; spinis tenuibus setis simillimis. Cell. corp. diam. 18μ.

Lismore (290).

Cf. Chodat, Alg. vertes, p.221, f.147B. This form has the sides almost flat, the angles obtuse, and very delicate spines like setæ.

Var. EXCAVATUM, n.var. (Pl. lviii., f.22).

Forma pentaëdrica, valde excavata; angulis radiantibus, conicis, haud inflatis, lateribus planis, apicibus modice acutis, spinis tenuissimis instructis. Cell. corp. diam. ca. 20μ.

Lismore (290).

In this form, the body is much more excavated on all sides; the cell consists of little more than 5, conical, radiating angles, not inflated, but with nearly flat sides, and rather acute at the apices. Spines very delicate.

TETRAEDRON HORTENSE, n.sp. (Pl. lviii., f.23).

Cellulæ maximæ, æqualiter tetraëdricæ; lateribus levissime concavis; angulis late-rotundatis. Membrana minute punctulata, ad extremos angulos interdum levissime granulata, punctis in seriebus duabus decussatim ordinatis. Cell. diam. 46-72μ.

Botanic Gardens (3, 150); Prospect Reservoir.

Compare, with this species, *Tetr. gigas* Wittr., Gotl. o. Oelands Söttvattensalg., p.33, T.4, f.4, and *Tetr. tumidulum* Reinsch, *Polyedr.* Monog., p.506, T. vi., f.3. The cells are very large, tetraëdral, generally with broadly rounded angles, and very slightly concave sides; the angles, however, sometimes tend to be pointed. The membrane is minutely punctate all over, the puncta arranged in decussating lines.

TETRAEDRON ACUTUM, n.sp. (Pl. lviii., f.24, 25).

Cellulæ tetraëdricæ; lateribus plus minus (sæpe valde) concavis, angulis protractis; angulis spinis singulis instructis.

Cell. diam. c. sp. 20-34; sp. long. 6-10μ.

Parramatta (136); Lismore (258, 259, 263); Enoggera.

The cells are tetraëdrical; in optical section, triangular, with more or less concave sides, angles very acute and produced. The angles are furnished with fine spines; it is sometimes difficult to say where the angle ends and the spine begins.

Var. RECTILINEARE, n.var. (Pl. lviii., f.26).

Cellulæ tetraëdricæ; lateribus planis nec retusis; angulis acutis haud protractis, spinis singulis præditis. Cell. diam. c. sp. 25μ.

Enoggera.

The cell is tetrahedral; in optical section, triangular, with sides quite flat, angles acute, not produced, furnished with short spines. Nageli's figure, Gatt. einz. Alg., T. iv, B, fig. 1b, is a plane form of this variation.

TETR. HASTATUM var. ELEGANS, n.var. (Pl. lviii., f.27).

Cellulæ tetraëdricæ; lateribus concavis; angulis in processus hyalinos bifidos singulos protractis. Cell. diam. c. proc. 32μ.

Parramatta Park (136).

Cf. *Tetr.* (*Polyedrium*) *hastatum* Reinsch, Algenfl. v. Frank., p.77, T. v., f.3, also Chodat, *l.c.*, p.172, f.95. The sides of the cell are very concave, and the single process at each angle more regular; the processes are hyaline, and bifid, with recurved ends, sometimes doubly dichotomous.

TETR. TRIGONUM var. MAMMILLATUM, n.var. (Pl. lviii., f.28).

Cellulæ planæ triangulares; lateribus convexis; angulis obtusis in papillas singulas productis; a latere visæ lenticulares.

Cell. diam. 12μ. Lismore (258).

Cf. *Tetr.* (*Polyedrium*) *trigonum* var. *crassum* Näg., in Eichler, Flor. wodor. ok. Miedzyrzeca, 1892, T. ix., f.17. This form has each angle produced into a short, mammillate projection.

TETRAEDRON CRUCIFORME, n.sp. (Pl. lviii., f.29).

Cellulæ planæ, angulis radiantibus 4 exstructæ, medio valde constrictæ, inferne et superne retusæ; angulis acutis vix inflatis, spinis minutis singulis instructis, Chloroplastides dilute virides.

Cell. long. c. sp. 18, centr. 10; lat. c. sp. 20, constr. 6μ.

Botany.

A plane form, deeply constricted in the middle after the style of an *Arthrodesmus*, and somewhat retuse above and below, the angles acute, hardly inflated and furnished with a minute spine.

TETRAEDRON STRIATUM, n.sp. (Pl. lviii., f.30).

Cellulæ tetraëdricæ; lateribus valde concavis; angulis haud inflatis in processus angustos breves protractis, extremis truncatis, transverse striatis. Cell. diam 26μ.

Enoggera.

The cell is tetraëdral, with very concave sides, angles not inflated but produced in short processes, like certain forms of *Staurastrum*; processes narrow, transversely striate (? rows of puncta), ends truncate.

TETRAEDRON WASTENEYSII, n.sp. (Pl. lviii., f.31).

Cellulæ tetraëdricæ; lateribus convexis; angulis obtusis in processus breves hyalinos claviformes singulos productis.

Cell. diam. c. proc. 20, corp. $8\frac{1}{2}\mu$. Enoggera.

Named in honour of my erstwhile correspondent, Mr. Hardolph Wasteneys, who sent me the Enoggera-samples. The cell is tetraëdral, the body with convex sides; the obtuse angles are produced into short, hyaline, club-shaped processes, with smooth, rounded ends.

PHYTHELIEÆ.

Genus RICHTERIELLA Lemm.

RICHTERIELLA BOTRYOIDES (Schm.) Lemm. (Pl. lix., f.1, 2).

Cell. diam. 3-8; setæ long. 20-30μ.

Parramatta Park (136).

Genus LAGERHEIMIA Chodat.

Including *Chodatella* Lemmermann. In "Plankton of the Sydney Water-Supply," these Proceedings, 1912, in consideration of their evident connection, one with another, I felt bound to arrange the various forms of *Lagerheimia* as variations of one species. While just as much as ever convinced of the biological connection, I find this method of nomenclature cumbrous, and of very doubtful utility, and have abandoned it. The following list gives the revised nomenclature:—

L. genevensis Chod., *p.p.*	=	*L ciliata* v. *genevensis*, *l.c.*, p.522, Pl. 53, f.7.
,, var. *gracilis* Playf.	=	*L. ciliata* v. *gracilis*, p.523, f.10-12.
L. acuminata Playf.	=	,, v *acuminata*, p.523, f.13-19.
L. globosa Playf.	=	,, v. *globosa*, p.524, f.20.
L. cristata Playf.	=	,, v. *cristata*, p.525, f.21.
L. comosa Playf.	=	,, v. *comosa*, p.525, f.26.
L. subsalsa (Lemm.) mihi	=	,, v. *subsalsa*, p.524, f.32, 33.
L. coronata Playf.	=	,, v. *coronata*, p.522, f.3.
,, var. *inflata* Playf.	=	,, v. *inflata*, p.522, f.4, 5.
,, var. *striolata* Playf.	=	,, v. *striolata*, p.525, f.22, 25.

Genus BERNARDIA,* gen.nov.

Cellulæ sphæricæ vel oblongæ, spinis (neque setis) longis, rigidis 4 (polaribus 2, equatorialibus 2) armatæ, basibus spinarum expansis. In cellulis maturioribus processus gracillimi, basibus valde expansis, apicibus obtusis vel minute cuspidatis, in vicem spinarum inveniuntur.

BERNARDIA CHODATI (Bernard) mihi. (Pl. lix., f.3, 4).

Cellulæ sphæricæ, spinis rigidis 4 (polaribus 2, equatorialibus 2) instructæ; spinis e papillis orientibus.

Cell. diam. 7, spin. long. 16μ.

Dunedin, N.Z.; Enoggera, Q.

Syn., *Lagerheimia Chodati* Bernard, Protococc. et Desm., p.170, f.349, 350. In its younger stages, this plant resembles a *Lagerheimia*, but, instead of hair-like or bristle-like setæ, the cells are furnished with four rigid spines ("*forte barbe roide . . . . . à l'extremité très fine et très aiguë*"—Bernard); and these are not subapical, but exactly polar and equatorial. More mature cells, gathered from the lake in Parramatta Park, have convinced me, however, that the plant is organised on quite different lines to *Lagerheimia*. The stiff spines have become very slender processes, with blunt or minutely cuspidate apices, and very

* In honour of M. Chas. Bernard, Dr. ès Sciences, of Buitenzorg, Java.

strongly expanded bases, so broad, indeed, as sometimes to enclose the whole cell. The processes are akin to those of *Staurastrum* or the horns of *Pediastrum*. Indeed, the fully developed plant resembles nothing so much as a four-celled *Pedi. simplex*. Bernard gives, cells 5-10μ, spines 13-20μ, for Javanese specimens.

Var. CRUCIATA, n.var. (Pl. lix., f.5, 6).

Cellulæ in vicem spinulorum processubus longis gracillimis 4 (polaribus 2, equatorialibus 2) basi valde expansis, instructæ; membrana sæpe dilute rufescente.

Cell. diam. 6-12, process. long. 18-27μ.

Parramatta Park (136).

In this, apparently the mature, form, the spines are replaced by long, slender processes, greatly expanded at the base; see notes on the type, *supra*.

BERNARDIA WRATISLAVENSIS (Schröd.) mihi. (Pl. lix., f.7).

Cell. long. 8, lat. 3; spin. long. 16μ,

Lismore (258).

Syn., *Lagerheimia Wratislavensis* Schröder, Ber. d. deutsch. bot. Gesellsch., xv., T.17, f.7: Chodat, Alg. vertes, p.188, f.103. This form has spines arranged as in *Bern. Chodati*, and should accompany that species. The spines and processes, also, in this genus are more or less rufescent, which I have never noted in the setæ of *Lagerheimia*.

DICTYOSPHÆRIEÆ.

Genus TETRACOCCUS West.

TETRACOCCUS BOTRYOIDES West. (Pl. lix., f.8, 9).

Cell. diam. 3-8μ. Lismore (285).

PALMELLACEÆ.

Genus SPHÆROCYSTIS Chod.

SPHÆROCYSTIS SCHROETERI Chod. (Pl. lix., f.10).

Cœnob. diam. 28-300; cell. diam. 3-12μ.

Botany; Sydney Water (80, 81); Lismore (260, 281, 286); Grafton, Nymboidia River (268).

Cf. Chodat, Bull. de l'Herbier Boissier, 1897, p.292, T. ix.; Alg. vertes, p.114, f.53. I have never been able to see any difference between *Glœocystis* and *Sphærocystis*, except that cœnobia of the latter run to greater dimensions. In regard to the size of the cells, *Sph Schröteri* occupies exactly an intermediate position between *Glœocystis vesiculosa* and *G. gigas*; and when its large cells divide into groups of 8, they form cœnobia which are *Gl. vesiculosa* pure and simple, as figured by Nägeli, Gatt. einz Alg., T. iv F, fig.1, the normal form of the species, and, indeed, the only one I have ever noted.

Var TETRAEDRICA, n.var. (Pl. lix., f.11).

Cellulæ intra cœnobium tetraëdrice ordinatæ.

Cœnob. diam. 44-45; cell. diam. 9-12μ.

Sydney Water (80, 81); Coogee; Botany.

This form is not uncommon; the cells are close together, and and obviously arranged tetraëdrically.

Genus GLŒOCYSTIS Nägeli.

GLŒOCYSTIS VESICULOSA Näg. (Pl. lix., f.12).

Cœnob. diam 14-60; cell. diam. 3-6μ.

Auburn; Collector; Sydney Water (63).

Cf. Nägeli, Gatt. einz. Alg., T. iv F, fig.1. He gives the cells as spherical or ellipsoid; in those specimens I have met with, the cells were always spherical.

GLŒCYSTIS GIGAS (Kütz.) Lag. (Pl. lix., f.13, 14).

Cœnob. diam. 30-60; cell. diam, 10-20μ.

Auburn; Collector, Murray's Lagoon; Botany (71).

Syn., *Protococcus gigas* Kutz., *Glœocapsa ampla* Kütz., *Glœocystis ampla* Rabh., *Chlorococcum gigas* (Kütz.) Grun.

GLŒOCYSTIS AUSTRALIS, n.sp. (Pl. lix., f.15).

Cœnobium globosum vel subglobosum, cellulas ovales 4, 8, 16 includens.

Cœnob. sphær. diam. 42-60, subglob. long. 20-34, lat. 15-20; cell. long. 12-18, lat. 8-12μ.

Auburn; Guildford (23).

This species has oval cells instead of the usual spherical ones. A family of eight cœnobia, of eight cells each, was noted.

Var. AMPLA, n var. (Pl. lix., f.16).

Cœnobium maximum, cellulas permultas includens.

Cœnob. diam. 145; cell. long. 10-12, lat. 6-8μ.

Auburn. Cum priori.

A form with cœnobium much larger than usual, and enclosing a very large number of cells.

EXPLANATION OF PLATES LVI.-LIX.

Plate lvi.

Figs. 1-4.—*Carteria multifilis* (Fresen.) Dill, forma; (×660).
Figs. 5-7.—*C. scrobiculata*, n.sp.; (×660).
Fig. 8.—*C. scrobiculata* var. *ovalis*, n.var.; (×660).
Fig. 9.—*C. australis*, n.sp.; (×1000).
Fig. 10.—*C. australis* var. *ovata*, n.var.; (×1000).
Figs. 11, 12.—*Chlamydomonas glœocystiformis* Dill, formæ; (11) ×1000, (12) ×1330.
Fig. 13.—*Chl. pisiformis* var. *attenuata*, n.var.; (×1000).
Fig. 14.—*Chl. pisiformis* var. *glœocystiformis*, n.var.; (×500).
Fig. 15.—*Chl. globulosa* var. *pertusa*, n.var.; (×1000).
Fig. 16.—*Chl. monadina* var. *ovalis*, n.var.; (×1000).
Fig. 17.—*Chl. globosa* Snow; (×1330).
Fig. 18.—*Chl. Lismorensis*, n.sp.; (×2000).
Figs. 19, 20.—*Chl. Lismorensis* var. *ovata*, n.var.; (×2700).
Figs. 21, 22.—*Phacotus bullatus*, n.sp., (*b*) side, (*c*) end; (21) ×1000, (22) ×1330.
Fig. 23.—*P. bullatus* var. *conicus*, n.var.; (×1000).
Figs. 24, 25.—*Pteromonas cruciata*, n.sp., (24) front, (25) side, (*a*) end; (×1000).
Fig. 26.—*Pt. cruciata* var. *pulchra*, n.var., (*a*) front, (*b*) side, (*c*) end; (×1000).

Plate lvii.

Fig. 1.—*Pediastrum tetras* var. *fluviatile*, n. var.; (×660).
Fig. 2.—*P. tetras* var. *apiculatum*, n.var.; (×660).
Fig. 3.—*Crucigenia tetrapedia* var. *ornata*, n.var.; (×1330).
Fig. 4.—*C. triangularis* Chodat; (×660).
Fig. 5.—*C. quadrata* var. *secta*, n.var.; (×1000).
Fig. 6.—*Tetrastrum elegans*, n.sp.; (×1000).
Fig. 7.—*T. elegans* var. *dentatum*, n.var.; (×1000).
Fig. 8.—*Cœlastrum crenatum* var. *cubicum*, n.var.; (×660).

Fig.9.—*C. obtusum* (Eichler) mihi, *cœnobium cubicum*; (× 1000).
Fig.10.—*Selenastrum gracile* var. *minutum*, n.var.; (× 1000).
Fig.11.—*Scenedesmus quadricauda* var. *incurvus*, n. var.; (× 660).
Figs.12, 13.—*S. quadricauda* var. *inermis*, n.var.; (× 1000).
Fig.14.—*S. denticulatus* var. *gracilis*, n.var.; (× 1330).
Fig.15.—*S. denticulatus* var. *australis*, n.var.; (× 660).
Figs.16, 17.—*S. securiformis*, n.sp.; (× 1000).
Fig.18.—*Ankistrodesmus falcatus* var. *mirabilis* W. & G. S. West; (× 660).
Fig.19.—*A. falcatus* var. *contortus* (Thuret) mihi; (× 660).
Fig.20.—*A. dulcis*, n.sp.; (*a*) × 1000, (*b*) × 660.
Fig.21.—*A. dulcis* var. *cingulum*, n.var.; (× 1000).
Fig.22.—*A. Braunii* (Näg.), forma; (× 660).
Figs.23-25.—*A. Braunii* var. *minutus*, n.var.; (23) × 1330, the others × 660.
Figs.26, 27.—*Actinastrum Hantzschii* Lagerh.; (× 1000).
Figs.28, 29.—*A. bacillare*, n.sp.; (× 1000).
Fig.30.—*A. aciculare*, n.sp., (× 500); (*a*) single cell × 1000.
Fig.31.—*A. guttula*, n.sp.; (× 1000).
Fig.32.—*Kirchneriella elegans*, n.sp.; (× 660).
Fig.33.—*K. lunaris* var. *acuta*, n.var.; (× 1330).

Plate lviii.

Fig.1.—*Oocystis crassa* var. *Ostenfeldii* Playf., forma; (× 1000).
Figs.2, 3.—*O. crassa* var. *elongata*, n.var.; (× 1000).
Fig.4—*O. crassa* var. *granulosa*, n.var.;(× 740).
Fig.5.—*O. apiculata* var. *major* Playf.; (× 660).
Fig.6.—*Nephrocytium Agardhianum* var. *majus* Näg.; (× 400).
Figs.7, 8.—*N. Agardhianum* var. *planktonicum*, n.var.; (× 250).
Figs.9, 10.—*Tetrallantos Lagerheimii* Teiling; (× 1000).
Fig.11.—*Tetraëdron minimum* (A.Br.) Hansg; (× 1330).
Figs.12, 13.—*Tetr. minimum* var. *australe*, n.var.; (× 1000).
Figs.14, 15.—*Tetr. minimum* var. *pinacidium* (Reinsch) mihi; (14) × 1000, (15) × 1330.
Figs.16, 17.—*Tetr. minimum* var. *rectilineare*, n.var.; (× 1000).
Fig.18.—*Tetr. minimum* var. *morsum* (W. & G. S. West) mihi; (× 1000).
Fig.19.—*Tetr. regulare* Kütz., forma; (× 660).
Fig.20.—*Tetr. regulare* var. *papilliferum* (Schröder) mihi, forma; (× 330).
Fig.21.—*Tetr. spinulosum* Schmidle, forma; (× 1000).
Fig.22.—*Tetr. spinulosum* var. *excavatum*, n.var.; (× 1000).
Fig.23.—*Tetr. hortense*, n.sp.; (× 660).
Figs.24, 25.—*Tetr. acutum*, n.sp.; (24) × 1000, (25) × 1500.
Fig.26.—*Tetr. acutum* var. *rectilineare*, n.var.; (× 1000).
Fig.27.—*Tetr. hastatum* var. *elegans*, n.var.; (× 660).
Fig.28.—*Tetr. trigonum* var. *mammillatum*, n.var.; (× 1330).
Fig.29.—*Tetr. cruciforme*, n.sp ; (× 1330).

Fig.30.—*Tetr. striatum*, n.sp.; (×660).
Fig.31.—*Tetr. Wasteneysii*, n.sp.; (×1000).

Plate lix.

Figs.1, 2.—*Richteriella botryoides* (Schmidle) Lemm.; (1)×1000, (2)×660.
Figs 3, 4.—*Bernardia Chodati* (Bernard) mihi: (3)×660, (4)×1000.
Figs.5, 6.—*B. Chodati* var. *cruciata*, n.var.; (×660).
Fig.7.—*B. Wratislavensis* (Schröder) mihi; (×1000).
Fig.8.—*Tetracoccus botryoides* West; (×500).
Fig.9.—*T. botryoides*, tetrads of cells radiating from a common centre; (×200).
Fig.10.—*Sphærocystis Schröteri* Chodat; (×500).
Fig.11.—*S. Schröteri* var. *tetraëdrica*, n.var.; (×500).
Fig.12.—*Glœocystis vesiculosa* Näg.; (×660).
Figs.13, 14.—*G. gigas* (Kütz.) Lagerh.; (×250).
Fig.15.—*G. australis*, n.sp.; (×500).
Fig.16.—*G. australis* var. *ampla*, n.var.; (×250).
Fig.17.—*Tetraëdron regulare* var. *inerme*, n.var.; (×1330).
Fig.18.—*Carteria scrobiculata*, n.sp., end-view; (×660).

RECORDS OF AUSTRALIAN FUNGI. No. i.

By J. Burton Cleland, M.D., and Edwin Cheel, Botanical Assistant, Botanic Gardens, Sydney.

We propose to record, from time to time, under the above heading, various fungi, more especially Basidiomycetes, that have passed through our hands. Nearly all the specimens referred to belong either to our private collections, or to that in the National Herbarium, Sydney. In recording specimens, we propose to do so in such a way, that the actual plants may be identified from our reference, and from a note attached to them citing the reference. In searching the literature on Australian fungi, we have found records of many species, but rarely any means by which the identification can be checked, as, for instance, by examination of the actual plants identified. In consequence, some, probably many, mistakes have been made, which now cannot be rectified. We propose to give our successors every assistance in criticising our decisions. In such a difficult subject, at present in an almost chaotic state, mistakes are bound to be made by us, but we want them to be retrievable in the light of further and fuller knowledge.

Coprinus.

Coprinus comatus Fries.—Recorded by Cooke for Victoria, and for this State by one of us (E.C.) in Proc. Linn. Soc. N. S. Wales, 1907, xxxii., 475. We have met with this esculent species on several occasions during winter and early spring, on Milson Island, Hawkesbury River (July), and in Sydney. It is quite common in the Botanic Gardens and Domain during the month of June. (Specimens in the National Herbarium under No.56). During 1914, it was very abundant, growing near the roadside at Kensington, Sydney, in large tufts (spores $14\text{-}15{\cdot}5 \times 8{\cdot}5\text{-}9\mu$). Young specimens were cooked and eaten, after scraping off the scales, and proved very palatable. In the Milson Island specimens, the spores measured 17·3 × 10-11μ.

Coprinus atramentarius Fries.—Our specimens were collected in June and July, 1907, in a plantation in the Botanic Gardens, and are preserved in the National Herbarium under Nos.55 and 64. Spores 5-8 × 4-6μ.

Coprinus extinctorius Bull.—Specimens of this species were collected on a manure-heap in the Botanic Gardens, in April, 1908, and recorded by one of us (E.C.), *l.c.* Spores 10-13 × 6-7μ.

Coprinus fimetarius Fries.—We have collected this species on dung at Milson Island, in March (spores 11-12 × 7-7·5μ). Some large specimens, with yellowish-brown, crusty scales on the top of the pileus, and with stems 5 inches long, and nearly 4 lines thick, growing on manure at Sydney, had spores 10-10 8 × 7-7 2μ in size. The spores of specimens growing on dung at Adelaide, in July, were 13·8 × 8μ. Narrabeen, January (spores 10·4-13·8 × 7-8·5μ).

Coprinus micaceus Fries.—Recorded by Cooke, for Victoria and South Australia. The species is common in New South Wales, being found densely fasciculate at the base of old stumps, posts, telegraph-poles, etc. It is common in the Botanic Gardens during the month of June. The spores are obliquely oval, dark brown to blackish, 8·5 × 5·2-7μ. Milson Island, Hawkesbury River, and Sydney.

Coprinus deliquescens Fries.—A species growing on a rotten stick at Neutral Bay, Sydney, in March, agrees with the description and Cooke's plate of this species. Spores dark brown, 7·8-9 × 5·2-7μ.

Coprinus congregatus Bull. Specimens, resembling the figures of this species, were obtained, growing amongst decaying straw, at Milson Island, in July. Spores 12-13 × 7μ.

Coprinus sclerotianus, n.sp.—Several irregular-shaped sclerotia, about the size of mung-beans ($1\frac{1}{2}$-$2\frac{1}{2}$ lines diam.) were found at Colo, Southern Line, under cow-dung, in March, 1914.

Three of these were placed in cow-dung covered with watch-glasses, and kept moist. After 16 days, each sclerotium produced a white, mealy projection, which at first developed very slowly, but after several days showed more rapid growth, and a distinct differentiation into pileus and stipes was noticeable. Two weeks later, the sporophore was fully grown, and, in 24 hours, the pileus opened out into 9 rays, and the plant elongated very rapidly.

The outer coating of the sclerotium is thin, and dark or nearly black in colour, and the inner substance is whitish, evidently composed of closely woven hyphæ. Pileus cylindrical at first, pallid or pale grey, very mealy, about 2½-4 lines long, and 1½-2 lines in diameter, splitting at length into rays, which are striate, and become a darker grey at maturity. Gills few, at first white but soon dissolving into a black, inky fluid. Stem, under natural conditions, very slender and comparatively smooth; but, under artificial culture, about ½ line thick, and more or less covered with a mealy substance, which somewhat resembles silky down. When fully matured, it elongates very rapidly, reaching a length of about 2⅓ inches, and is quite smooth and glabrous in the upper part, but still retains the silky down in the lower part. Spores elliptical, $8\text{-}10 \times 4\text{-}5\mu$.

We have collected this species, which resembles somewhat the figures of *C. tomentosus* and *C. niveus*, on three other occasions, but have, in only one of these cases, found the attached sclerotium. One of these was collected on rich soil at Neutral Bay, in June, 1913. The cap was conical greyish from fine particles, and striate. Stem white, 1½ inches long, spores $8{\cdot}5\text{-}10 \times 5{\cdot}2\mu$. The second was on a dunged garden at Neutral Bay, in April, 1915. The cap appeared as if covered with a fine, grey felt. There was a long, black root. Spores $10{\cdot}4 \times 5{\cdot}5\mu$. The third specimen was collected in the same garden in December, 1915, attached to a black sclerotium, the size of a pea; which, on section, was whitish. The pileus was bluntly conical, ½ inch high and ⅜ inch broad, covered with a grey tomentum, and finely striate. Stem 1¾ inches high, white, finely fibrous. Gills very crowded, blackish, ascending, adnexed, covered, before expansion, with a fine grey tomentum. On expanding, the pileus become very thin, and revolute. Spores dark purple, nearly black, in the mass, 8·5-10·5 × 5·2μ, oval. The sclerotium was kept moist in a saucer, and at once showed several, small, fluffy projections. One of these gradually elongated, being covered with a whitish tomentum. Eventually, this rapidly elongated, and bore a smaller and whiter pileus than the one found developing naturally.

Coprinus radiatus Fries.—A small, ephemeral species, found growing on dung, at Sydney, in March, may be referable to this species. It was at first conical, white, and covered with snowy particles, later becoming convex. The spores were nearly spherical, with the ends a little pointed, 7μ in diameter or 7 × 5μ. Other specimens collected on dung at Mosman, Sydney, in July, are certainly this species. Their description is as follows: about $\frac{3}{16}$ inch in diameter, at first cylindrical, with a greyish bloom, finally plane and greyish, except for the pale fawn, depressed centre, showing pale fawn-coloured, scurfy granules, ribbed. Gills about 23, moderately distant. Stem about 1 inch high, white, base thickened, a little downy. Spores subspherical to triangular, 5·5-7μ. Specimens also from Hill Top, growing on cow-dung, spores 8 × 5μ; and Terrigal, on dung, June, spores 7 × 4·3μ, 7μ, irregular.

Coprinus stercorarius Fries.—We have collected specimens on dung at Ryde, in May (spores 10·5-15·5 × 7-10μ). Specimens obtained at Manly, in July, showed a conical cap, $\frac{1}{2}$ inch high and $\frac{1}{2}$ inch broad, covered with a white, micaceous meal, with a slight grey tinge. Gills dark grey, ascending, adnate. Stem 2 inches high, white, somewhat floccose, hollow, base a little swollen. Spores 12-13·8 × 8·5-10·5μ, often obese. Hill Top, January, 1913, spores 14 × 5-10μ. Hyde Park, on manured soil, January, spores 10-13 × 7-9μ.

Coprinus ephemerus Fries.—Recorded by Cooke for Queensland. We have found it in Sydney, on horse-dung, in March (pileus minutely furfuraceous when young, spores 15·5-17 × 10·4μ); also at Penshurst, in February, 1911; spores 10-16 × 8-10μ.

COPRINUS PLICATILOIDES Buller.—Buller (Researches on Fungi, 1909, p.69) describes a (frequently) minute *Coprinus*, resembling *C. plicatilis*, under this name. He states that it grows on horse-dung, and is often amongst the most tiny of the Agarics, being sometimes only 1 cm. long, and 2 mm. wide. The average length is 3 cm. (a little over an inch), with a cap 5 to 6 mm. wide. The fruit-bodies are very delicate. He adds, that he considers it undescribed, and that, though having a depressed disc at maturity, like *C. plicatilis*, this is narrow and not broad, whilst the gills are not attached to a collar, and the spores are oval.

We have, on several occasions, collected a species which, from the above description and Buller's figures, we believe to be this. *C. ephemerus*, in Cooke's Illustrations, resembles our species, but is larger, and has an elevated disc. Specimens collected on horse-dung, at Sydney, in March, may be described as follows:—Small. When young, conical, with fine, brownish granules, then convex, ¼ inch in diameter, grey, centre depressed, coarsely ribbed, covered with a few, fine, brown flakes. Gills 12 to 20 or 30 in number, narrow, distant, alternate ones short, fading away as the stem is reached. Stem 1 inch or more high. Spores black, $13{\cdot}8\text{-}16 \times 8{\cdot}5\text{-}9\mu$. Specimens collected in numbers, on horse-dung, at Dubbo, in October, are very similar. The pileus is at first uniformly covered with fine, brown scales; later, these become scattered, revealing the paler brown, striate pileus. The stem is white, and more or less fluffy, or even radiately strigose at the base. Spores $14\text{-}14{\cdot}2 \times 7\text{-}8{\cdot}2\mu$.

COPRINUS ANGULATUS (Lloyd, in "Mycological Notes," Dec., 1900, p.46).—"Pileus when young hemispherical, even, striate, becoming convex and plicate-sulcate when mature, smooth, when young white with ochreous tints, when partly grown dark grey with a brown (somewhat hygrophanous) centre, thin. Gills rather distant, reaching the stem, when mature (but before deliquescing) black with a white edge. Stipe pure white, equal, hollow, striate, when *very young* evidently white scurfy, but appearing glabrous when grown. Spores very peculiarly angular shape like a keystone, $14 \times 9\mu$. On burnt ground, somewhat gregarious."—Lloyd.

On Milson Island, Hawkesbury River, in November, 1914, and again in February, 1916, a fungus appeared on bare ground (which had possibly been burnt—a fire had been near), which resembles markedly the photograph given by Lloyd, and is characterised by what was described, at the time, as "irregularly oval" or "rather triangular" spores, somewhat smaller than the dimensions given by this author. The plant in question seemed to be a *Coprinus*, though, later, dried specimens were found, which is sometimes the case with *Coprinus micaceus* when hot, dry conditions rapidly supervene. Though these slight discrepancies exist, this Australian species seems best placed under this description, at least for the present. A description of our plants is as follows:—Pileus up to $1\frac{1}{4}$ in. in diameter, at first somewhat hemispherical and slightly umbonate, then convex and later nearly plane, greyish-brown, becoming pale, with a pallid brown or yellowish-brown centre, slightly depressed in the middle, and with a few, scattered, scurfy scales; the periphery densely sulcate-striate, the striæ thick and forked from half-way, the striæ running up to the central $\frac{5}{6}$ in., which is a duller brown than the centre itself. Gills dark grey, adnate, crowded, narrow, no collar. Stem $2\frac{1}{2}$-$2\frac{3}{4}$ inches, white, fragile, hollow, finely striate; on drying and shrinking, found to be attached to the ground by a swollen, fluffy base. Spores rather triangular or irregularly oval, occasionally $7 \times 5{\cdot}2\mu$, usually $10{\cdot}4 \times 7$-$8{\cdot}5\mu$.

Coprinus plicatilis Fries.—The following description applies to a common species growing on the ground at Sydney. It seems to be *C. plicatilis*, though the collar, to which the gills are attached, is not marked, and the spores are smaller. When young, conico-cylindrical, covered with chestnut, scurfy scales, sandy brown, striate, closed by the veil. When expanded, $\frac{1}{3}$ to $\frac{1}{2}$ inch; disc pale brown, depressed, ribs double, bifurcated at the edge, greyish-brown or greyish-white, disc and ribs flecked with dark brown scales. Gills whitish, just reaching the stem, very thin and fragile, moderately crowded. Stem $1\frac{1}{2}$ inches, white, attenuated upwards, a slight mycelium at the base. Spores black, oval, one end more pointed, $9{\cdot}5$-$10{\cdot}5 \times 7{\cdot}3$-$8{\cdot}5\mu$.

COPRINUS HEMEROBIUS Fries.—The following has been found on the ground at Neutral Bay. Cap up to $1\frac{1}{4}$ inches, convex, umbonate, umbo light brown, ribs greyish-white, often bifurcate at the edge Gills white, then black. Stem up to 3 inches high, white, slightly attenuated upwards, hollow. Spores egg-shaped, $8{\cdot}6 \times 7\mu$, $7 \times 6\mu$. It is also quite common in the Domain during the month of June. Spores $7\text{-}9 \times 6\text{-}7\mu$.

COPRINUS sp.(1).—Resembles *C. radiatus*, but the spores are larger; and there are scattered hairs on the cap and stem. When young, it is the size of a large pin's head, conical, pale brown, apex darker, slightly striate, later expanded. Stem white, $\frac{1}{2}$ inch long. Stem and cap with scattered, minute hairs. Spores $10{\cdot}4\text{-}12 \times 7\mu$. On horse-dung, Manly, April 4th, 1915. (Herb. J. B. Cleland. Formalin-specimen, No 90).

COPRINUS sp.(2).—Small, conical, then convex, finally more expanded. Woolly-white, then greyish. Slightly ribbed, very thin. Stem up to 1 inch. Spores oval, $8{\cdot}5\text{-}9 \times 5\mu$. On cow-dung, Adelaide, September 22, 1913. Covered with white down. On cow dung at Neutral Bay, July 27, 1913. Spores black, $8 \times 3{\cdot}5\mu$.

THELEPHORACEÆ.

CRATERELLUS CORNUCOPIOIDES L.—Recorded by us as new for New South Wales, in Journ. Proc. Roy. Soc. N. S. Wales, 1913, p. xv.

LACHNOCLADIUM CONGESTUM Berk.—Cooke records this species (as *Thelephora congesta*) for Victoria, Queensland, and New South Wales. Lloyd has kindly identified specimens for us, which, he says, agree exactly with his photograph of the type. He adds: "I made the spores of the type 'smooth, globose, 8-10 micr., pale-coloured.' These spores I make 'pale-coloured,' not 'purplish-brown,' and almost smooth." The plant is common in the neighbourhood of Sydney, on bare, damp ground, such as foot-paths. We have collected it at Neutral Bay, and at Waterfall, in April; and also at Milson Island, Hawkesbury River. The Neutral Bay plants, which Lloyd has seen, are gregarious, and consist of numerous, separate individuals, each with a slender stem, and several branches: whilst the Waterfall specimens, also identified by him, form plants up to $\frac{3}{4}$ inch in diameter, showing a thick, short, stem-like base, which expands into numerous dendritic branches. The spores of the former were $8{\cdot}5 \times 5{\cdot}2\text{-}7\mu$, slightly irregular; of the latter, pale brown microscopically, $10 \times 7\mu$, somewhat irregular and oval. Another collection, resembling the Neutral Bay specimens, showed shed spores purplish, oval, knobby and spicular, $8{\cdot}5 \times 7\mu$ - the bases of these plants were purplish, and the tips silvery-white; whilst, on squashing specimens, there was a seminal smell.

THELEPHORA DENTOSA Berk.—Specimens of this species, growing under native shrubs and trees (*Angophora lanceolata*) at Neutral Bay, have been identified by Lloyd, who states that the species was originally described from Cuba; and he points out that it is subincrusting, and sends up free pilei, which is peculiar among the Thelephoras. The spores are vinous, irregular, $8{\cdot}5 \times 7\mu$.

THELEPHORA TERRESTRIS Ehrenb., (*T. laciniata* Pers.).—We have met with this species, of which Lloyd has examined specimens for us, on several occasions, and *always under or close to species of Pinus*. It is unquestionably an introduced species, and seems unable to exist apart from the introduced Pines. Lloyd informs us that *T. laciniata* is a synonym. The plant is recorded, under both names, by Cooke, for Victoria. We now add New South Wales; we have seen specimens under *Pinus* at Adelaide. The plants often occupy an area of several inches in extent on the ground, or may encrust sticks or the bases of stumps. Pine-needles are often incorporated in the growth. The spores are very irregular, microscopically brownish, with a large, oval, central "nucleus," $8{\cdot}5 \times 7\mu$. Richmond, N.S.W., (August, 1912); Willoughby, Sydney (August, 1915); Randwick (W. F. Blakely; January, 1911); Cheltenham (A. A. Hamilton; February, 1911).

STEREUM CAPERATUM Berk. et M.—Specimens of this species were recorded for the Tweed River by Berkeley (Journ. Linn.

Soc., Bot., xviii., p.385, 1880), and for Daintree River (Grevillea, xi., p.29, 1882). In addition to the above localities, Massee (Journ. Linn. Soc., Bot., xxvii., p.161, 1890) records it for the Clarence River. See also Grant, in Reports Botanic Gardens, Sydney, (1902) 1903, p.9; and Cheel, (1909) 1910, p.10. In the National Herbarium, there are several very fine specimens, the largest from Mount Cooroy, Queensland, measuring, when quite fresh, $17\frac{1}{4}$ inches across; and another from Gosford, N.S.W., measuring 13 inches across, and 11 inches high, from the pad of the foot-stalk to the surface of the pileus. The foot-stalk of the various specimens is variable in length, some being almost sessile, whilst others have it up to $2\frac{1}{2}$ inches long. The tomentum on the foot-stalk, as well as on the upper surface of the pileus, is also very variable, being sometimes thickly matted, and, in other cases, very thin; the hymenium varies considerably in being more or less plicate. The following is a list of the localities and collectors:—Manning River (J. L. Boorman; October, 1902); Coff's Harbour (Forest Guard; April, 1909); Ourimbah (J. Staer; December, 1910); Wamberal (E. Cheel; April, 1911); Lilyvale (A. A Hamilton; June, 1910). From Warburton, Victoria, there are some deformed specimens, collected in April, 1907; and the Mount Cooroy, Queensland, specimens, mentioned above, were collected by J. Staer, in March, 1910. Specimens collected by one of us (J.B.C.) in June, 1916, at Lisarow, had fusiform, thick-walled cystidia, $42\text{-}50 \times 12\text{-}13{\cdot}8\mu$. Others, obtained at Bulli Pass in April, 1914, had shed spores, $8{\cdot}5\text{-}8{\cdot}8 \times 3{\cdot}5\text{-}5\mu$ in size. In many of the last two collections, the stem is nearly lateral.

STEREUM ELEGANS Fr.—In connection with this species, Lloyd states (Synopsis of the Stipitate Stereums, p.24, 1913) that it is very common in Australia. The only specimens we have seen in this State are from Gladesville (Miss Flockton: April, 1911), and Mount Kembla and Mount Jellore (E. Cheel: April, 1912). There are also some specimens from Grose Vale (Miss Campbell, No.21; September, 1912) in the National Herbarium, which seem to belong to this species, but unfortunately they are partly destroyed by the larvæ of some insects.

Stereum nitidulum Berk.—We have a collection obtained at Terrigal, in June, 1914, which Lloyd thinks is this species. The pileus was fawn-coloured when fresh, with darker zones and pale tips. The hymenium was paler. Spores pear-shaped, oblique, $5{\cdot}2 \times 3{\cdot}4\mu$. Growing on the ground..

Stereum pergamaneum Berk.—Specimens, identified as probably this species by Lloyd, were obtained at Pittwater, in April, 1914, attached to wood at the base of an old stump. The spores were pear-shaped, white, $5 \times 3{\cdot}5\mu$, with a large, central "nucleus."

Stereum hirsutum Fries.—This species was recorded for New England by Berkeley (in Journ. Linn. Soc., Bot., xiii., p.168, 1873), and for Pennant Hills, Parramatta (*l.c.*, xvi., p.40, 1878). It has also been recorded for this State by Lloyd (Letter No.19, 1908, and Letter No.60). We have numerous specimens in our collections, and have also examined those in the National Herbarium. The spores measure $5{\cdot}5\text{-}7 \times 2{\cdot}2\text{-}2{\cdot}5\mu$. The following localities are represented:—Penshurst (E. Cheel: July, 1907); Bowral (E. C.; September, 1907); Narrabeen (E. C.; May, 1908); Colo Vale (E. C.; August, 1908); East Hills (E. C.; September, 1908); Chatswood (A. A. Hamilton; August, 1908); Wiseman's Ferry (J. L Boorman; March, 1908); Cronulla Beach (A. A. Hamilton; March, 1909); Bowral (W. Greenwood; June, 1909); Pittwater (A. Maclellan; September, 1909): Lane Cove on living plant of *Casuarina* (A. A. Hamilton: August, 1909); Upper George's River (J. Staer: January, 1910); Rookwood (Miss A. Spencer; July, 1910); St. Mary's (A. A. Hamilton; August, 1910); Springwood and Leura (A. A. Hamilton; March, 1910); Lilyvale (A. A. Hamilton; June, 1910); Erina (J. Staer; May, 1910); Milson Island (J. B. Cleland; June, 1912); Kurrajong Heights; (J. B. Cleland; August, 1912); Grose Vale (Miss Campbell; September, 1912); Galston (E. Cheel; June, 1913); Hill Top (E. Cheel; April, 1914); Orange (J. B. Cleland; October, 1914); Mosman (J. B. Cleland; April, 1915); Blue Mountains (May); Mount Macedon, Victoria (E. Cheel; February, 1908).

STEREUM MEMBRANACEUM Fries, (syn., *S. papyrinum* Mont.—Lloyd).—In identifying specimens of this species for us, Lloyd says:—"It does not seem to be in Cooke's compilation, but it is a very common and wide-spread, tropical species. The hymenium is densely covered with pale (almost hyaline) setæ."

This purple-brown, usually mostly resupinate, species is very common in the Sydney district, on fallen logs and old stumps. The pileus, often ill-developed, is hairy, obscurely zoned, and greyish-brown; the hymenium rather tuberculose, and dark purplish to light purplish-brown. The cystidia are brownish, acuminate to somewhat clavate, rough, 51-120 × 8·5-10·4μ. Spores colourless, 7-8·5 × 3·5μ. On dead shrub, Long Bay, Sydney (J. B. Cleland; September, 1913); Sydney (J.B.C; various collections); Kew, North Coast (J.B.C.; October, 1915); Botanic Gardens, Sydney, on fence-rails (E Cheel; June, 1907); Penshurst, on *Melaleuca linariifolia* (E. Cheel; June, 1907); Leura (A. A. Hamilton; January, 1912); Drouin, Gippsland (C. C. Brittlebank; October, 1916).

STEREUM ILLUDENS Berk., (syn., *S. spinigerum*—Lloyd, Letter No.51, Note 155).—The type-specimens were collected by Drummond (No.158), probably in Western Australia (Hooker's London Journ. Bot., iv., p.59, 1845). It has since been recorded for Sealer's Cove, Wangaratta, Fifth Creek, and Port Darwin (Journ. Linn. Soc., Bot., xiii., p.168, 1873). Specimens, collected in this State, have also been identified by Lloyd (Letter No.60, Note 346), who states that *S. spinigerum* is a synonym based on young specimens, and adds "the hyaline, spiny cystidia (dendrophysen) are entirely different from the coloured setæ of *Hymenochæte*." This is a common species in New South Wales, with a zoned, dark brown to palish-brown pileus, with light chestnut hairs covering the ridges. The undersurface, when moist, is smooth, slightly wavy, of a peculiar purplish greyish-brown, with a paler yellowish-brown edge, when dry pale grey. The colourless cystidia are subclavate, rough with projections, 17-35 × 3·5μ, occasionally to 6μ. Spores elongated, colourless, 7-10·4 × 3·6μ. We have a fine series of specimens from the following localities:—Peakhurst (W. Buckingham: July, 1899);

Penshurst (E. Cheel; June, 1907); Colo Vale (E. Cheel; August, 1908); Leura (A. A. Hamilton and T. Steel; April, 1908); Lane Cove (A. A. Hamilton; August, 1909); Thirroul (J. B. Cleland; April, 1909; no cystidia seen); Cheltenham and Hornsby (A. A. Hamilton; May, 1910); Lilyvale (A. A. Hamilton; June, 1910); Hawkesbury River (J. B. Cleland; April, 1910); Erina (J. Staer; May, 1910); on dead wood, Milson Island (J. B. Cleland and E. Cheel; July, 1912); Grose Vale (Miss Campbell, No.25; September, 1912); on fallen log, Kurrajong Heights (J. B. Cleland; August, 1912); Hill Top (E. Cheel and J. B. Cleland; October, 1913); Wellington (J. B. Cleland; October, 1914); Hornsby, on *Pultenæa flexilis* (W. F. Blakeley; August, 1915); Kew (J. B. Cleland; October, 1915); Willoughby (A. G. Hamilton); near Adelaide (J. B. Cleland; 1898). There are also specimens in the National Herbarium, from Tasmania, collected by W. H. Archer.

STEREUM (HYMENOCHÆTE) VILLOSUM Lev., (syns., *H. phæum*, *H. spadiceum*, and *H. strigosum* of Berkeley—Lloyd. Lloyd states (Letter No.46) that this species is the analogue in the East of *S. tabacinum*.

This is a common species in the neighbourhood of Sydney, with a rich dark brown, hairy, somewhat zoned pileus, and a duller brown hymenium. The cystidia are dark brown, acuminate, 43-70 × 7-8·5μ, up to 13·5μ at the base. Hawkesbury River (J. B. Cleland; May, 1915); Tuggerah, on under side of fallen log (J.B.C.; October, 1914); Milson Island, Hawkesbury River (J.B.C.; November, 1914); Stanwell Park (J. L. Boorman; June, 1902); Lane Cove (A. A. Hamilton; August, 1909).

PENIOPHORA.

PENIOPHORA CINEREA Fries.—This species has been recorded by Cooke for Victoria. We have New South Wales specimens, growing on the bark of small, dead branches, which Lloyd suggests may be this species. Our plants form effused, pale greyish, ashy patches, about an inch in extent. The hymenium is finely tuberculated, and cracks. There are rough, somewhat club-shaped, colourless cystidia 25 × 8·5μ; and the spores are sausage-shaped, slightly curved, 7-9 × 3·5μ. Massee states that, in *P. cinerea*, the cystidia are fusoid, 30-50 × 15-20μ, and the spores are globose, 5-7μ. If these measurements be correct, then our specimens are probably a distinct species: at present, however, they are best left under *P. cinerea*.

PENIOPHORA CRUSTOSA Cooke.—Specimens found on a rotten log, at Kurrajong Heights, in August, 1914, were referred to Lloyd. He says: "*P. crustosa*(?) I judge from the description only. I have never studied it in detail. For me, however, it would be a resupinate *Stereum*, from its woody texture, close to *Stereum annosum* Berk." Our specimens form a thickish, firm, irregularly nodular, cracking crust of a pallid colour, with a faint fawn tint. The cystidia are rough, 26-29·5 × 8·5μ. Spores were not seen. Cooke records this species for New Zealand, and gives the cystidia as 50-60 × 10-15μ.

TREMELLINEÆ.

HIRNEOLA AURICULA-JUDÆ L.—Specimens, collected by Mr. Darnell-Smith, at Mount Kembla, in November, 1914, have been identified for us by C. G. Lloyd as this species. They were almost gelatinous, and very thin, about 2 inches in diameter, contracted to a stem-like lateral base, one surface smooth and convex, and pale reddish-brown, the other surface lighter and obscurely folded. Shed spores sausage-shaped, 10·5-12 × 5·2-7μ. Cooke gives the spores of *H. auricula-judæ* as 20-25 × 7-9μ. Lloyd, in his letter to us, states that, after comparing many specimens under many names, he has come to the conclusion that there are only two species of *Hirneola*, perhaps only one.

HIRNEOLA POLYTRICHA Mont.—This species has been dealt with by one of us (E.C.) in "The Australian Naturalist" (ii., p.225, 1913). We have since collected additional specimens, the spores of which are sausage-shaped, slightly curved, 16-17·5 × 6μ. These have been identified by Lloyd. We have also found it at Thirroul (J. B. Cleland; April, 1909), and growing on *Ficus rubiginosa*(?) at Narrabeen (March and July, 1916. Spores 15·5 × 6μ).

TREMELLA MESENTERICA Retz.—New South Wales plants collected by us have spherical spores, 9μ in diameter.

TREMELLA FUSIFORMIS Berk.—Plants of this species, found on a dead trunk, at Mt. Irvine, in June, 1915, have been identified by C. G. Lloyd. White, with irregular flat lobes. Spores apparently 7 × 3·4μ.

SEISMOSARCA HYDROPHORA Cooke.—Specimens have been kindly identified for us by C. G. Lloyd. Both came from the Sydney district, one from Mosman (July). Spores apparently granular, elongated, 13·5-14·5 × 7μ.

We are unable, as yet, to place several other species belonging to this family. These include (1) a pale coral-pink, tremelloid species, with sausage-shaped spores 15·5-20 × 5·2-6μ, on trunk, Bulli, May, 1914; (2) a pale yellow, frondose, jelly-like species, with spores 7-8 × 4μ, Mosman, October, 1914.

Family CLAVARIEÆ.

Cooke records for Australia, under this family, one species of *Sparassis* (N.S.W.), 41 species of *Clavaria* (11 for N.S.W.), and 6 species of *Calocera* (none for N.S.W.), the latter genus being, by some authors, placed in the *Tremellineæ*. Massee (Brit. Fungus-Flora) records for Britain one species of *Sparassis*, 10 of *Typhula*, 43 of *Clavaria*, 6 of *Pistillaria*, and 2 of *Pterula*.

CLAVARIA BOTRYTES Pers.—This species, one of the commonest of Australian Clavarias, easily recognised by its cauliflower-like appearance, and reddish-fawn or buff colour, is recorded by Cooke for all the Australian States except South Australia, in which State, however, one of us has frequently seen it. It seems to vary somewhat, both as to the degree of division of its ultimate segments, and as to its colour (from a pale fawn to a reddish or yellowish fawny-buff). Massee, in his "British Fungus-Flora," gives the spores as 8 × 5μ, but in his later work, "British Fungi and Lichens," as 12-14 × 5-6μ, whilst Cooke gives them as 12-15 × 6μ. Our specimens comprise the following:—Hawkesbury River, N.S.W., (May, 1913), plant pale yellowish, spores pear-shaped, 11 × 5·5μ; Terrigal, N.S.W. (June, 1914), reddish-fawn, spores pear-shaped, 10 × 4·5μ; Hawkesbury River, N.S.W. (June, 1912), spores 11·5-12·5 × 5·5μ; Hawkesbury River, N.S.W. (May, 1913), very pale fawn or brown, sometimes with a yellowish tint, spores 9 × 5·5μ; New South Wales, buff-coloured, spores 8·5-10·4 × 4·4μ; Mt. Lofty, S.A. (July, 1914), reddish-fawn, spores 10·4 × 5μ. Another Mt. Lofty specimen, taken at the same place on the same date, was yellowish-brown, and the spores appeared as "elongated rods, 6-10 × 2-2·5μ." A reddish-fawn specimen from the Hawkesbury River (May, 1913), with spores 10 × 4·5μ, has the ultimate ends of the branches more divided and less knobby.

Clavaria formosa Pers.—The discrepancies in the descriptions of this species, given by various authors, are rather disconcerting. Thus Massee places it amongst the Ochrosporæ, and gives the spores as ochraceous, 9 × 3-4μ; whilst the same author later (Brit. Fungi and Lichens) states that the spores are colourless, and 12-15 × 5-6μ. The coloured figure in the last-named work also differs from that given by Cooke (Aust. Fungi). Whatever be the explanation of these differences, the plants we have met with, and placed under *C. formosa*, are identical with Cooke's plate. Microscopically, the spores also show a faint ochraceous colouration, perhaps explaining why some authors consider them as colourless, and others as tinted. The spores of our specimens measure 7-9, occasionally 11, × 4-5·5μ. Hawkesbury River (May and June); Newington (June). A pale yellow form found at Newington (spores 7-8·5 × 4·2μ), close to pinkish-fawn and reddish-ochre plants, may perhaps be *C. aurea*, which was collected at Pennant Hills, Parramatta, during the Challenger Expedition. (Journ. Linn. Soc., Bot., xvi., p.38, 1877).

Clavaria rugosa Bull.(?).—The following, found on several occasions, approaches closely to *C. rugosa*, and is at present best placed under it. It differs, apparently, in the spores not being warty, in the apex often becoming yellow-brown, and in a slight, fœtid smell. Up to 1½ inches high, clubs simple or with several irregular prongs, or occasionally dividing into two near the base, apex blunt, occasionally slightly rugose but usually not so, solid, pure white or creamy-white, apex often yellow-brown, somewhat mealy. A definite, slightly fœtid smell (when kept in a bottle, a strong, rotten-cabbage smell). Spores colourless, subspherical, 7μ, 8·5 × 7μ. North Bridge, Sydney (April and June, 1916); near shady rock, Hawkesbury River (May, 1916). Specimens collected at Milson Island, in June and July, 1912, with thick-walled, colourless spores 9-11 × 7-7·5μ, appear to be the same species. Previously recorded for Wentworth Falls, by R. T. Baker (These Proceedings, 1906, 720).

Clavaria muscoides Linn.(?).—The following, beautiful little species agrees with the description of *C. muscoides*, save that the spores are smaller. Barely 1 inch high, furcate three or four times, usually unequally, ultimate segments short and blunt to subulate and blunt, orange-yellow, spores colourless, spherical, 2·8-3·5μ. Amongst moss, under *Kunzea* bushes, on clay soil, Lane Cove River, June, 1916 (D.I.C., Watercolour, No.68).

Clavaria cinerea Bull.—Baker (These Proceedings, 1906, 719): Cheel [Report Bot. Gardens, Sydney, 1910 (1911), 11]. At Neutral Bay and Mosman, Sydney, a grey Clavaria has been frequently met with. Apart from the cinereous colour, the most constant feature is the size of the spores, which are spherical to subspherical, and 9 × 7·5μ, 8·5-10·4μ, etc. Some specimens are simple, swollen, rugose clubs, several growing close together, in appearance rather resembling *C. inæqualis*: others are more slender, with a few branches near the tip like a stag's horn: still others, from a short, thick trunk, exhibit large, blunt, rugose and swollen branches; whilst still others resemble the plate in Massee's "British Fungi and Lichens," though the colour is more dingy. The colour, locality, and spore-measurements, together with gradations between specimens, all indicate that one species comprises all our specimens. Massee, in his work last quoted, supports this view when he states, that the species is very variable, and that the spores are 7-9μ in diameter. In his "British Fungus Flora," the spores are given as 5-6 × 5μ, whilst Cooke gives them as 8-10 × 5-6μ. Our specimens are sometimes hollow. Neutral Bay and Mosman (April, June, November); Gladesville (Miss Flockton; April, 1910); Leura (T. Steel; November, 1911); Rookwood (Miss Spencer; July, 1910); Cook's River (A. A. Hamilton; May, 1915).

CLAVARIA STRICTA Pers.(?)—A very graceful specimen found by Mr. Darnell-Smith, growing on wood, near Gosford, in August, 1915, may be this species. Pale ochraceous spores were not seen. The plant was orange-brownish, and showed a short stem, from which numerous, ascending, slender, subulate branches arose, which, at first, bifurcately branched several times, the ultimate branches being about an inch long. The species is recorded by Cooke for Victoria and New South Wales.

CLAVARIA CRISPULA Fries.—Pale orange plants, gathered on a fallen trunk, at Mt. Irvine, in June, 1915, agree with the description given by Cooke (Handbook of Aust. Fungi, No.1115) of this species. The spores are colourless, $7 \times 4{\cdot}2\mu$.

CLAVARIA INÆQUALIS Müll.—Australian plants, which we have met with on several different occasions, though approaching most closely to *C. inæqualis*, also resemble in some points *C. fusiformis*. They approach the former in being gregarious, and only rarely subcæspitose, and in being a rich orange; and the latter, in being hollow, and in having spherical, *smooth* spores, Massee laying considerable stress on the *warty* spores of *C. inæqualis*. Specimens collected under moist rocks, on the Hawkesbury River, in November, 1914, and again in August, 1916, may be described as follows:—Clavate, up to 2½ inches high, by ¼ inch thick, rich salmon-orange, the salmon tint becoming more evident in drying; hollow, the inside pallid salmony-whitish, the outer layer darker; sometimes bursting irregularly at the top, with yellowish tips, leaving an irregular, trumpet-like opening; spores smooth, spherical, $4\text{-}5{\cdot}8\mu$ in size; basidia with four, occasionally two, sterigmata. A faint apricot-smell. Numerous, fine specimens were collected also at Narrabeen, under moist rocks, on January 1st, 1915. There are also specimens in the National Herbarium, Sydney, collected at Berowra by Mr. A. H. S. Lucas, in July, 1914, which were of a rich salmon pink colour at first, changing to rich cream.

Clavaria rosea Fries.—At Mosman, Sydney, in June, 1915, and at Neutral Bay, in June, 1916, we came upon many specimens of a salmon-pink Clavaria. These agree with the description of *C. rosea*, save that the spores, instead of being 2 or 3μ in size, are 6 × 3·6μ. The following is the description of our specimens:—Up to 2¼ inches high, slender, somewhat flexuous, attenuated both ways from the middle, sometimes rather broadened or ribbon-like, coral-red or rosy-pink, often pruinose above, when buried amongst leaves with a whitish base, solid, flesh bright coral-red, gregarious amongst leaves under shrubs. There are also specimens in the National Herbarium from Penshurst (E. Cheel; May, 1901); Mount Victoria (A. G. Hamilton; March, 1910); Botanic Gardens, Sydney (E. Bennett; January, 1901).

Clavaria aurantia Cooke & Massee.—Specimens collected under rocks, at Neutral Bay, in June, 1916, may be described as follows:—Clavate, 1½ inches high, occasionally slightly forked at the tip, often with one or two furrows longitudinally, usually a little twisted, bright clear egg-yellow, apricot-smell when crushed [spores not seen]. We have also collected it in the same situations and place, in June, 1912, and June, 1913.

Calocera guepinioides Berk.—This species seems common on rotten wood. We have specimens from the Hawkesbury River, and from Mt. Lofty, near Adelaide. Spores 8·3-12 × 3·5-5·5μ.

Calocera cornea Fries.—Terrigal, June, 1914. Spores 8·5 × 3 5μ.

Calocera stricta Fries.—Gosford (Darnell-Smith; August, 1915).

FURTHER RESEARCHES UPON THE PROBLEMS OF THE RADIAL AND ZYGOPTERID SECTORS IN THE WINGS OF ODONATA, AND UPON THE FORMATION OF BRIDGES.

By R. J. Tillyard, M.A., B.Sc., F.L.S., F.E.S., Linnean Macleay Fellow of the Society in Zoology.

(Six Text-figures.)

My previous studies upon the problem of Dragonfly wing-venation (**2**, **3**) have conclusively shown that the sub-Order Zygoptera differs from the Anisoptera in possessing no sector to the radial trachea. The latter is straight and unbranched in the Zygoptera. The place occupied by Rs in the Anisoptera, viz., between M_2 and M_3, is filled in the Zygoptera by an additional trachea branching off from M. This I have termed the Zygopterid sector, Ms. As the imaginal wing-venation has to be interpreted by means of the precedent tracheation of the larval wing-sheath, I have logically applied the same terms to the venation.

Now, in a former paper (**2**), I indicated one genus, *Neosticta*, which might possibly prove an exception to the above rule. In the wings taken from a larva of this genus, I thought that I could distinguish a true trachea Rs. The pigmentation of the wing-sheath, however, was so dense, and the specimen so far advanced towards metamorphosis, that the decision had to be held in suspense, pending the discovery of more material. Since that time, I have carefully examined a large number of larval wings of genera belonging to all three Zygopterid families (*Calopterygidæ*, *Lestidæ*, and *Agrionidæ*) without discovering a single exception to the rule stated above, viz., that R is unbranched in Zygoptera. Thus it became more than ever important that the doubt concerning *Neosticta* should be cleared up.

Unfortunately, *Neosticta* is a rare genus, the larvæ being only obtainable from one locality, Heathcote, twenty-one miles south of Sydney. These larvæ are rock-dwellers, somewhat resembling those of *Diphlebia*, but much smaller, and possessing two-jointed caudal gills. They live in the deep pools of clear cold water in Heathcote Creek and the Woronora River, and are only to be got by hauling rocks out of these recesses.

Thanks to the kindness and energy of Mr. F. W. Carpenter, M.A., Science Master at Sydney Grammar School, I was enabled to obtain, in August last, five well-grown larvæ of *Neosticta canescens* from Heathcote. Four of these were in excellent condition for study, having only recently entered the last larval instar. The fifth was more advanced, being, in point of fact, at almost exactly the same stage as the one previously examined.

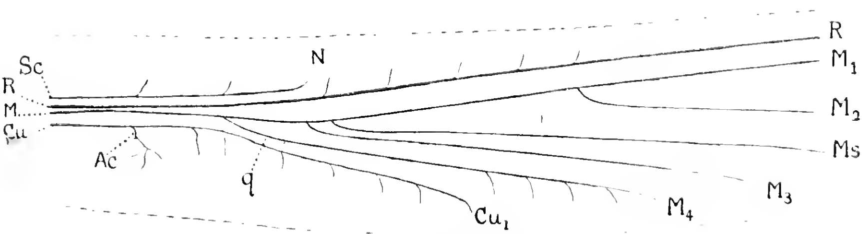
A preliminary examination of one of the cut-off wings of this last larva showed that it closely resembled the one studied and figured in my previous paper (**2**, Pl. xiii., fig.4). The pigmentation was very dense, and there was the same appearance of Rs descending from R as before. However, when this condition was studied under strong transmitted light, it was at once seen to be due to the cuticularisation of the wing-sheath, already noticed by me in the case of *Diphlebia* (**3**, p.227). There was no sign of the presence of a trachea Rs at all.

Turning then to the less advanced larvæ, it was an agreeable surprise to find that the dissected-off wings were moderately transparent, so that the tracheation could be easily followed out in detail. All four wings of each of the four larvæ were carefully studied. Of the sixteen, fourteen agreed exactly with the results obtained for all other *Agrionidæ*, viz., R is simple and unbranched, and Ms arises from the main stem of M between M_2 and M_3. The other two wings (one being a right forewing, the other a right hindwing) showed a peculiar aberration, the origin of M_3 having become shifted on to Ms near its base. This peculiarity at once struck me as being of the utmost importance as evidence of the true nature of bridges and oblique veins, and will be dealt with fully later on in this paper. The normal tracheation is shown in Text-fig.1, the aberration in Text-fig.4.

Having thus satisfied ourselves that *Neosticta* is in line with all other Zygoptera in possessing an unbranched radius and a Zygopterid sector, Ms, arising from M or one of its branches, let us now review the whole question at issue. This is a very fundamental one, and may be put as follows :—

Is the Zygopterid sector, Ms, homologous with the Radial Sector, Rs, of Anisoptera, or merely analogous with it?

In a previous paper (**3**), I contended that the two were not homologous. No rebuttal of the evidence there adduced has appeared in print; but I have received numerous criticisms,



Text-fig.1.
Normal tracheation of larval wing of *Neosticta canescens* Tillyard.

ranging from a complete acceptance of my views (Dr. F. Ris), down to an absolute unwillingness to agree with them, in spite of the evidence I have selected Dr. P. P. Calvert's criticism as a very fair statement of the case in favour of the homology between Rs and Ms. He writes as follows :—

"If M_1, M_2, M_3, and M_4 are homologous in Zygoptera and Anisoptera, as you say on p.224 (**3**), is there not something *more than the analogy* between the Anisopteran Rs and the Zygopteran Ms which you recognise on the same page? If Zygoptera and Anisoptera had a common origin, must not Ms and Rs have come from one and the same primitive trachea? If this be the case, then the distinction between Ms and Rs is really not such a fundamental one after all. If, on the other hand, Anisoptera and Zygoptera had not a common ancestry, then the apparent homologies of the other tracheæ are only the result of convergence (a position I can't admit). and Rs and Ms are really quite different things. I should be glad to have your explanation of these difficulties (as they seem to me)."

Now this is a very lucid statement of the case, and one with which I must confess great sympathy. Like Dr. Calvert, I could not for a moment admit that Anisoptera and Zygoptera had no common ancestry, though I would hold, perhaps, that the cleavage between them is greater, and that the common ancestry lies further back in geological time, than Dr. Calvert may be prepared to grant. For this reason, I felt that the researches which I had carried out could not be left in their present state. Having satisfied myself that *Neosticta* (the only doubtful genus) falls into line with all the rest, I was spurred on, by Dr. Calvert's very reasonable statement of the case, to investigate the whole problem as fully as possible, so as to review the whole evidence, and to come to some definite conclusion.

In order to delimit the problem, let me state clearly at the start that, as far as I can see it, we have actually two cognate problems to deal with. The first of these concerns the relationship between *trachea* Rs and *trachea* Ms, the second that between *vein* Rs and *vein* Ms. As we shall see in the sequel, these two problems may very well lead to different results.

Leaving aside altogether the question of palæontological evidence, which cannot be admitted into this problem satisfactorily, owing to the complete absence of the tracheational interpretation of fossil vein-formations, I have classed the available evidence under three main headings :—

(1) *The structural evidence.* By this I mean the evidence obtained from a study of the wing-tracheation of the last larval instar, and the interpretation of the corresponding imaginal wing-venation.

(2) *The ontogenetic evidence.* This is the evidence obtained from the tracheation of the wings of the developing larva, from the earliest examinable stage up to the last instar.

(3) *The evidence from Bridges and Oblique Veins.* The connection of these structures with the problem in hand is not, per-

haps, at first evident. Actually, they assume a position of immense importance, and must be fully dealt with if the problem is to be solved.

I propose now to take these three kinds of evidence in full, and to draw definite conclusions from them.

1. *The Structural Evidence.* (Text-figs.1, 3).

We may best marshall this by gathering together all the results of wing-tracheational studies by different students of the Order, and arranging them in tabular form. I have before me the published results of Professor Needham (**1**) and myself (**2**, **3**), together with the beautiful series of photographs taken by Dr. Ris from the larvæ of *Libellula*, *Calopteryx* (**3**, Plate xxxiv.), and *Ischnura*. No doubt other students have examined other genera; but, as their statements have not been published, they cannot be here included.

The point to notice is that the evidence is, *without a single exception*, in favour of the view that *trachea Rs in Anisoptera is not homologous with trachea Ms in Zygoptera*. It follows also that, if the veins Rs and Ms in the imaginal wing are laid down in their entirety upon the previously existing tracheæ Rs and Ms respectively, then *vein Rs in Anisoptera is not homologous with vein Ms in Zygoptera*. This second conclusion must not, however, be accepted without a fuller examination of the interplay of tracheational and venational developmental forces, which are discussed later on, on p.879.

The following table exhibits the results obtained :—

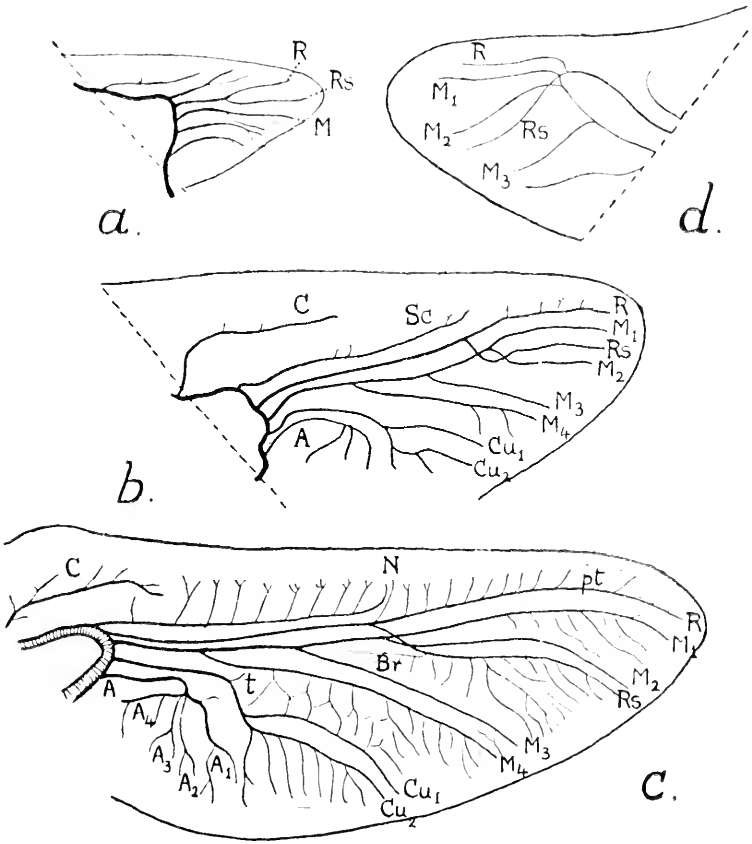
TABLE OF GENERA EXAMINED FOR WING-TRACHEATION.

(N = Needham, R = Ris, T = Tillyard.)

ZYGOPTERA.	ANISOPTERA.
R simple and unbranched. An extra trachea, the Zygopterid Sector Ms, developed from M between M_2 and M_3.	R once branched, the branch being the Radial Sector Rs, which crosses M_1 and M_2, so as to come to lie between M_2 and M_3.
Families CALOPTERYGIDÆ and AGRIONIDÆ.	Family ÆSCHNIDÆ.
Ms arises from the main stem of M.	*Gomphus* * (N)
* *Diphlebia* (T)	*Lanthus* (N)
* *Calopteryx* (R)	*Austrogomphus* (T)
Neosticta (T)	*Hemigomphus* (T)
Isosticta (T)	*Cordulegaster* (N)
* *Argiolestes* (T)	*Dendroaeschna* (T)
* *Ischnura* (R and T)	* *Æschna* (T)
* *Caliagrion* (T)	*Anax* (N and T)
Austroagrion (T)	
Family LESTIDÆ.	Family LIBELLULIDÆ.
Ms arises from M_2 near its base.	* *Synthemis* (T)
* *Synlestes* (T)	*Didymops* (N)
Lestes (N)	*Austrocordulia* (T)
* *Austrolestes* (T)	*Cordulephya* (T)
	* *Hemicordulia* (T)
	* *Libellula* (N and R)
	Orthetrum (T)
	Diplacodes (T)
Total genera examined : 11.	Total genera examined : 16.

2. *The Ontogenetic Evidence.* (Text-fig.2).

In the table given above, the genera marked * are those in which more than one larval instar has been examined. In the Zygoptera, it has not been possible to examine more than the *four* last larval instars (which I have done in *Austrolestes*), owing to the delicacy of the tracheæ. *In the earliest examinable stage*, R is simple and unbranched in Zygoptera, and remains so up to the last larval instar. Very different is the case with the Anisoptera, in which Needham (1, Fig.1) has shown that, at the earliest examinable stage, R is strongly and definitely branched (Text-fig.2,*a*). At a later stage (the exact instar is not noted,



Text-fig.2.—Ontogenetic stages in the development of the larval wing-tracheation in Odonata. *a*, *Gomphus*, very early stage, 1 mm. wing; *b*, *Gomphus*, later stage, 3 mm. wing, Rs between M_1 and M_2; *c*, *Gomphus*, last larval stage, Rs across M_1 and M_2, and bridge (*Br*) indicated; *d*, *Libellula*, very early stage, 0·8 mm. wing, Rs already across M_1 and M_2. *a-c*, after Needham; *d*, drawn from a photomicrograph taken by Dr. F. Ris.

but it would appear to be the last but three), Needham shows Rs thrown over M_{1-2} just before it divides into M_1 and M_2, and then crossing M_2 again so as to lie between M_1 and M_2 (Text-fig. 2, *b*). At the latest stage (Text-fig. 2, *c*), Rs is thrown across both M_1 and M_2, so as to lie between M_2 and M_3.

Dr. Ris has photographed (Text-fig. 2, *d*) the triangular wing-bud in a very early stage of *Libellula* (this would appear to be one instar earlier than Needham's earliest stage, since the wing is only 0·8 mm. long, and definitely more triangular in shape than Needham's wing of *Gomphus*, which was 1 mm. long). This shows Rs already crossing both M_1 and M_2! I find the same result in the earliest stages of *Hemicordulia*. But we must remember that the *Libellulidæ* are far more specialised than *Gomphus*. The latter (if Needham's observations are correct, and I see no reason to doubt them) has preserved the ontogenetic stages in detail; the former reaches the final condition of Rs while the wing is yet very small.

We see, then, that the ontogenetic evidence supports the structural evidence, but with greater force. *How can a trachea which, in the earliest examinable larval stage of Anisoptera, is a branch of R not even crossing M at all, and which only reaches its final position (in Gomphus) by two successive changes, be homologous with the branch of M which is present in a fixed position (between M_2 and M_3) in Zygoptera from the earliest examinable stage!* One must either accept the proof as definitely against the homology, or deny one's belief altogether in the Biogenetic Law.

We must conclude then, both on the structural and on the ontogenetic evidence, that *trachea Rs of Anisoptera is not homologous with trachea Ms of Zygoptera.*

3. *The Evidence from Bridges and Oblique Veins.*

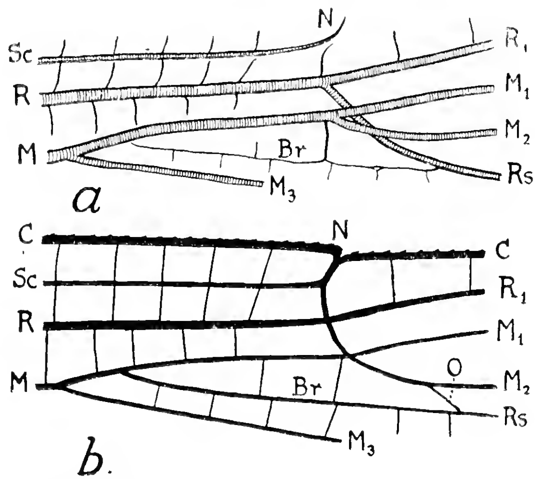
We have now to approach very cautiously the crux of the whole problem, viz., whether we have been correct in maintaining that the imaginal veins Ms and Rs are wholly laid down upon the preceding tracheæ Ms and Rs respectively, or whether they may not have, in special cases, a more composite origin.

Thus we have to deal with a question that is even more fundamental than the point immediately at issue, viz., the interaction of the two great forces whose interplay has moulded the Odonate wing from the very start. These are, the force of *tracheational* *development*, which is mainly concerned, throughout larval life, with supplying each cell of the developing wing with sufficient oxygen, and the force of *venational development*, which is concerned only with the final production, at metamorphosis, of an imaginal wing-plan best suited to withstand the strains and stresses of flight. Both these forces, in the evolutionary scheme, aim at perfection. But, as they are at any rate to some extent antagonistic the final result must be a compromise. This compromise is best seen, in the imaginal venation, in the formation of *bridges and oblique veins*—structures which, we may well believe, are not wanted at all to ensure perfection of flight, but which have been forced upon the imaginal pattern owing to the trend of tracheational development. On the one hand, the tracheational scheme appears early in the developing larval wing; one might almost imagine that the forces controlling it must have had everything their own way, and that the imaginal pattern, when first laid down in the wing of the last larval instar, must be absolutely dependent upon it. On the other hand, in spite of the long start gained by the tracheational forces, can we doubt that it is the imaginal wing-plan which must be aimed at all along? For, if this be not attained successfully, the type would be weak in flight, and would soon die out.

It is just here that we have to study intensely the problem of bridges and oblique veins. Professor Needham's now famous discovery and explanation of the bridge-veins in Odonata is well-known, but needs to be shortly summarised. In the Anisoptera, the bridge is, according to him, a "brace evolved out of the boundaries of ordinary cells," in order to "correct the mechanical weakness of the unilateral fork" (**1**, p.755), (*i.e.*, the fork represented in the imaginal venation by the point of departure of Rs from M_2 at O). Text-fig.3 will explain Needham's view of the formation of the bridge.

In Needham's view, also, the bridge is a "trunk *secondarily developed* to connect the radial sector with vein M_{1-2}." (**1**, p.711).

I think that all students of Odonata, including myself, have, up to the present time, accepted these statements without question. My views, however, have now undergone a change, owing to the fact that I have recently seen a bridge formed in the Odonata, as it were under my very eyes, and the process does not agree with Needham's dictum. I refer to the aberrant condition which I discovered in *Neosticta*, and which is figured in

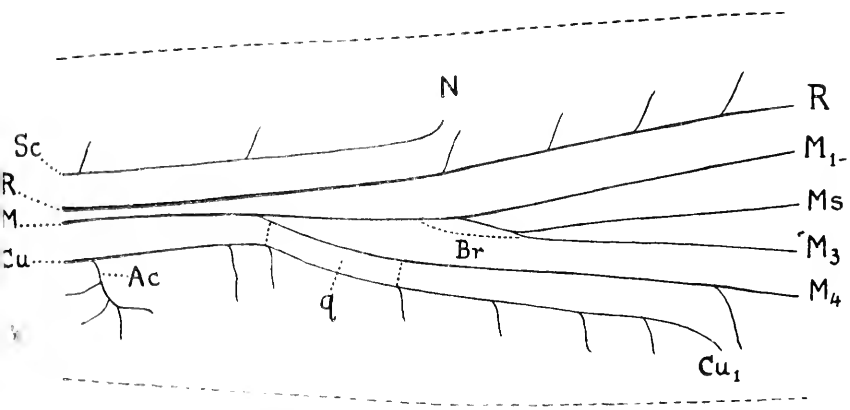


Text-fig. 3.—Formation of bridge (*Br*) and oblique vein (O) in Anisoptera (*Libellulidæ*). *a*, Tracheation of wing at last larval instar. *b*, Corresponding imaginal venation.

Text-fig. 4. Here is the case of a genus in which, apart from its extreme reduction, the venational plan is simple and primitive. Ordinarily, no bridge is present. Owing to the extreme narrowness of the wing, *M_3 lies for most of its length very close under Ms.* In the aberration, M_3 becomes hitched on to Ms, not gradually, by progression distad along M towards Ms, but *per saltum.* And *the imaginal wing-venation keeps its original position, in the form of the bridge (br), clearly visible as a pigment band.*

Searching through a long series of imagines of *Neosticta*, I am able to find two wings which have clearly been derived from this aberrant tracheal condition. In both, the change in the position of M_3 basally is betrayed by the shortening and slight obliquity of the cross-vein usually in this position. The cross-vein has, in fact, become *an oblique vein*, and the proximal part of M_3 has become a *bridge*.*

Now, with this example of how a bridge may be formed fortuitously before us, we must ask ourselves whether Needham was right in determining the bridge-vein as a secondary formation.



Text-fig. 4.—Aberrant tracheation of larval wing of *Neosticta canescens* Tillyard. M_3 has been captured *per saltum* by Ms. Original course of basal part of M_3 persists in the imaginal venation as a bridge (*Br*).

Is it not more rational, after all, to see in the bridge-vein *the original basal part of a main vein*, while the oblique vein is the sign that *the tracheation has become specialised.* Let us examine the two well-known cases of Bridge-formation in Odonata in this new light:—

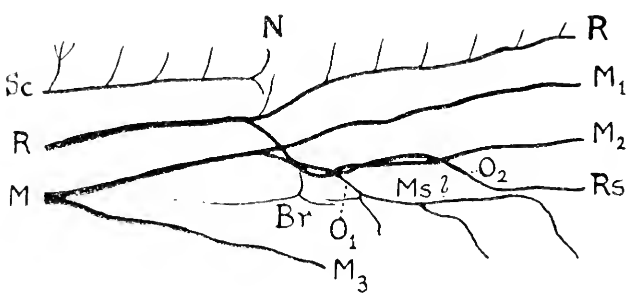
(*a*) *The long bridge of Lestidæ.* If this new view be correct, the *Lestidæ* must be derived from ancestors in which M_2, Ms, M_3, and M_4 all came off separately from M. Owing, however, to progressive narrowing of the wing, Ms must have come to lie close under M_2 at a point near its base. Finally, trachea M_2

* It should be carefully noted that this aberration has nothing to do with the long bridge of *Lestidæ*, which is caused by Ms becoming attached to M_2.

must have *captured* trachea Ms *per saltum* just in the same way that trachea Ms has captured trachea M_3 in the *Neosticta* aberration, *leaving the original basal portion of vein Ms existing as the long bridge*, while the new base of Ms became the *oblique vein*.

The fact that, in *Synlestes*, the oblique vein cannot always be determined, is evidence in favour of this view. If a large number of larvæ were to be examined, may not some of them still possess the *original* tracheation in one or more wings? The imaginal venation from such a wing would lack the oblique vein.

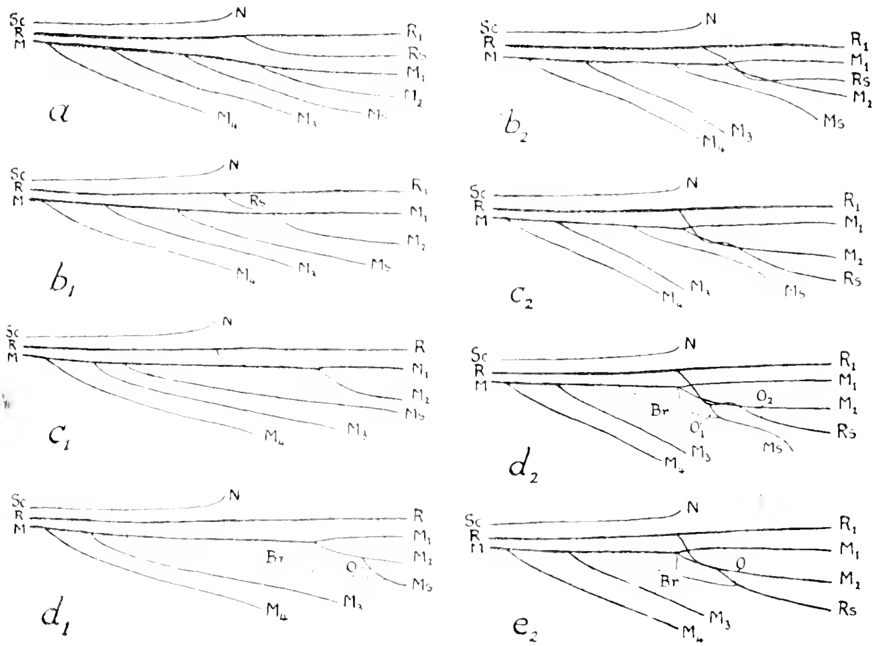
It becomes necessary, also, on this new view, to examine the earliest wing-buds of the *Lestidæ*, with a view to determining the *original* position of trachea Ms with respect to M, as shown by the ontogenetic evidence. Such an examination I hope to carry out later on.



Text-fig.5.—Formation of the two oblique veins (O_1, O_2) in *Cordulegaster*. Ms?, the trachea which, it is suggested, was originally Ms, and has been captured *per saltum* by Rs. Adapted from Needham.

(*b*) *The bridge of Anisoptera.* In this case, any question of Rs having become hitched to M_2 *per saltum* cannot be entertained, owing to the fact that the ontogenetic evidence is absolutely against it. We must either accept Needham's view of this bridge as correct—*i.e.*, it is secondarily formed to strengthen the unilateral fork—or we must seek for some other explanation.

It is well known that, in the subfamilies *Cordulegastrinæ* and *Petalurinæ* (the two most archaic subfamilies of the Anisoptera), there are *two oblique veins* present (Text-fig.5, O_1, O_2). This is due to the fact that trachea Rs in these forms is itself branched. Now, unfortunately, we do not know the ontogeny of the larval wing in these subfamilies. The suggestion I would make is that, in these archaic forms, we have trachea Rs and trachea



Text-fig.6. Suggested phylogeny of the Odonate wing in the region of radius, media, and branches. *a*, archaic ancestor of Zygoptera and Anisoptera; b_1-d_1, phylogeny of Zygoptera; b_1, reduction of Rs; c_1, loss of Rs = *Megapodagrionine* stage; d_1, capture of Ms *per saltum* by M_2 = *Lestid* stage (original course of vein Ms preserved as the bridge *Br* in the imaginal venation); b_2-e_2, phylogeny of Anisoptera; b_2, Rs crosses M_1 (*cf.* Text-fig.2*b*); c_2, Rs crosses M_1 and M_2; d_2, Rs captures Ms *per saltum* (*cf.* Text-fig.5); e_2, Ms suppressed (the original course of vein Ms preserved as the bridge *Br* in imaginal venation).

Ms both present, and that, in the last larval instar, the latter trachea becomes hitched on to Rs, just as M_3 became hitched on to Ms in the *Neosticta* aberration. In that case, the whole bridge, from its origin basally on M up to the second oblique vein O_2, represents, in the venation, the original Zygopterid sector Ms, with the oblique vein O_1 standing upon it to mark the point where trachea Ms has been captured by trachea Rs. The vein continuing the bridge is the true Rs, of which also O_2 must be an essential part.

The above explanation, as it seems to me, offers the only solution possible in favour of a *partial* homology between veins Ms and Rs, as now present in the wings of Odonata. Text-fig.6 would show, on this supposition, the two lines of development leading to Zygoptera and Anisoptera respectively. For the common ancestor, we should have to postulate a form possessing both a true Rs and a true Ms (Text-fig.6,*a*). From this, the Zygoptera would be derived by reduction, Rs being entirely eliminated.* The Anisoptera, on the other hand, would be derived from the ancestral form viâ the *Petalura-Cordulegaster* stage, trachea Ms being first of all captured by Rs, as in these forms, and then entirely eliminated; while, in the imagines, the short Anisopterid bridge would remain as the *true vein Ms*, and therefore *homologous with* the long bridge of *Lestidæ*, and also with the basal part of Ms in the *Calopterygidæ* and *Agrionidæ*.

This might be exhibited as follows:—

Trachea or Vein.	Zygoptera.		Anisoptera.	
	Calopterygidæ + *Agrionidæ*.	*Lestidæ*.	*Petalurinæ* + *Cordulegastrinæ*.	Other subfamilies.
Trachea Ms	present, attached to M	present, captured by M_2	present, captured by Rs	absent
Trachea Rs	absent	absent	present	present
Vein Ms ...	present in full	present in full (basal portion = long bridge)	present (= bridge)	present (= bridge)
Vein Rs ...	absent*	absent*	present, from O_2 to wing-margin	present, from O to wing-margin

The new view of Bridge-formation, embodied in the above

* Unless, indeed, the subnodal vein itself be the remains of Rs.

discussion and table, may be briefly contrasted with the older (Needham's) view as follows:—

(1) *Needham's view:*—When the fusion or crossing of two main tracheæ causes the formation of a unilateral fork, preceded by a weak area not possessing a main trachea, this weak area and the fork are secondarily strengthened, in the imaginal venation only, by the backward development of a strong vein called a bridge. The base of the unilateral fork persists as the oblique vein.

(2) *The new view:*—When the fusion or crossing of two main tracheæ causes the formation of a unilateral fork, preceded by a weak area not possessing a main trachea, the imaginal venation does not follow this specialisation in the tracheal system, but adheres to the older and more advantageous venational plan. Thus, the imaginal vein originally present *persists as a bridge* along that part of the wing now devoid of a main trachea. The point of attachment of the shifted trachea is represented in the venation by the oblique vein.

The principal argument in favour of the new view seems to me to be this:—If we take any specialised Odonate wing, in which an oblique vein is present, and replace the oblique vein by an ordinary cross-vein, then the venation will be seen to resemble what is admitted to be the most archaic venational plan for the sub-order. For instance, if we cut out the oblique vein from *Lestes* or *Synlestes*, the arrangement of R, M and branches at once becomes similar to that of the archaic *Megapodagrioninæ*, in which no oblique vein or bridge has ever been developed. We may well ask, how is it that there is a bridge developed in this position in every form where tracheational specialisation has set in? If Needham's view be correct, then there must have been a period in the evolution of the wing-venation (before the bridge became fully formed) in which the place of the bridge was taken by the irregular boundaries of polygonal cells from which the bridge is supposed to have arisen. Can anyone maintain that such a weakened imaginal form would have been able to hold its own during the evolution of the bridge? Or, if it is argued that the bridge was formed link by link, as the trachea moved distad, then the answer is that, in *Neosticta*, we see a bridge formed *per saltum*, and there is no evidence that the trachea did move distad gradually. The effort required to construct evolutionally such an immensely long bridge as that of the *Lestidæ* in this fashion is almost inconceivable. Moreover, as a support to the unilateral fork at O, it is absurdly misplaced. One would have expected it to run back to M about half-way between Ms and M_3, if such were the object of its development.

Further, it should be noted that, in other Orders, the formation of an oblique vein through tracheational specialisation does not involve the formation of a bridge. Thus, in the forewing of the *Myrmeleontidæ* (**4**), the vein M_2 comes off from M_1 by means of an oblique vein, but it is continued basad by Cu_1, and not by a bridge-vein. In the Odonata, if the bridge-vein be Ms, and not a new development, the position is an analogous one.

Here I must leave this fascinating line of inquiry, for which much more evidence would need to be brought forward before it could be regarded as fully established. As regards the main argument, concerning the supposed homology between Ms and Rs, the position may be summed up as follows:—

1. Trachea Ms is *not* the homologue of trachea Rs. On this both the structural and ontogenetic evidence are overwhelming.

2. If we interpret the main veins solely from their underlying main tracheæ, it follows that vein Ms is *not* the homologue of vein Rs.

3. If, however, we allow that the venation may retain the archaic plan, while the corresponding tracheation becomes specialised, then we must alter our view of the significance of bridges and oblique veins. In that case, the long bridge of *Lestidæ* may reasonably be regarded as the original vein Ms. In the case of the Anisoptera, the bridge may also represent Ms, while the vein continuing it beyond O is undoubtedly Rs. Thus, the *basal portions* of the veins now called Ms and Rs respectively would be true homologues; the distal portions (beyond the oblique vein, when it is present) are never homologous.

Thus we see that, *under no circumstances can we prove veins Ms and Rs to be complete homologues.* And, until further evidence can be brought forward in support of statement No.3 above, it would seem advisable to retain the notations Ms for Zygoptera and Rs for Anisoptera in their entirety.

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[Printed off 4th April 1917.]

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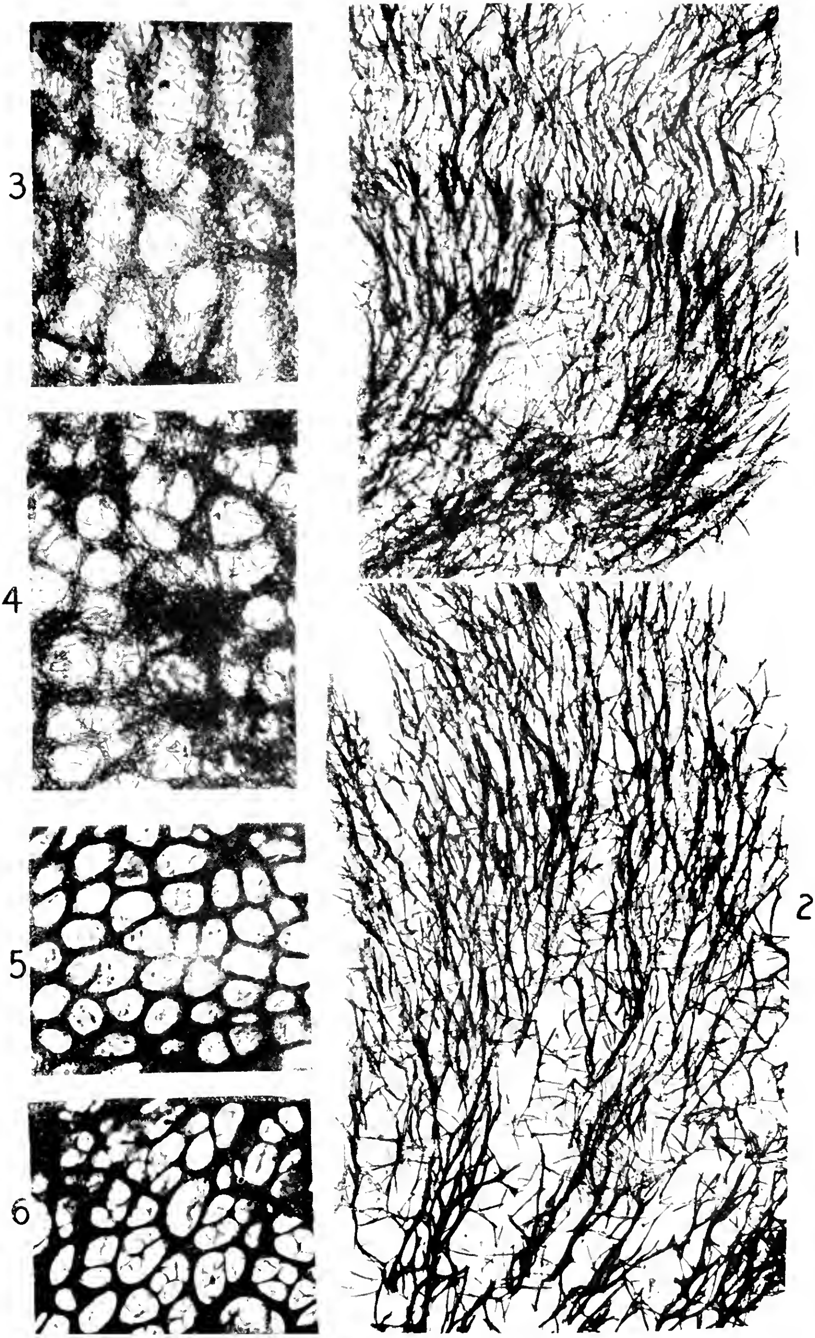
(*a*) GENERAL INDEX.

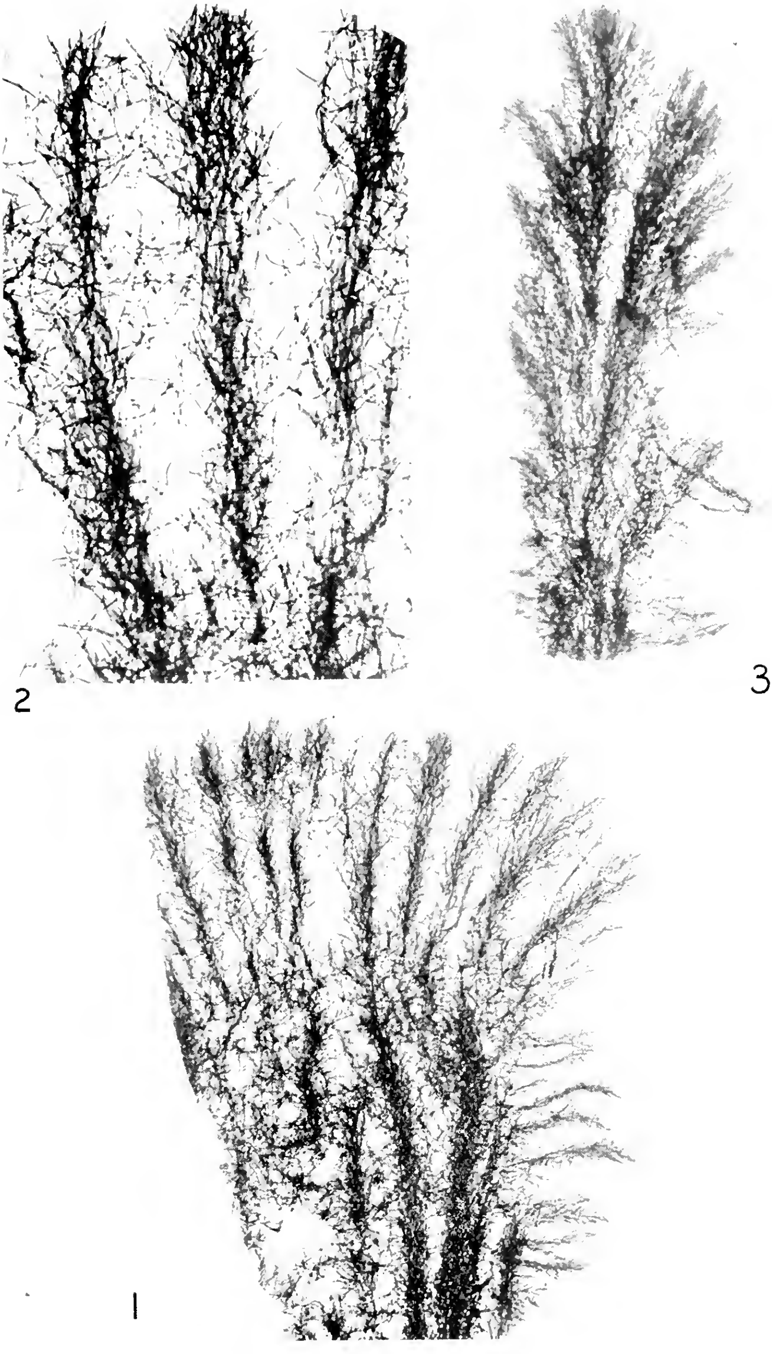
(b) BIOLOGICAL INDEX.

Names in italics are synonyms.

[Printed off, April 3rd, 1917.]



1-4. *Higginsia.* 5-6. *Allantophora.*



1-3. *Higginsia coralloides* var. *scabra.*

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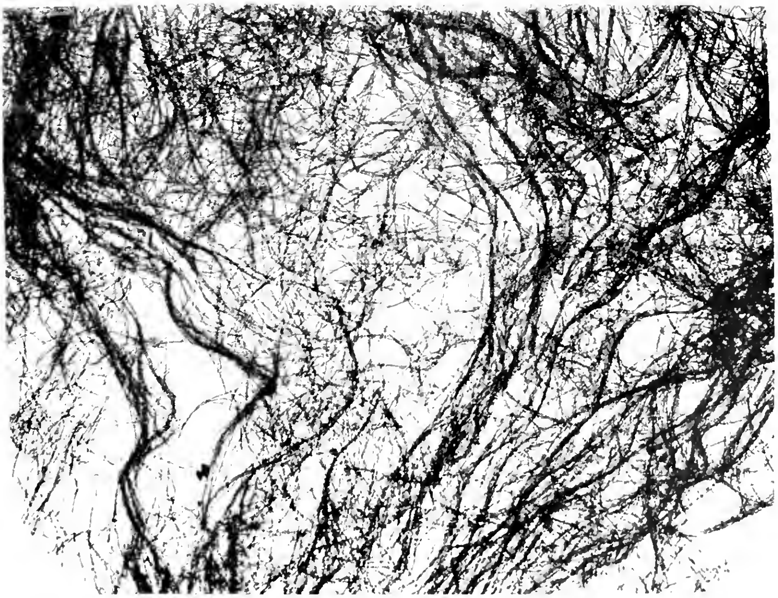
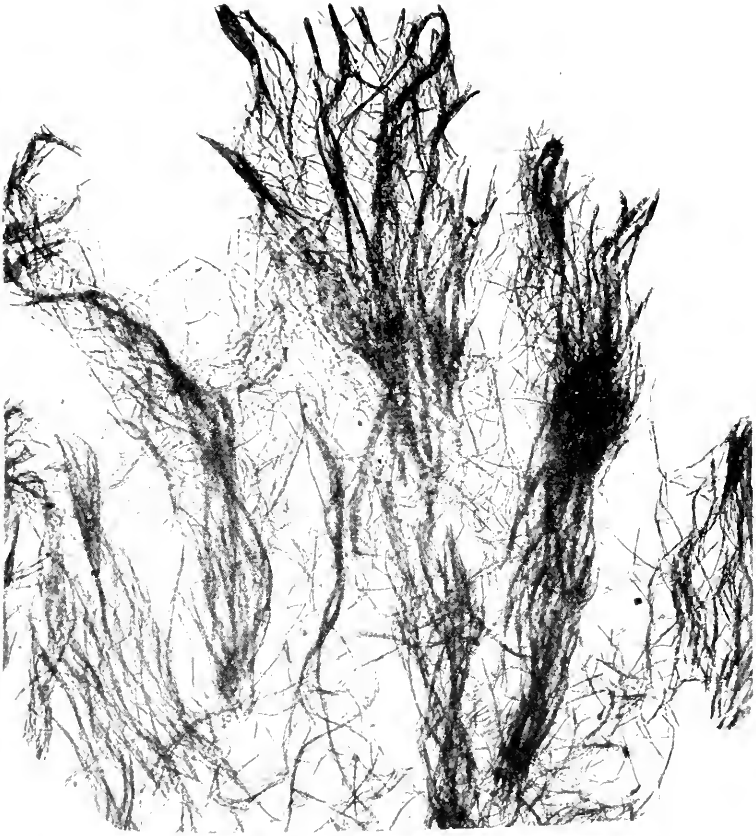
2


1-2. *Rhaphoxya typica*, n. sp.

1



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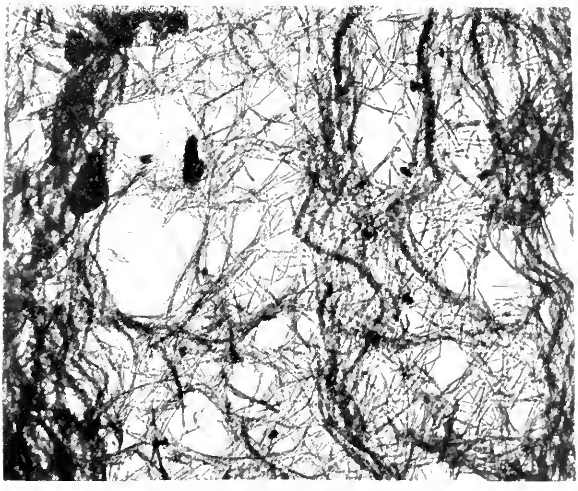
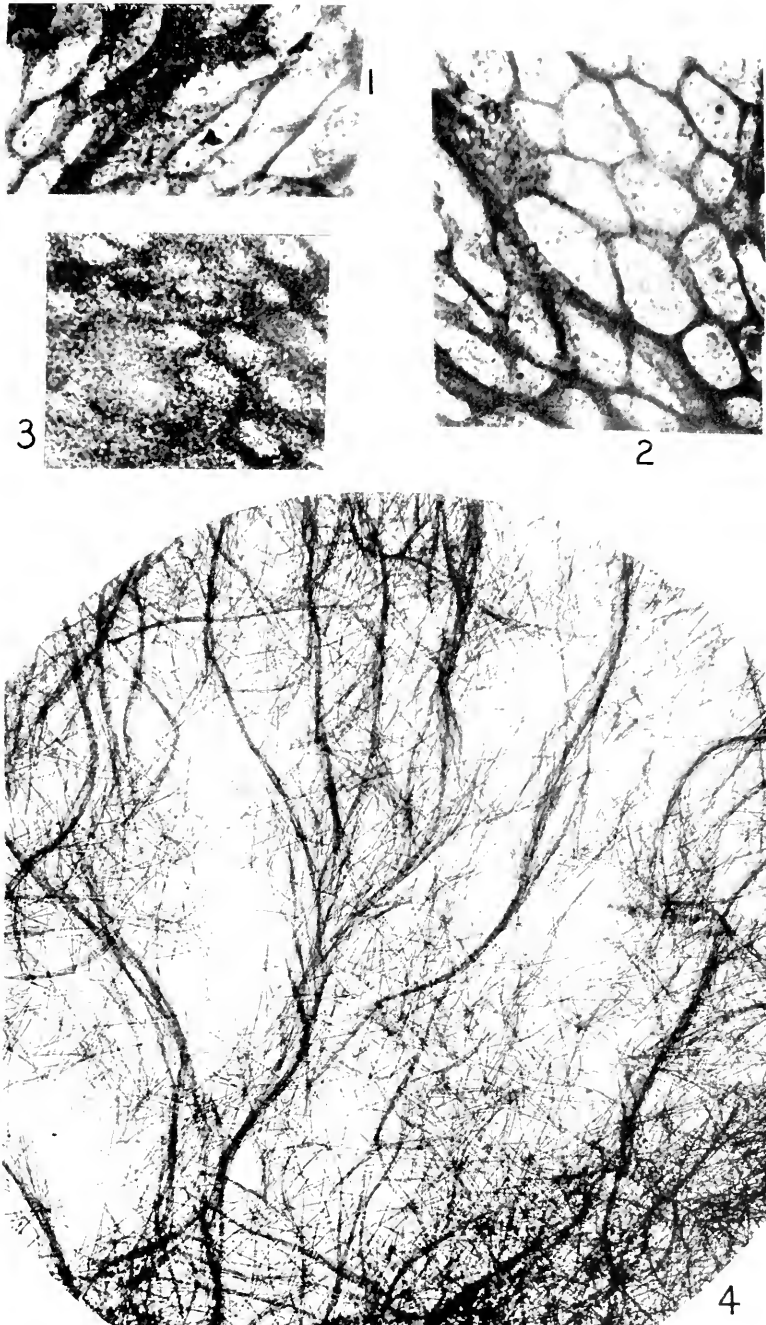
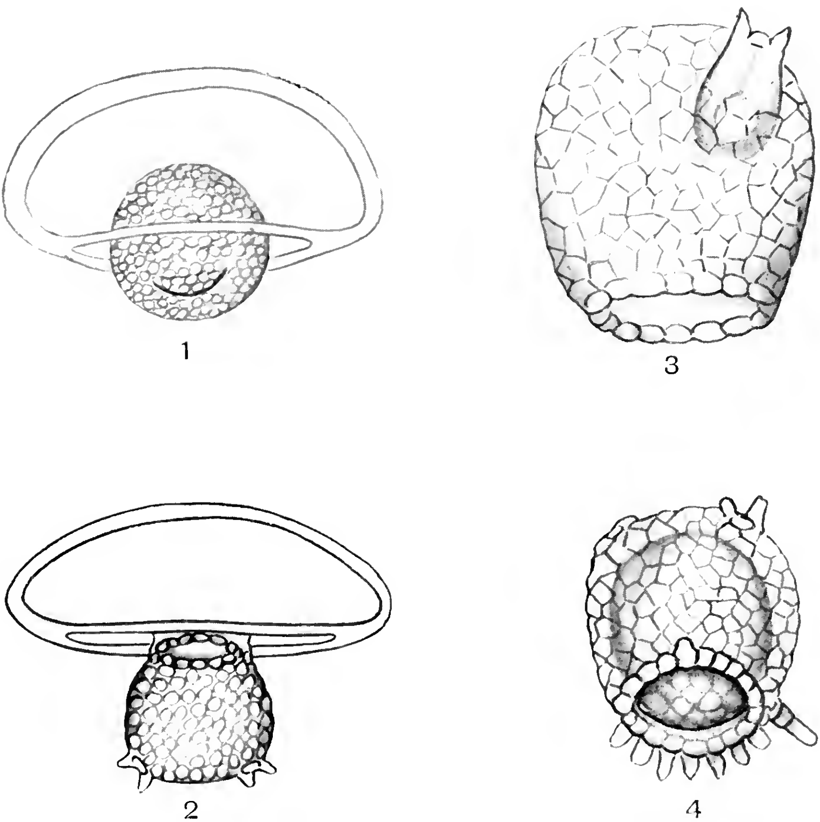


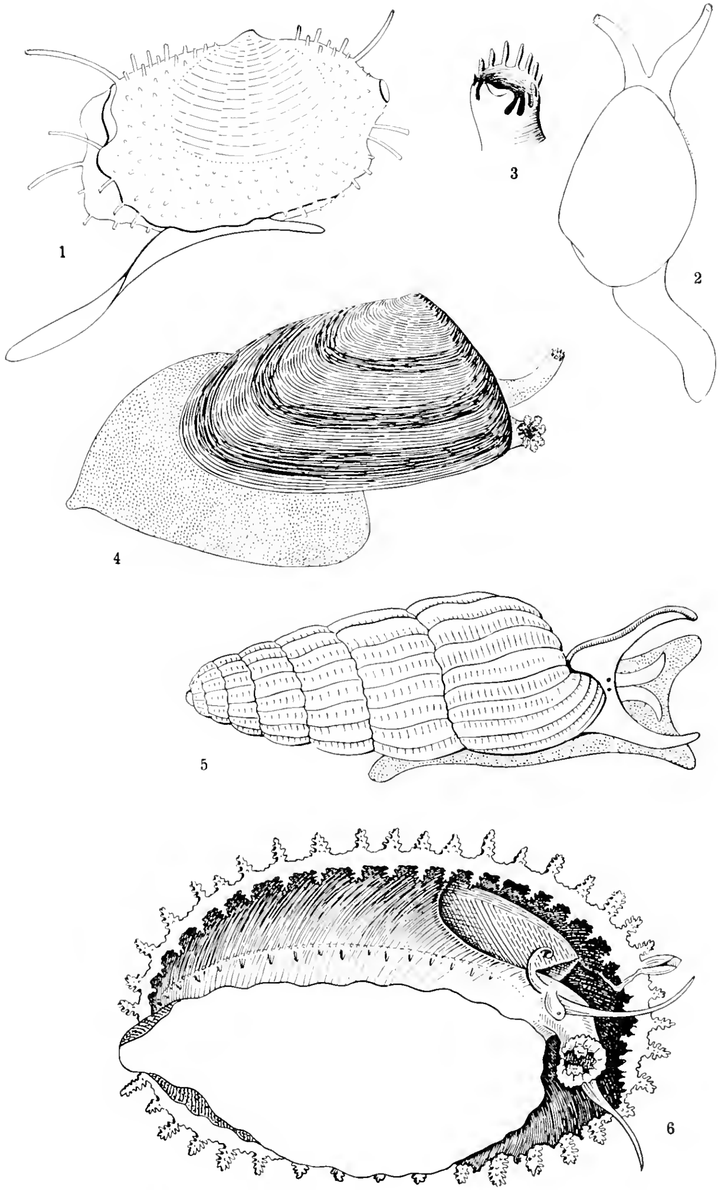
1-2. *Rhaphoxya (?) pallida* Dendy.



1-2. *Rhaphoxya typica*, n.sp. 3. *R.* (?) *pallida* Dendy. 4. *Desmoxya lunata* Cart.



Gametophytes (male, female) &c. of *Psilotum triquetrum*.



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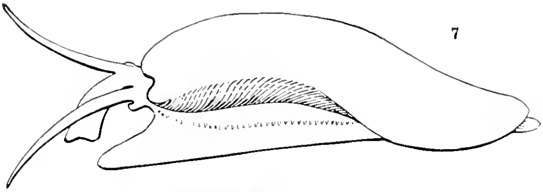

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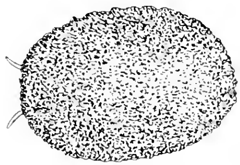

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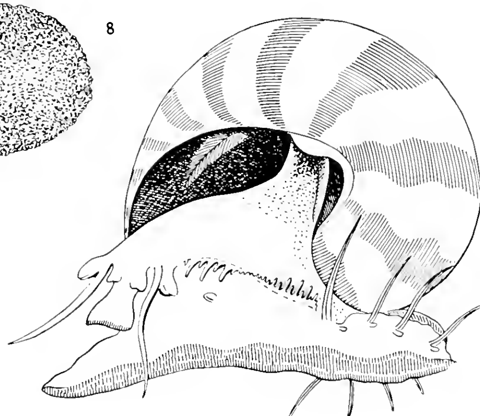

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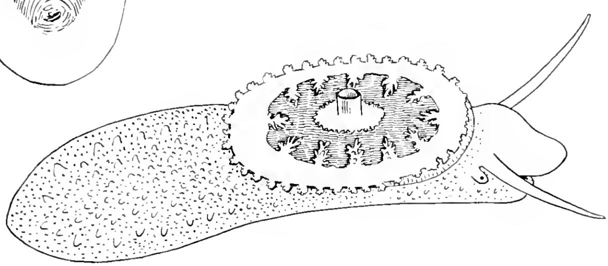

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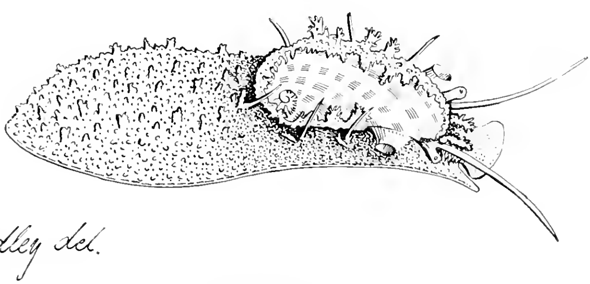

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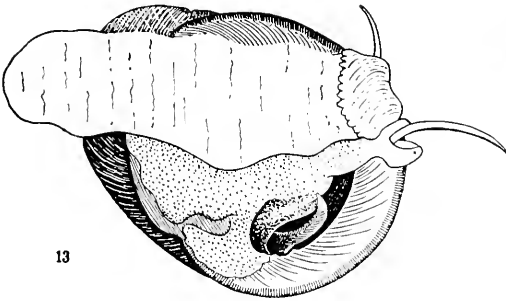

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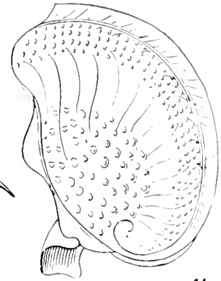

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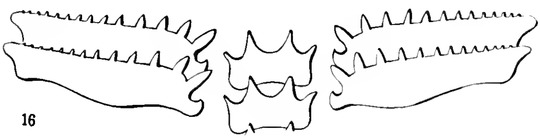

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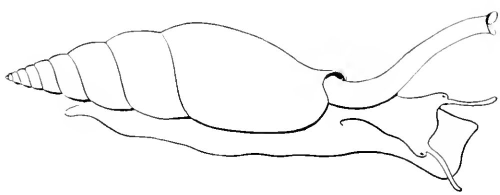

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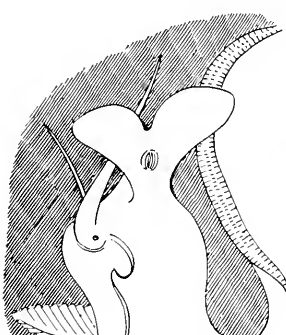

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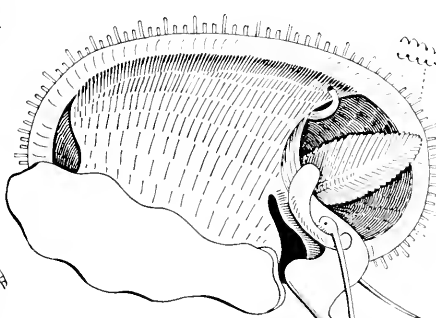

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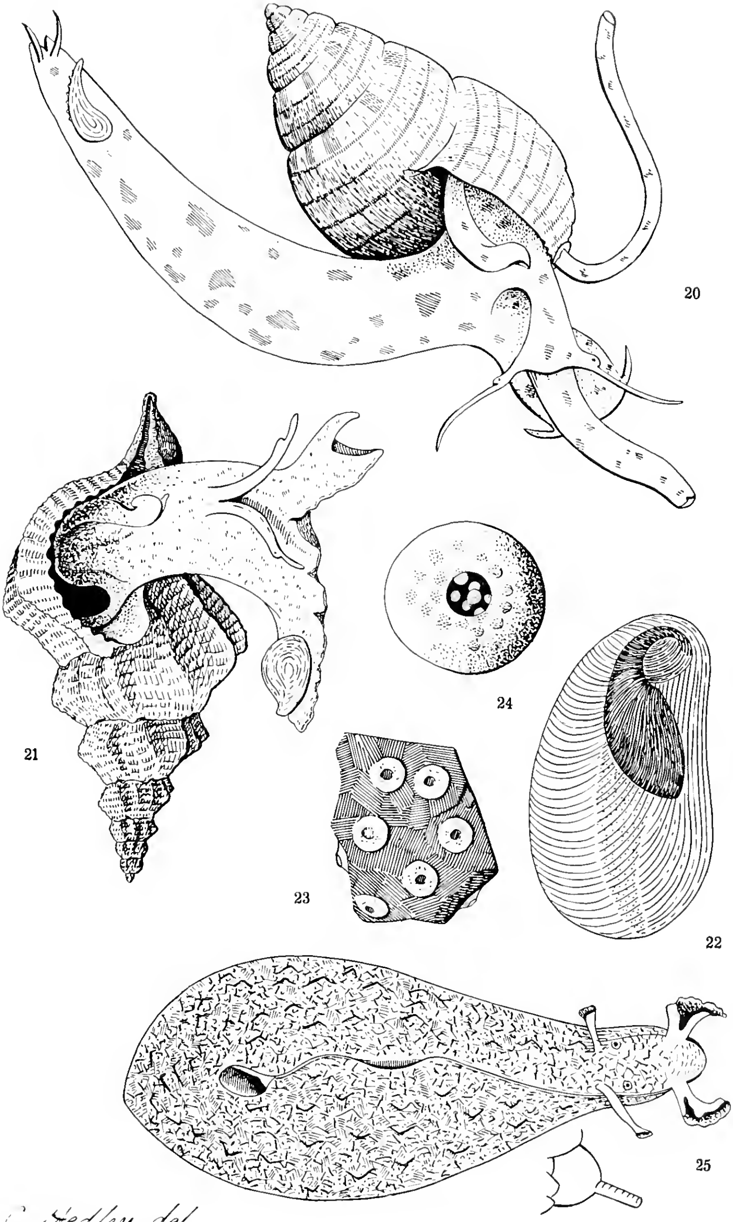

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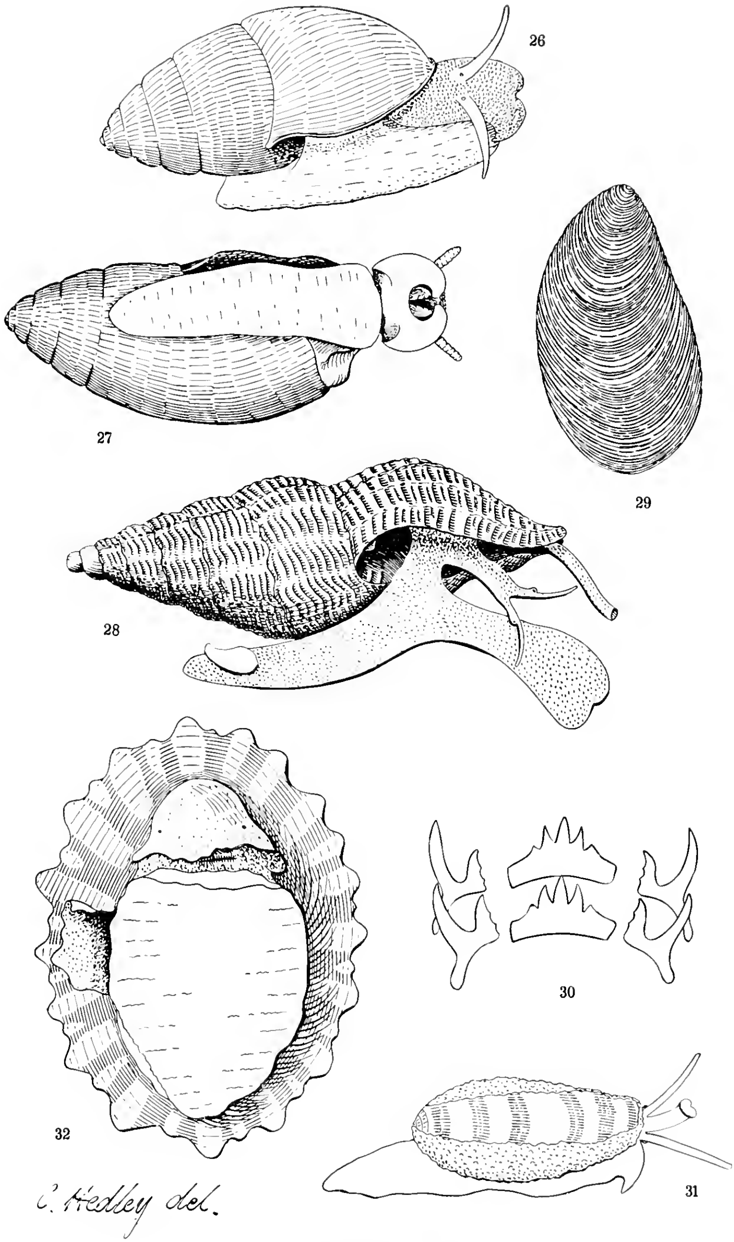

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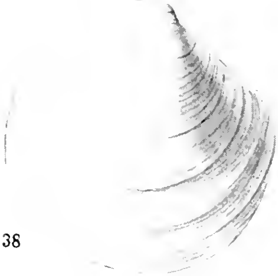
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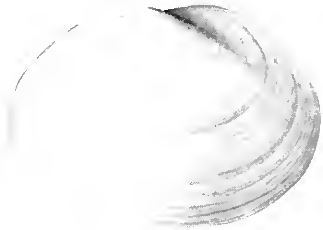
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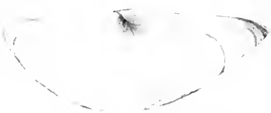
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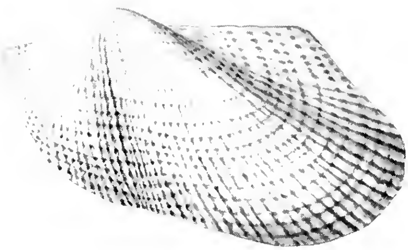
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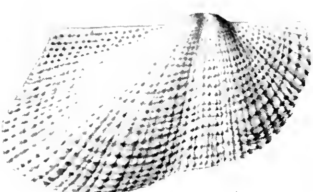
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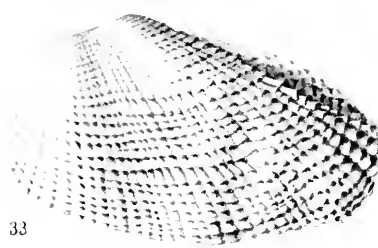
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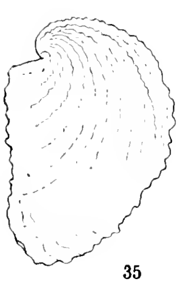
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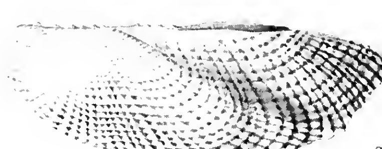
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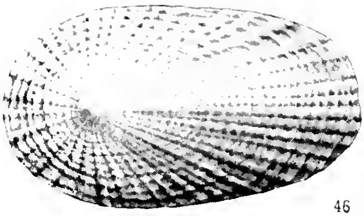
Phyllis F. Clarke

Australian Mollusca.



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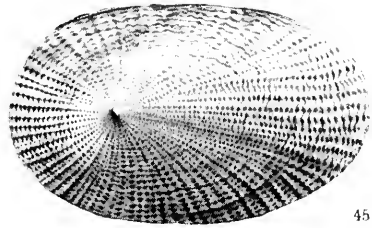

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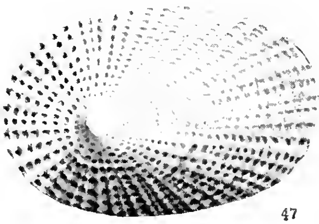

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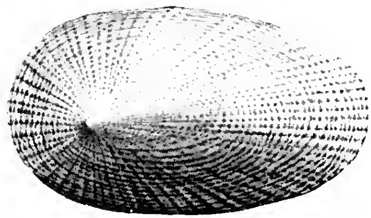

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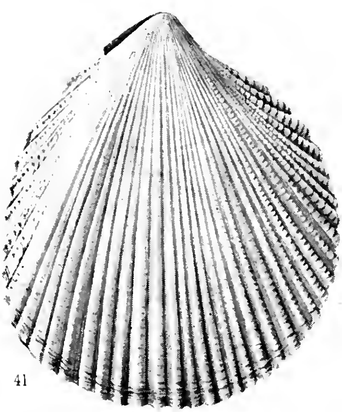

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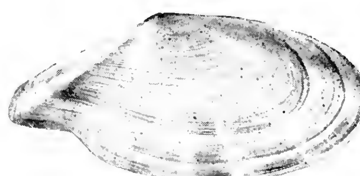

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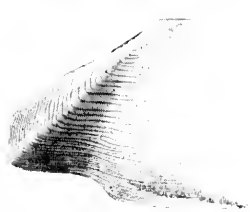

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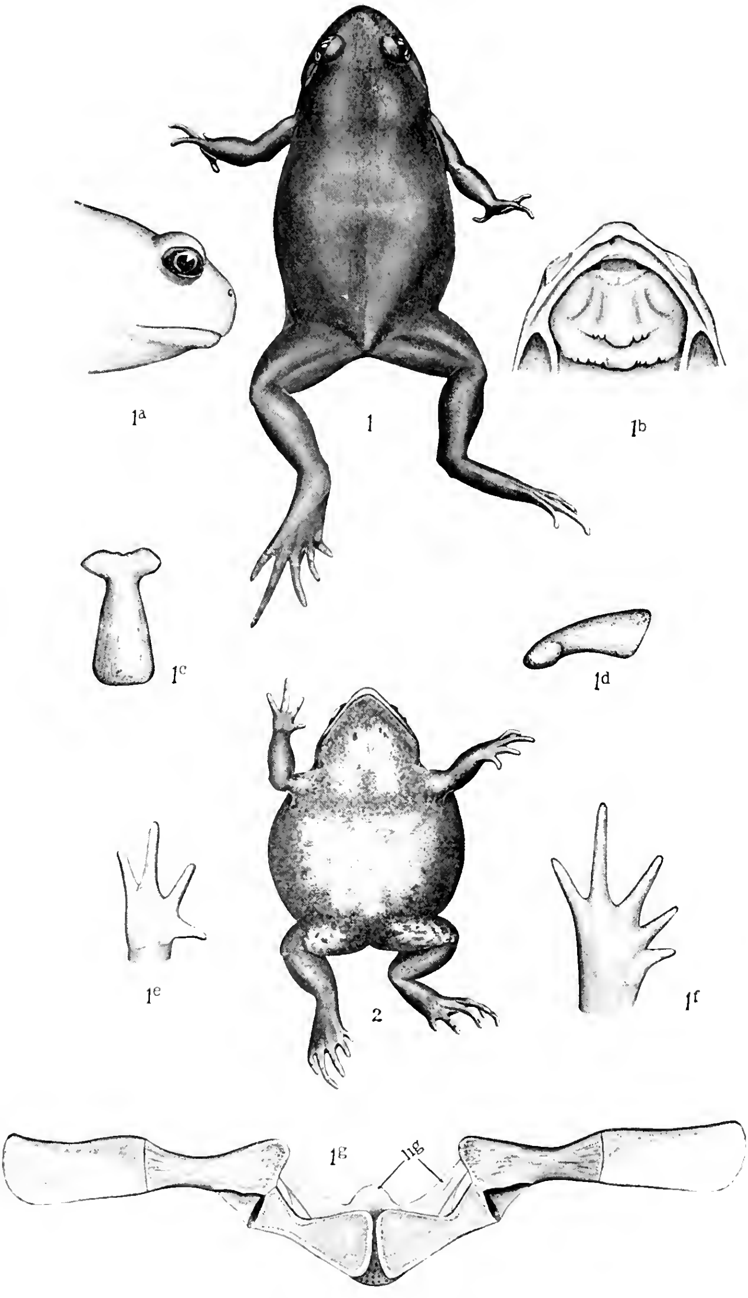
Phyllis F. Clarke

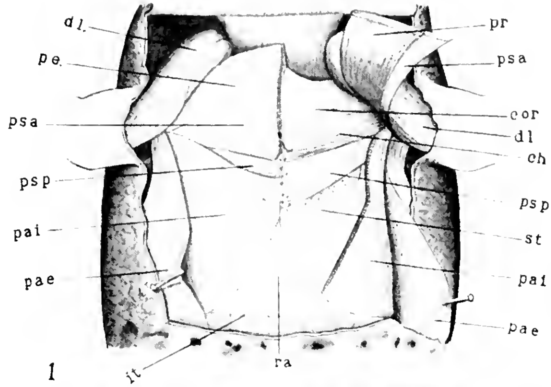
Australian Mollusca.

Head of calf, showing early stage of lesion caused by the Buffalo-fly.



D.B.F. del.

Aphantophryne pansa, g. et sp. n.



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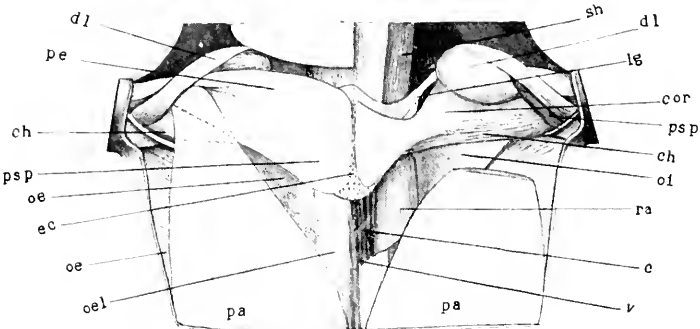

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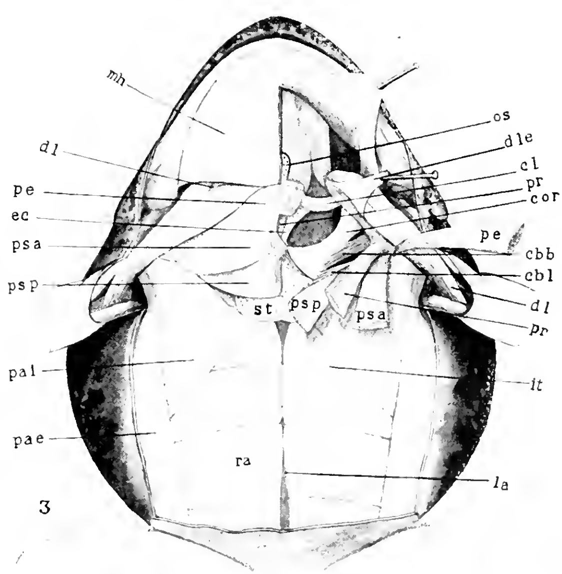
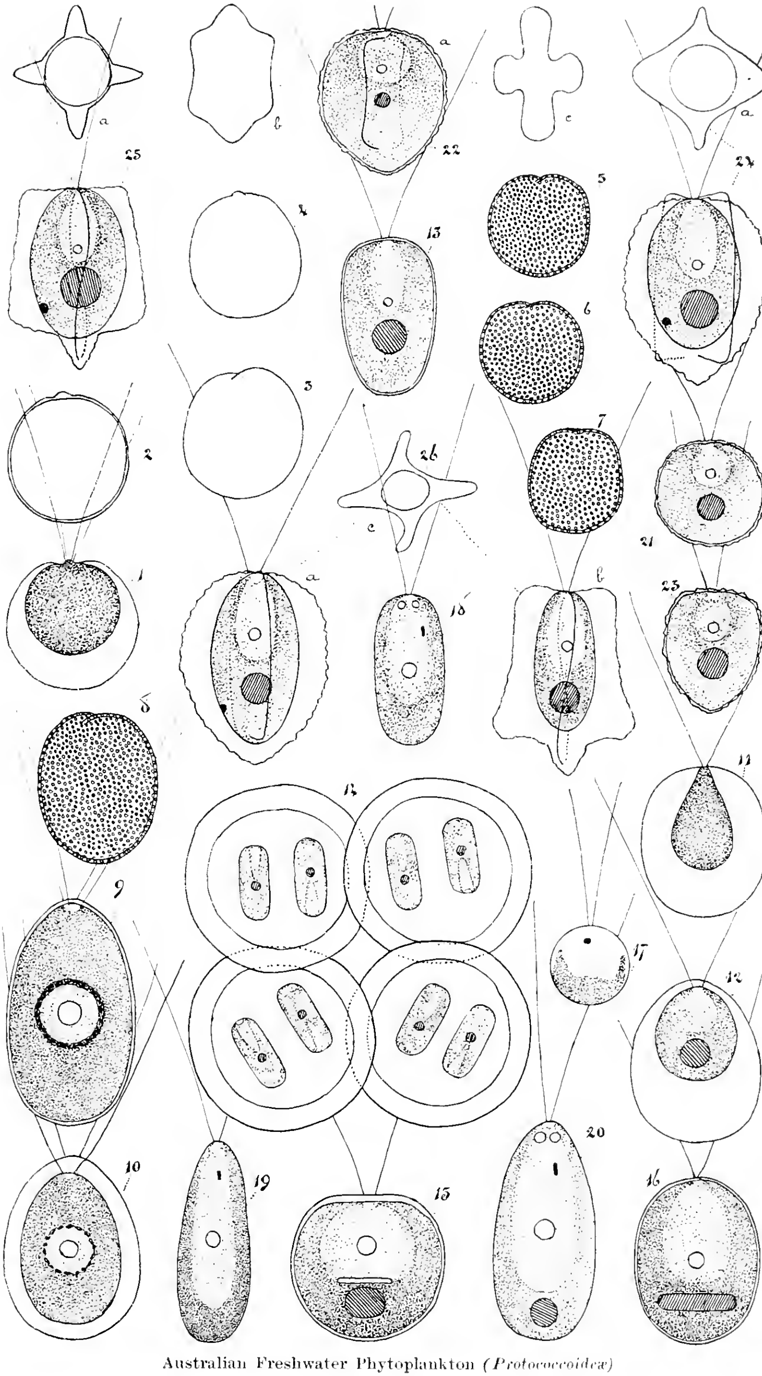


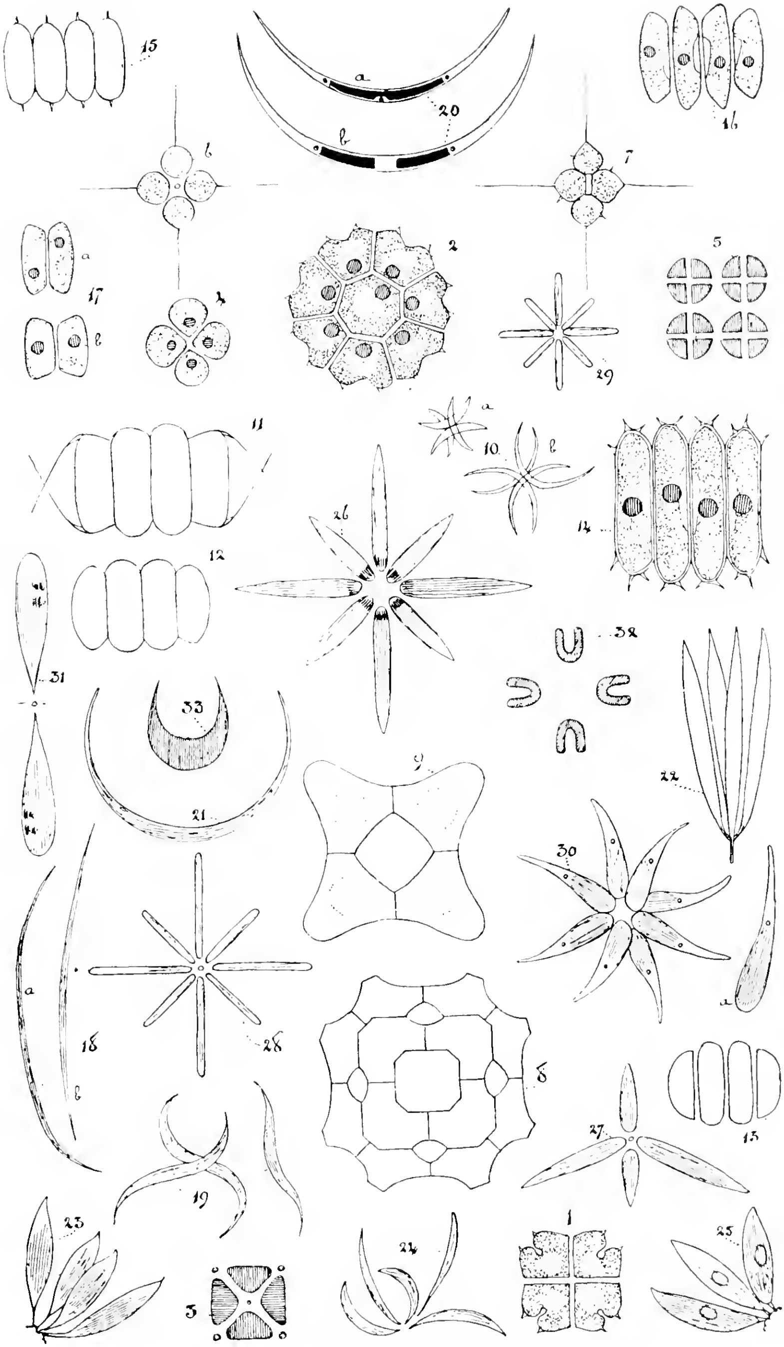
3

D.B.F. del.

1. *Kaloula pulchra.* 2. *Aphantophryne pansa*, n.sp.
3. *Limnodynastes dorsalis* v. *dumerilii.*



Australian Freshwater Phytoplankton (*Protococcoideæ*)



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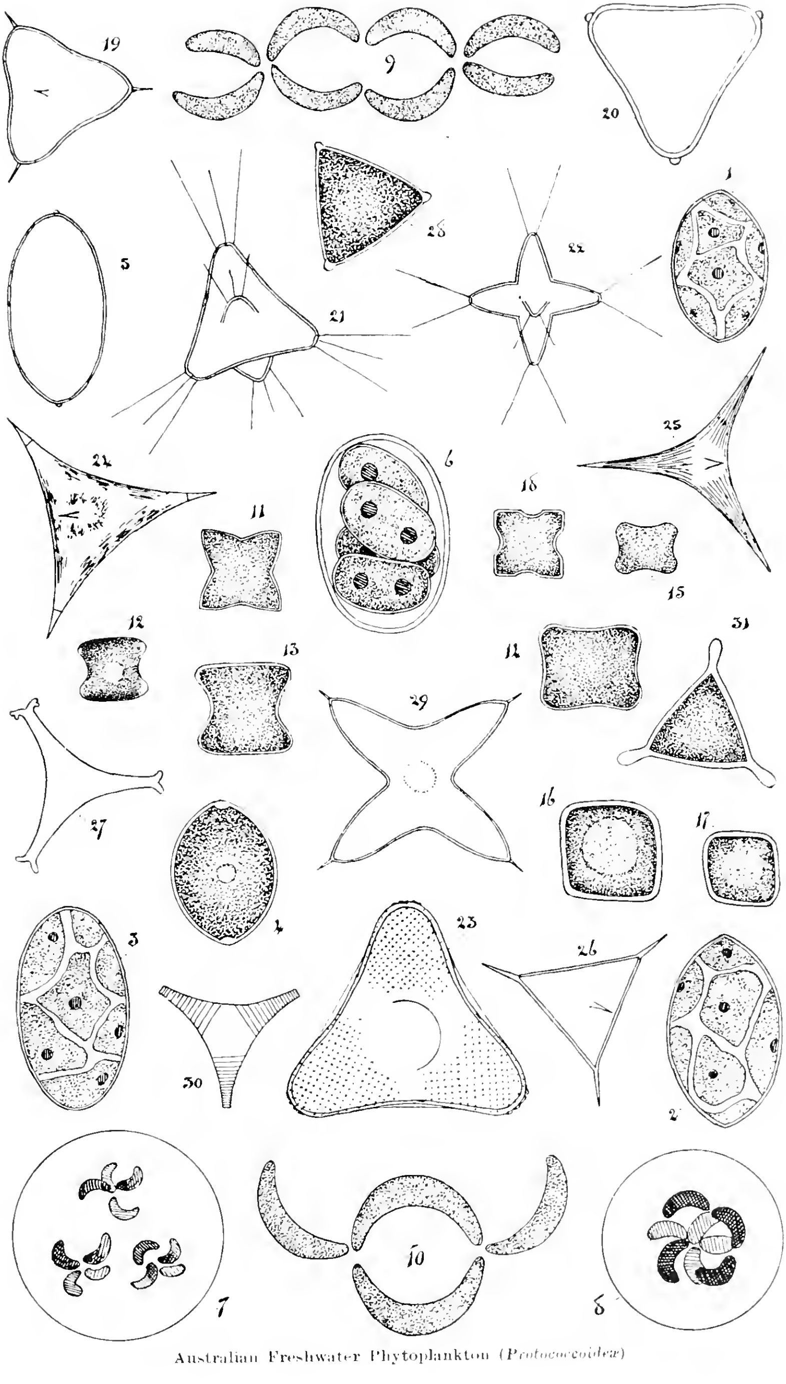

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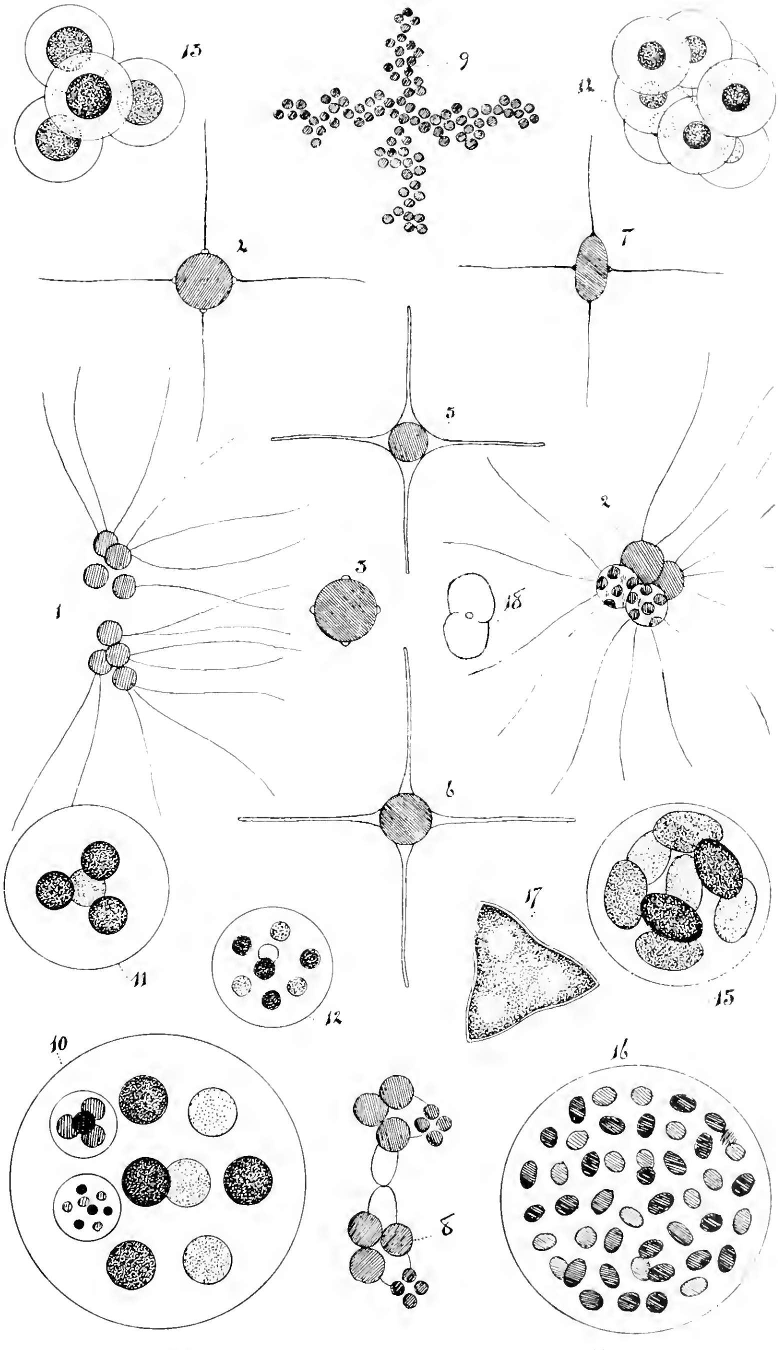

Australian Freshwater Phytoplankton (*Protococcoideæ*)

Issued 14th June, 1916.

Vol XLI.
Part I. **No. 161**

THE PROCEEDINGS OF THE LINNEAN SOCIETY OF NEW SOUTH WALES FOR THE YEAR 1916

PART I. (pp. 1-192)

Containing Papers read in

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WITH NINE PLATES

(Plates i.-ix.)

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PROCEEDINGS, 1916, PART 1.

CONTENTS.

Issued 13th September, 1916.

Vol XLI.
Part 2. **No. 162**

THE

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES

FOR THE YEAR

1916

PART II. (pp. 193-416)

Containing Papers read in

MAY-AUGUST (in part),

WITH TEN PLATES

[Plates x.-xix., and one Transparency (x.*bis*).]
(Plate xx. will be issued with Part iii.)

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PROCEEDINGS, 1916, PART 2.

CONTENTS.

Correction in Dr. Turner's Paper (p.254).

Omit name and description of *Capua crypserythra*, n.sp., and substitute

CAPUA LEUCOSTACTA.

Capua leucostacta Meyr., Proc. Linn. Soc. N. S. Wales, 1910, p.202.

One ♀ example. Also from N.S.W.: Lawson.—Vic.: Beaconsfield.

Page 249, line 8 —*for* six, *read* seven.—line 9, *for* 12, *read* 11.—line 22, *for* 7, *read* 6.

* Plate xx. will be issued with Part iii.

Issued 9th December, 1916.

Vol XLI.
Part 3.

No. 163

THE

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES

FOR THE YEAR

1916

PART III. (pp. 417-632)

Containing Papers read in

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WITH TWENTY-ONE PLATES

[Plates xx.-xxxix., and xlv.]

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Vol. XLI.
Part 4.
No. 164

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FOR THE YEAR

1916

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